Radio Call Book Magazine and Technical Review

Established 1921

25¢

June, 1932

In This Issue:

SERVICE - ENGINEERING - SALES

They say you CAN'T, *but*

I say you

get Enjoyable Programs Every day of

E. H. Scott
Pioneer Designer of 'round the world broadcast receivers.

Seven years ago, newspaper and magazine editors gave columns and columns of space to the amazing performance of a theretofore unknown receiver. They heralded the advent of transoceanic reception, on the broadcast band (200-550 meters) as the greatest radio achievement of the age. They named the receiver "World Record Super," because it brought in 117 programs from 19 stations, ALL OVER 6000 miles away, and WITHIN THE SHORT SPACE OF 13 WEEKS.

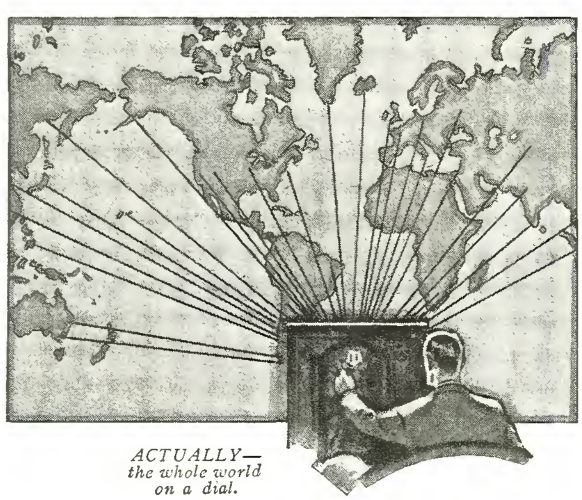
This receiver was the work of E. H. Scott, who believed that a radio set designed in accord with certain advanced ideas of his own, and engineered to micrometric precision, would do things no other receiver was ever able to do. These sets were built in the laboratory. Not even a screw was touched by an unscientific hand, and the radio industry was given a new target.

During the following years, E. H. Scott set still higher standards for radio's performance. Today, as the culmination of these efforts, he offers the Scott All-Wave, a hand-built instrument of scientific precision that is sold with a guarantee of regular, 'round the world reception, or YOUR money back.

MANY prominent radio engineers STILL contend that dependable daily reception of extremely distant foreign stations is impossible.

"It can't be done!" they shout. They insist that the distance is too great—that atmospheric conditions are too variable—that signal strength is insufficiently constant—that if foreign reception is to be obtained at all, an ideal location must be had—and, last, that there is no receiver generally available today that is sensitive enough to bring in foreign stations regularly.

Many of those making these statements are receiver manufacturers; men who have been forced to conclude that mass production methods cannot produce receivers capable of regular foreign reception. Seeming disbelief in the practicability of foreign reception is therefore the result of someone's failure. The only reason for *sincere* disbelief is ignorance of the facts.



ACTUALLY— the whole world on a dial.

You are entitled to the truth. It is your privilege to know the FACTS, because the most interesting—the most enjoyable world of radio is to be found between 15 and 200 meters. Hence, I have written this answer to disbelievers and to the unadvised, and I am spending my own money to publish these four pages of FACTS.

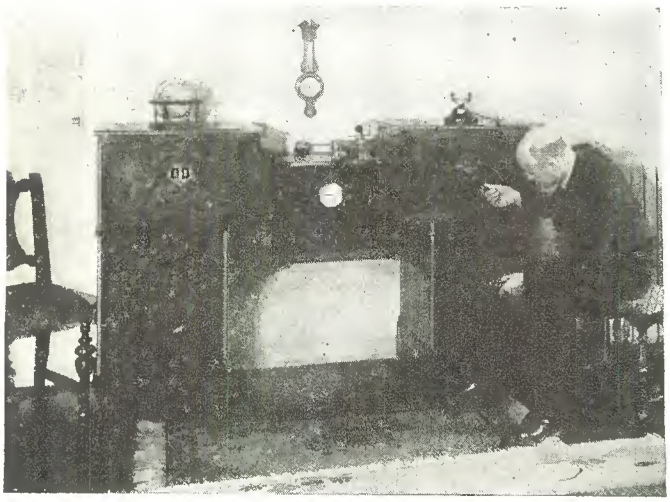
You will find in them a full explanation of what foreign reception is; how regularly it comes in; what the programs are and how they sound. In addition—you'll find undeniable PROOF that the Scott All-Wave 15-550 meter Superheterodyne is certain to give you enjoyable round the world reception every day of every month of the year. Yes, EVERY day, even during the summer months! I say, "You CAN do it!" *E. H. Scott*

RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW, June, 1932. VOL. XIII, No. 6. Published monthly at Chicago, Ill. Subscription price, $2.00 per year. 25 cents per copy. Entered as second-class matter September 3, 1931, at the Post Office of Chicago, Ill., under the Act of March 3, 1879. Citizens Radio Service Bureau, Inc., Publishers, 508 S. Dearborn St., Chicago.

CAN

4 Pages of PROOF

from dozens of Foreign Stations Every month of the Year



Reception from VK3ME sent back to Melbourne, Australia, by telephone from Chicago by E. H. Scott.

The AUSTRALIAN TEST

first proved regular reception possible

For a considerable period, short wave broadcasts from England, France and Italy have been picked up by the broadcasting chains in this country, on highly developed laboratory-type short wave receivers and re-broadcasted on the 200-550 meter band to listeners in America. The fact that these broadcasts were always planned, weeks in advance, convinced us that their reception was contemplated with absolute certainty. Why, then, couldn't *all* foreign broadcasts be depended upon? To ascertain whether or not they could be, we selected the station farthest from Chicago that broadcasted regularly, and set out to see how many of its programs we could pick up with the Scott All-Wave.

All Programs Recorded

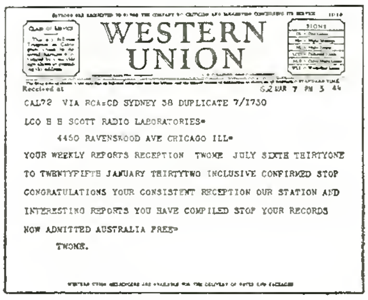
VK3ME at Melbourne, Australia, is 9560 air miles from Chicago. This station broadcasts two times a week on a wave length of 31.55 meters. The reception test was begun June 6th, 1931. Ten months have elapsed, and *every* broadcast (excepting three) was received with sufficient loud speaker volume to be clearly heard and logged. The three programs were missed only because an illegal code transmission interfered.

Each broadcast from VK3ME has not only been clearly heard, and its reception verified by the station, but they have all been recorded just as they came from the amplifier of the Scott All-Wave on aluminum discs. These recordings are available to anyone who wishes to hear them.

Program Returned to Australia by Phone

The engineer of VK3ME was curious to know with what quality his program was received in Chicago. He realized, of course, that clarity was sufficient to permit logging of details, but beyond that he was skeptical. So on January 23rd, 1932 Mr. Scott telephoned VK3ME from Chicago, and while VK3ME's program was being received, the telephone mouthpiece was pointed toward the speaker and the program sent back to Melbourne—another 9560 miles, and with perfect clarity as verified by the engineer's written acknowledgment.

This 10 month test on reception from a point nearly 10,000 miles away, proves, beyond any doubt, that enjoyable foreign reception can be depended upon, IF the receiving equipment is competent. It PROVES that DISTANCE is *no* obstacle! And it PROVES that variable conditions of the atmosphere are not insurmountable obstacles! To further substantiate our contentions we began a test of VK2ME at Sydney. VK2ME's acknowledgment of this reception is reproduced below. Both of these tests PROVE that there IS a receiver having more than enough sensitivity to detect and reproduce the broadcast from foreign stations regularly and with adequate volume!



WESTERN UNION

Received at 62 MAR 7 PM 3 44

CAL72 VIA RCA=CD SYDNEY 38 DUPLICATE 7/1730

LCO E H SCOTT RADIO LABORATORIES=

4450 RAVENSWOOD AVE CHICAGO ILL=

YOUR WEEKLY REPORTS RECEPTION TWOME JULY SIXTH THIRTYONE TO TWENTYFIFTH JANUARY THIRTYTWO INCLUSIVE CONFIRMED STOP CONGRATULATIONS YOUR CONSISTENT RECEPTION OUR STATION AND INTERESTING REPORTS YOU HAVE COMPILED STOP YOUR RECORDS NOW ADMITTED AUSTRALIA FREE=

TWOME.

Other Owners Do Even Better

This remarkable performance was not a stunt. It was not a freak happenstance occurring to one Scott All-Wave ideally located and installed. To the contrary, it appears as mediocre performance when compared to the 9,535 logs of foreign reception sent to us during January, February and March from Scott All-Wave owners located in all parts of the country! These logs, constituting further proof of the practicability of foreign reception, are discussed on the next two pages.

(*Turn the page, please*)

9535 Detailed Logs *by* Scott tell *What You hear* *and prove the absolute* Dependability of the Scott All-Wave

See preceding pages

Clarity

THE detail contained in this log, submitted by Mr. Roye Bilheimer of Pennsylvania, demonstrates the clarity with which the Scott All-Wave brings in foreign stations 10,000 miles away. This log was made Feb. 28, 1932, and while only 30 minutes of it are shown here, the log, as submitted, covered the entire 2 consecutive hours of the broadcast.

6:00 a.m. E.S.T.—Chimes are heard striking the hour of 9:00 p.m., and you say, "Just 9:00 o'clock, Sunday evening." You go on to say, "VK2ME, 47 York Street, Sydney, Australia, would be pleased to receive reports from those overseas relating to the reception of these programs. Our next record is rather an interesting broadcast. I am going to play for you, a record recorded in Chicago. This record was picked up by Mr. Scott of Chicago, an ardent listener of VK2ME. It was then recorded on his home recording set, on aluminum discs, and then sent to VK2ME, and we will now play this record over for you, which will give you some idea of the reception in the United States, especially in Chicago. This is a musical selection by the Band of His Majesty's ———— Guards. Stand by a second, please."

6:05 a.m. E.S.T.—VK2ME, Sydney, Australia. The record you have been listening to was one made in Chicago by Mr. Scott, an ardent listener to VK2ME. The original recording was transmitted some time ago and Mr. Scott received that recording, and cut in the record on his home recording set, and forwarded this to VK2ME. That was the record which has just arrived in Sydney and we have just played it for you, to see how you will receive it. I shall now play for you the laugh of the "Kookaburra," that was also picked up in Chicago by the same gentleman.

6:06½ am. E.S.T.—Laugh of the "Kookaburra." Now you say, "That was the laugh of the 'Kookaburra,' reproduced in Chicago again after receiving the original recording from VK2ME. We should be glad to receive reports from other listeners as to how they receive these recordings." A talk of the day is entitled "Australia Commences the Travel Idea," prepared by Charles Holmes, Director of the Australian National Travelers' Association. Now you continue with the talk:

"Set in the sunshine of southern seas, Australia is the world's littlest continent. Australia is a continent that is different from other lands in its appearance, its geographic formation, and its strange animals, as well as its age-old peoples. Then, too, the remainder of the native race that originally inhabited Australia are a stone-age people, but now I wish you could see them in the Government Reservations, and in the far-back places of the continent, where many still lead their primitive lives.

6:12 a.m. E.S.T. — They were entertained by Australian aborigines who are located in a settlement there. They were amused to see them throw their boomerangs, that strange wooden weapon which, when thrown by a person, returns to the thrower, and the visitors had an amusing time practicing among themselves. Rudolph Friml gazed at a group of black fellows who were playing a tune with the leaf of the eucalyptus tree, "Rose Marie," from the famous play he had written.

6:14 a.m. E.S.T.—You are now speaking of native bears, and say: "Here the visitors saw the quaint and lovable little bears. 'Living toys,' one visitor called them. One gentleman wanted to buy them outright, so enthused was he by these little native animals. Some of the ladies brought honey and candy, and were greatly disappointed when their gifts were refused by the bears. They prefer to get their own sweets from the eucalyptus tree.

"Australia welcomes the visitor. We want the world to know us better, and we, ourselves, seek a greater knowledge of people of other lands. In these days, travel is more than a great pleasure maker—it is a great peace maker, and that is what the world today is most in need of. This concludes my short talk, entitled 'Australia Commences the Travel Idea,' prepared by Charles Holmes, Director of the Australian National Travelers' Association."

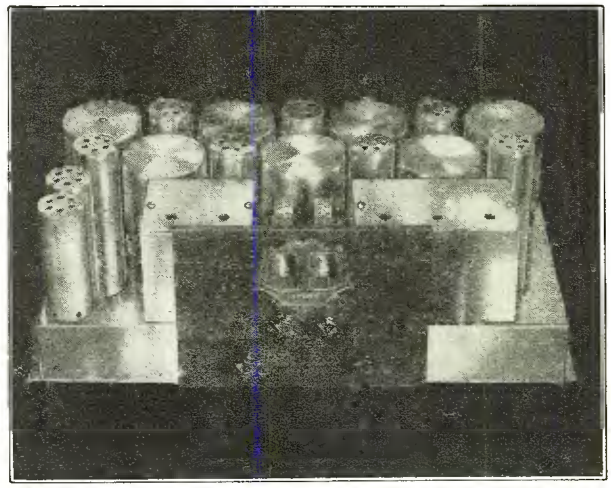
6:15 a.m. E.S.T.—The Band of His Majesty's Air Force will play "Washington Braves," arranged by Victor Herbert.

6:18 a.m. E.S.T.—VK2ME, Sydney, Australia. You now give the time as 18 minutes past 9:00 Sunday evening. Contralto solo, "God Shall Wipe Away All Tears," by Sullivan.

6:22½ a.m. E.S.T.—VK2ME, Sydney, Australia. An organ solo, "Just Imagine," by Leslie James. This is coming through with fine volume and clarity, although the weather here is very bad. It is very foggy and rainy.

6:25 a.m. E.S.T.—VK2ME, Sydney, Australia. The time is 26 minutes past 9:00 Sunday evening. You now announce the next selection, a waltz.

6:30½ a.m. E.S.T.—VK2ME, Sydney, Australia. The band of His Majesty's Guards directed by R. G. Evans, playing "Intermezzo," by Reeves



9,535 Detailed logs of foreign programs have been sent to us since January 1st, 1932. All of these logs are complete—proving that the reception was not only *heard*, but that the *clarity* was *perfect*. Two of these logs are reproduced (in part only, for lack of space) on these pages. Think of it! 9,535 logs from 186 stations in 40 different foreign countries! It is difficult to understand, how anyone after reading these logs, could believe that dependable, day in, day out foreign reception is anything but a complete, and thoroughly satisfactory actuality.

What Countries Will You Hear?

Any Wednesday, Saturday or Sunday morning you can tune in the Australian stations and listen to a three hour program, in English, of course. Then if you wish something with a decidedly foreign flavor, you can dial Saigon, Indo-China, and listen to the weirdest, Eastern music you have ever heard.

Right after breakfast, most any morning, you can tune in the Radio Colonial at Paris, France—or Chelmsford, England, from which station comes an English version of the World's latest news.

From 11:30 A. M. until 5 P. M. you have your choice of musical programs, talks, plays, etc. from Italy, France, Germany or England. In the late afternoon, the offerings from Portugal will be found very entertaining.

In the evening you may have your choice of a dozen or more different stations including Colombia and Ecuador in South America. Then, too, there is Spain, and Cuba.

Is this all?—Indeed not!—These are just a few of the many foreign stations that will be found on the dial of the Scott All-Wave. A complete list showing the exact time to tune dozens of foreign stations, is furuished with the receiver.

What Will You Hear?

From a large number of these foreign stations you'll hear news in English, and you'll delight in the variety of aspect the different countries give to an item of international interest.

You'll hear music from everywhere. Weird chants from Indo-China, and in contrast, a tango from the Argentine. From Rome you'll hear the real Grand Opera—you'll hear the voice of the Pope, the Vatican Choir and solo voices mellowed in Italian sunshine. From Germany you'll hear political speeches, music and news. From France, Spain and Portugal you'll hear a wonderful musical program that will thrill you hour after hour. From England you'll hear plays—drama—comedy and musicales; delightful presentations, refreshingly different from those to which you are accustomed. You'll never tire of foreign reception, because it never loses its novelty.

Will the Reception Be Clear?

Foreign stations are tuned easily and smoothly with a Scott All-Wave. As the dial is turned to the correct spot, the station comes on, in most cases, with the same naturalness, clarity, and roundness of tone that characterizes *domestic* reception.

# of Foreign Reception Owners and *How You hear it*

Usually, you can have more volume than you wish, which means simply that the sensitivity may be lowered beneath the noise level, thereby permitting the program to come through with truly enjoyable bell-like clarity. There's no doubt about it. Dependable foreign reception is here; yours to thrill to; yours to enjoy as you have never enjoyed radio before.

Read These Logs*

The log reproduced at the right represents one day that E. B. Roberts of Massachusetts spent with his Scott All-Wave. During the day he journeyed from France to England, to Italy, back to France and in the evening to South America. The other log is that sent in by Mr. Roye Bilheimer of Pennsylvania who made a point of logging every word put on the air by VK2ME, Sydney, Australia, February 28, 1932. If you have any doubt concerning the authenticity of these two logs or the others sent to us, see the auditors' report herewith. Read these logs—then consider that 9,533 more detailed logs bear witness to the new world of radio pleasure opened to YOU by the Scott All-Wave 15-550 meter Superheterodyne.

THE SCOTT WELLINGTON

Typical of the many excellent models of Scott Consoles, the Wellington is a beautiful example of deluxe cabinet artistry. Fashioned from burl walnut and finished to go with the finest furniture. The center drawer contains the optional phonograph equipment, which, when wanted, is supplied with an automatic ten record changer.

Prove to yourself the practicability of Short Wave foreign reception

These four pages have told the story of short wave foreign reception in no uncertain terms. They have PROVED that clear, enjoyable reception of foreign stations can be enjoyed by anyone irrespective of the state or country in which he lives. And we want to prove to you, right in your own home—that YOU can tune 'round the world whenever you choose and enjoy every program you hear. To do that, we'll build a Scott All-Wave 15-550 meter superheterodyne to your order; we'll test it on reception from London, Sydney or Rome—and give you the exact dial readings. If you don't get enjoyable foreign reception from these stations—if the receiver does not eclipse every statement made for it, you may return it and your money will be refunded. The coupon below will bring full particulars of this offer—also the technical details of the Scott All-Wave. Clip the coupon—mail it now.

The E. H. Scott Radio Laboratories, Inc.

4450 Ravenswood Ave., Dept. CB62, Chicago, Ill.

The E. H. Scott Radio Laboratories, Inc.,
4450 Ravenswood Ave., Dept. CB62,
Chicago, Ill.

Send me full particulars of the Scott All-Wave Superheterodyne.

Name ....

Street ....

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

*AUDITORS' REPORT

We hereby certify that we have examined and counted 9,535 logs of programs reported by purchasers of Scott All-Wave Receivers from 186 stations, foreign to the country in which received, during the months of January, February, March, 1932.

CHESNUTT, MURPHY, POOLE & Co.
Certified Public Accountants

News and Music From Four Foreign Countries Received in One Day

These logs, made March 7, 1932, and submitted by E. B. Roberts of Massachusetts, indicate the variety of foreign programs that may be heard with a Scott All-Wave. For lack of space, only a portion of each log appears here.

NEWS FROM FRANCE
STATION RADIO COLONIAL—PONTOISE

8:44½ a.m. E.S.T.—"This is Radio Colonial from Paris calling. Wavelength 19.68 meters."
News in English from the Continental Daily Mail, Great Britain—The financial recovery of Great Britain has aroused the interest of the world.

8:45 a.m. E.S.T.—Chimes.
From N. Y., Sunday—The U. S. view is that the world economic crisis is behind. Sterling reflected by rising to a new high.
From Geneva, Sunday—Small nations are not willing that the League's authority be flaunted even if the larger nations are.
From N. Y., Sunday—Bulletin on the death of Bandmaster Sousa.

8:51½ a.m. E.S.T.—From Berlin, Sunday—Speeches regarding the election next Sunday. Will Hindenburg or Hitler be elected only question.

8:55 a.m. E.S.T.—From N. Y., Sunday—The Lindberghs have turned to the underworld for help as the authorities seem helpless.

NEWS AND MUSIC FROM ENGLAND
STATION G5SW—CHELMSFORD

1:15 p.m. E.S.T.—Chimes.

1:15½ p.m. E.S.T.—This is the British Broadcasting Corp. calling short wave listeners of the British Empire through G5SW. G5SW broadcasts on a wave of 17,550 kilocycles or 25.53 meters.

1:16 p.m. E.S.T.—Programs to be radiated today.

1:17 p.m. E.S.T.—Programs to be radiated tomorrow, March the 8th.

1:18 p.m. E.S.T.—News Bulletins for the Middle Zone. World copyrighted.
Briand died today. An ardent advocate of peace.
Bulletin regarding the Indian Budget.
Far East Bulletin—Dr. Yen announced that China is ready to enter negotiations to restore peace. The Japanese have no intention of advancing further.
Bulletin regarding the kidnaping of the Lindbergh baby—no news as yet.

NEWS AND MUSIC FROM ITALY—STATION I2RO
ROME

2:49 p.m. E.S.T.—Telling in Italian of the results of the six-day bicycle race in Madison Square Garden, which was won by the team of McNamara-Peden.

2:52 p.m. E.S.T.—Now talking about Primo Carnera and Young Stribling.

2:54 p.m. E.S.T.—"Raddio Roma-Napoli."
News bulletins from the U. S. A., Shanghai and Tokio.
News regarding the Lindbergh baby.

2:59 p.m. E.S.T.—Announcement.

3:01½ p.m. E.S.T.—Announcement. Gave names of Italian cities. Music by orchestra between announcements.

3:02 p.m. E.S.T.—Orchestra selection.

MORE MUSIC FROM FRANCE
STATION RADIO COLONIAL—PONTOISE

3:57 p.m. E.S.T.—"The Marseillaise."

3:59 p.m. E.S.T.—"Hllo, Hllo, Ici. Paree. Station Radio Colonial."

4:00 p.m. E.S.T.—Piano and violin selection.

4:06 p.m. E.S.T.—Announcement.

4:08 p.m. E.S.T.—Instrumental selection.

4:15 p.m. E.S.T.—Announcement.

4:16 p.m. E.S.T.—Cello solo.

4:21 p.m. E.S.T.—Announcement.

MUSIC FROM SOUTH AMERICA—STATION HKF
BOGOTA, COLOMBIA

8:25 p.m. E.S.T.—Vocal solo. Man singing native selection.

8:28 p.m. E.S.T.—Announcement.
Baritone solo, with choruses singing.

8:33 p.m. E.S.T.—Announcement.
Vocal duet.

8:46 p.m. E.S.T.—Announcement.

8:47 p.m. E.S.T.—Native instrumental selection.

8:50 p.m. E.S.T.—Announcement.

8:53 p.m. E.S.T.—Dance music. Waltz.

8:57 p.m. E.S.T.—Announcement.
Baritone solo.

9:02 p.m. E.S.T.—Announcement.

9:03 p.m. E.S.T.—Native dance selection.

9:06 p.m. E.S.T.—Announcement.

9:00 p.m. E.S.T.—Station announcement. "HKF, in Bogota, Colombia, South America."

9:10 p.m. E.S.T.—Instrumental selection.
Volume very good. Some fading.

Radio Call Book Magazine

AND TECHNICAL REVIEW

Established 1921

GEO. H. SCHEER, JR., *Editor*

E. H. PETERSON, *Service Dept.*

JUNE, 1932

Advertising Representatives
Chicago—C. O. STIMPSON, *Adv. Mgr.* Phone Wabash 1901, 508 South Dearborn St.
New York—J. J. LAMSON, Phone Wisconsin 7-5681, Room 1125, 154 West 42nd St.
Los Angeles—NED BRYDONE-JACK, Petroleum Securities Bldg.
San Francisco—THOMAS EMORY, Russ Bldg.

Executive Offices:
508 So. Dearborn St., Chicago, Ill.
Member Audit Bureau of Circulations

Vol. 13, No. 6

Table of Contents

Editorial

Another year and another annual RMA Convention and Trade Show is about to open in Chicago. This is the eighth of its kind to be held, with almost a hundred exhibitors showing in spite of what is termed the "depression." No doubt our readers are a bit curious as to what new developments may be expected in the receiver line. A survey of the tendency of the industry results in the following predictions.

Due to public favor, there will be new models of combination broadcast and short wave receivers. Probably the next year will see every manufacturer of note with at least one of these models. Class B amplification, with a tube, described in this issue, developed especially for the purpose will have more adherents, though the benefits are still in the doubtful stages. Of course there will be television receivers, but we do not believe any startling revelations will be made this year. The struggle is necessarily a slow one because of the many problems remaining to be solved.

In addition to the 46 type tube mentioned above, three new 2.5 volt tubes have been released to the industry, all described herein. They are the 56, 57 and 58 types, replacing the 227, 224 and 235 types respectively. These tubes have merits which make them truly important additions to the large family now available. In the latter two, the higher plate impedance will improve circuit characteristics due to the higher shunt impedance across the tuned circuit, and also give appreciably higher amplification per stage. Lighter filament windings will be of some consequence in transformer design since the drain has been cut in half. These tubes, though, are not merely for sales, and will stand on their own merits.

Of course, we will find more multiple-speaker receivers, the additional speaker giving slightly better quality, but whether the improvement is great enough to warrant the increase in price is a matter for individual decision. There is little doubt but what prices will rise, perhaps only slightly at first, after the Radio Show. It must come, since it will in all other industries as business improvement becomes more marked.

We hope that the next issue will appeal to all classes of radio readers. A page, at least, will henceforth be devoted to the many class of material of interest to the many readers who come under the "experimenter" category. This is in answer to the increasing demand for such material. We hope that in addition to the material furnished by our engineering staff, readers with interesting ideas and facts will submit them to us. We wonder if history is repeating itself?—EDITOR.

J. E. Smith, President, National Radio Institute, the man who has directed the Home-Study training of more men for the Radio Industry than any other man in America.

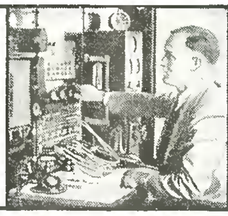
BE A RADIO EXPERT

Many Make $50 to $100 a Week

I'll Train You at Home in Your Spare Time for RADIO · TELEVISION · TALKING MOVIES

Set Servicing

Spare-time set servicing has paid many N. R. I. men $200 to $1,000 a year. Full-time men make as much as $65, $75 and $100 a week.



Broadcasting Stations

Employ trained men continually for jobs paying up to $5,000 a year.

Ship Operating

Radio operators on ships see the world free and get good pay plus expenses. Here's one enjoying shore leave.

Aircraft Radio

Aviation is needing more and more trained Radio men. Operators employed through Civil Service Commission earn $1,620 to $2,800 a year.

Talking Movies

An invention made possible by Radio. Offers many fine jobs to well-trained Radio men, paying as much as $75-$200 a week.

Television

The coming field of many great opportunities is covered by my course.

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

Many Radio Experts Make $50 to $100 a Week

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

Get Ready Now for Jobs Like These

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

Many N. R. I. Men Have Made $200 to $1,000 in Spare Time While Learning

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

Talking Movies, Television, Aircraft Radio Included

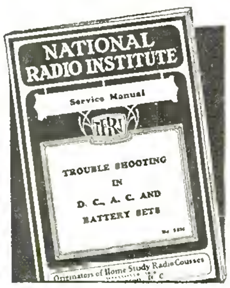
Special training in Talking Movies, Television and home Television experiments, Radio's use in Aviation, Servicing and Merchandising Sets, Broadcasting, Commercial and Ship Stations are included. I am so sure that N. R. I. can train you satisfactorily that I will agree in writing to refund every penny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

64-Page Book of Information FREE

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

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

SPECIAL FREE OFFER



Act now and receive in addition to my big free book "Rich Rewards in Radio," this Service Manual on D.C., A.C. and Battery operated sets. Only my students could have this book in the past. Now readers of this magazine who mail the coupon will receive it free. Overcoming hum, noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, poor Audio and Radio Frequency amplification and other vital information is contained in it. Get a free copy by mailing the coupon below.

THIS COUPON IS GOOD *for* *One* FREE COPY OF MY BOOK — *mail it now*

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

Dear Mr. Smith:
I want to take advantage of your Special Offer. Send me your two books: "Trouble Shooting in D.C., A.C. and Battery Sets" and "Rich Rewards in Radio." I understand this does not obligate me.

Name..

Address..

City.................................. *State*.................................. "M"

American Broadcasting Stations

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

KABC—1420 kc, San Antonio, Texas, Alamo Broadcasting Co., 100 w, C.
KARK—890 kc, Little Rock, Ark., Arkansas Radio & Equip. Co., 250 w.
KBPS — 1420 kc, Portland, Ore., Benson Polytechnic School, 100 w, P.
KBTM—1200 kc, Paragould, Ark., Beard's Temple of Music, 100 w, C.
KCMC—1420 kc, Texarkana, Ark., No. Miss. Bdcstg. Corp., 100 w, C.
KCRC—1370 kc, Enid, Okla., Champlin Refining Co., 100 w, C.
KCRJ—1310 kc, Jerome, Ariz., C. C. Robinson, 100 w.
KDB—1500 kc, Santa Barbara, Calif., Santa Barbara Broadcasters, Ltd., 100 w, P.
KDFN—1440 kc, Casper, Wyo., D. L. Hathaway, 500 w, P.
KDKA—980 kc, Pittsburgh, Pa., Westinghouse E. & M. Co., 50,000 w, E.
KDLR—1210 kc, Devils Lake, N. D., KDLR, Inc., 100 w.
KDYL—1290 kc, Salt Lake City, Utah, Intermountain Broadcasting Corp., 1000 w, M.
KECA—1430 kc, Los Angeles, Calif., Earle C. Anthony, Inc., 1000 w, P.
KELW—780 kc, Burbank, Calif., Magnolia Park, Ltd., 500 w, P.
KERN—1200 kc, Santa Maria, Cal., The Bee Bakersfield Bdcstg. Co., 100 w, P.
KEX — 1180 kc, Portland, Ore., Western Broadcasting Co., 5000 w, P.
KFAB — 770 kc, Lincoln, Nebr., KFAB Broadcasting Co., 25,000 w, C.
KFAC—1300 kc, Los Angeles, Calif., L. A. Bdcstg. Co., 1000 w, P.
KFBB—1280 kc, Great Falls, Mont., Buttrey Broadcast, Inc., 1000 w, M.
KFBK—1310 kc, Sacramento, Calif., James McClatchy Co., 100 w, P.
KFBL — 1370 kc, Everett, Wash., Leese Bros., 50 w, P.
KFDM—560 kc, Beaumont, Tex., Magnolia Petroleum Co., 500 w, C.
KFDY—550 kc, Brookings, S. D., State College, 500 w, C.
KFEL—920 kc, Denver, Colo., Eugene P. O'Fallon, Inc., 500 w, M.
KFEQ—680 kc, St. Joseph, Mo., Scroggin & Co., 2500 w, C.
KFGQ—1310 kc, Boone, Iowa, Boone Biblical College, 100 w, C.
KFH—1300 kc, Wichita, Kan., Radio Station KFH Co., 1000 w, C.
KFI—640 kc, Los Angeles, Calif., Earl C. Anthony, Inc., 50,000 w, P.
KFIO—1120 kc, Spokane, Wash., Spokane Broadcasting Corp., 100 w, P.
KFIU—1310 kc, Juneau, Alaska, Alaska Elec. Light & Power Co., 10 w.
KFIZ—1420 kc, Fond du Lac, Wis., Reporter Printing Co., 100 w, C.
KFJB—1200 kc, Marshalltown, Iowa, Marshall Electric Co., 100 w, C.
KFJF—1480 kc, Oklahoma City, Okla., National Radio Mfg. Co., 5000 w, C.
KFJI—1210 kc, Klamath Falls, Ore., KFJI Broadcasters, Inc., 100 w, P.
KFJM—1370 kc, Grand Forks, N. D., University of North Dakota, 100 w, C.
KFJR—1300 kc, Portland, Ore., Ashley C. Dixon, KFJR, Inc., 500 w, P.
KFJZ—1370 kc, Ft. Worth, Texas, Ralph S. Bishop, 100 w, C.
KFKA—880 kc, Greeley, Colo., Mid-Western Radio Corp., 500 w, M.
KFKB — 1050 kc, Milford, Kan., KFKB Brdcstg. Assn., 5000 w, C.
KFKU—1220 kc, Lawrence, Kan., University of Kansas, 500 w, C.
KFKX—See KYW.
KFLV—1410 kc, Rockford, Ill., Rockford Broadcasters, Inc., 500 w, C.
KFLX—1370 kc, Galveston, Texas, Geo. Roy Clough, 100 w, C.
KFMX—1250 kc, Northfield, Minn., Carleton College, 1000 w, C.
KFNF—890 kc, Shenandoah, Iowa, Henry Field Seed Co., 500 w, C.
KFOR—1210 kc, Lincoln, Neb., Howard A. Shuman, 100 w, C.
KFOX—1250 kc, Long Beach, Calif., Nichols & Warriner, Inc., 1000 w, P.
KFPL—1310 kc, Dublin, Texas, C. C. Baxter, 100 w, C.
KFPM—1310 kc, Greenville, Texas, The New Furniture Co., 15 w, C.
KFPW—1340 kc, Ft. Smith, Ark., John Brown Schools, 50 w, C.
KFPY—1340 kc, Spokane, Wash., Symons Broadcasting Co., 1000 w, P.
KFQD—1230 kc, Anchorage, Alaska, Anchorage Radio Club, 100 w.
KFQW—1420 kc, Seattle, Wash., KFQW, Inc., 100 w, P.
KFRC—610 kc, San Francisco, Calif., Don Lee, Inc., 1000 w, P.
KFRU—630 kc, Columbia, Mo., Stephens College, 500 w, C.
KFSD—600 kc, San Diego, Calif., Airfan Radio Corp., 500 w, P.
KFSG—1120 kc, Los Angeles, Calif., Echo Park Evan. Assn., 500 w, P.
KFUL—1290 kc, Galveston, Texas, W. H. Ford, 500 w, C.
KFUO—550 kc, St. Louis, Mo., Concordia Theological Seminary, 500 w, C.
KFUP—1310 kc, Denver, Colo., Fitzsimmons General Hospital, 100 w, M.
KFVD—1000 kc, Los Angeles, Calif., Los Angeles Broadcasting Co., 250 w, P.
KFVS — 1210 kc, Cape Girardeau, Mo., Hirsch Battery & Radio Co., 100 w, C.
KFWB—950 kc, Hollywood, Calif., Warner Bros. Broadcasting Corp., 1000 w, P.
KFWF—1200 kc, St. Louis, Mo., St. Louis Truth Center, Inc., 100 w.
KFWI—930 kc, San Francisco, Calif., Radio Entertainments, Inc., 500 w, P.
KFXD—1420 kc, Nampa, Idaho, Frank E. Hurt, 100 w, M.
KFXF—920 kc, Denver, Colo., Colorado Radio Co., 500 w, M.
KFXJ—1310 kc, Edgewater, Colo., Western Slope Broadcasting Co., 50 w, M.
KFXM—1210 kc, San Bernardino, Calif., Lee Bros. Broadcasting Co., 100 w, P.
KFXR—1310 kc, Oklahoma City, Okla., Exchange Avenue Baptist Church, 100 w, C.
KFXY—1420 kc, Flagstaff, Ariz., Mary M. Costigan, 100 w, M.
KFYO—1420 kc, Lubbock, Texas, Kirksey Bros., 100 w, C.
KFYR—550 kc, Bismarck, N. D., Meyer Broadcasting Co., 1000 w, C.
KGA—1470 kc, Spokane, Wash, Northwest Broadcasting System, Inc., 5000 w, P.
KGAR—1370 kc, Tucson, Ariz., Tucson Motor Service Co., 100 w, M.
KGB—1330 kc, San Diego, Calif., Don Lee, Inc., 500 w, P.
KGBU—900 kc, Ketchikan, Alaska, Alaska Radio & Service Co., 500 w.
KGBX—1310 kc, St. Joseph, Mo., KGBX, Inc., 100 w.
KGBZ—930 kc, York, Nebr., Geo. R. Miller, 500 w, C.
KGCA—1270 kc, Decorah, Iowa, Chas. W. Greenley, 50 w, C.
KGCR—1210 kc, Watertown, S. D., Greater Kampeska Radio Corp., 100 w.
KGCU—1240 kc, Mandan, N. D., Mandan Radio Association, 250 w, M.
KGCX—1310 kc, Wolf Point, Mont., First State Bank of Vida, 100 w, M.
KGDA—1370 kc, Mitchell, S. D., Mitchell Broadcasting Corp., 100 w, M.
KGDE—1200 kc, Fergus Falls, Minn., Jaren Drug Co., 100 w, C.
KGDM—1100 kc, Stockton, Calif., E. F. Peffer, 250 w.
KGDY—1200 kc, Huron, S. D., J. A. Loesch, 15 w, C.
KGEF—1300 kc, Los Angeles, Calif., Trinity Methodist Church, 1000 w, P.
KGEK—1200 kc, Yuma, Colo., Beehler Elec. Equip. Co., 100 w, M.
KGER—1360 kc, Long Beach, Calif., Consolidated Bdcstg. Corp., 1000 w, P.
KGEZ—1310 kc, Kalispell, Mont., Donald C. Treloar, 100 w, M.
KGFF—1420 kc, Shawnee, Okla., KGFF Bdcstg. Corp., 100 w, C.
KGFG—1370 kc, Oklahoma City, Okla., Oklahoma Broadcasting Co., Inc., 100 w, C.
KGFI — 1500 kc, Corpus Christi, Texas, Eagle Broadcasting Co., 100 w, C.
KGFJ—1200 kc, Los Angeles, Calif., Ben S. McGlashan, 100 w, P.
KGFK — 1500 kc, Moorhead, Minn., Red River Broadcasting Co., Inc., 50 w, C.
KGFL—1370 kc, Raton, N. Mex., KGFL, Inc., 50 w, M.
KGFW—1310 kc, Kearney, Neb., Central Neb. Bdcstg. Co., 100 w.
KGFX—630 kc, Pierre, S. D., Dana McNeil, 200 w, C.
KGGC — 1420 kc, San Francisco, Calif., Golden Gate Broadcasting Co., 100 w, P.
KGGF—1010 kc, South Coffeyville, Okla., Powell & Platz, 500 w.
KGGM—1230 kc, Albuquerque, N. Mex., New Mexico Broadcasting Co., 250 w.
KGHF—1320 kc, Pueblo, Colo, Ritchie & Finch, 250 w, M.
KGHI—1200 kc, Little Rock, Ark., O. A. Cook, 100 w.
KGHL—950 kc, Billings, Mont., Northwestern Auto Supply Co., 1000 w, M.
KGIQ—1320 kc, Twin Falls, Idaho, Radio Broadcasting Corp.
KGIR—1360 kc, Butte, Mont., KGIR, Inc., 500 w, M.
KGIW—1420 kc, Trinidad, Colo., Leonard E. Wilson, 100 w, M.
KGIX—1420 kc, Las Vegas, Nev., J. M. Heaton, 100 w.
KGIZ—1500 kc, Grant City, Mo., Grant City Park Corp., 100 w, C.
KGKB—1500 kc, Tyler, Tex., East Texas Bdcstg. 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, Sandpoint Bdcstg. Co., 100 w, P.
KGKY—1500 kc, Scottsbluff, Nebr., Hilliard Co., Inc., 100 w, C.
KGMB—1320 kc, Honolulu, Hawaii, Honolulu Broadcasting Co., 250 w, P.
KGMP—1210 kc, Elk City, Okla., Bryant Radio & Elec. Co., 100 w, C.
KGNF—1430 kc, North Platte, Nebr., H. L. Spencer, 500 w, M.
KGNO—1210 kc, Dodge City, Kans., Dodge City Broadcasting Co., Inc., M.
KGO—790 kc, San Francisco, Calif., National Broadcasting Co., Inc., 7500 w, P.
KGRS—1410 kc, Amarillo, Texas, Gish Radio Service, 1000 w, C.
KGU—750 kc, Honolulu, Hawaii, Marion Mulrony, Advertising Publ. Co., 2500 w.
KGVO—1420 kc, Missoula, Mont., Mosby's, Inc.
KGW—620 kc, Portland, Ore., Oregonian Pub. Co., 1000 w, P.
KGY—1200 kc, Lacey, Wash., KGY, Inc., 100 w, P.
KHJ—900 kc, Los Angeles, Calif., Don Lee, Inc., 1000 w, P.
KHQ—590 kc, Spokane, Wash., Louis Wasmer, Inc., 1000 w, P.
KICA—1370 kc, Clovis, N. M., W. E. Whitmore, 100 P.
KICK—1420 kc, Red Oak, Iowa, Red Oak Radio Corp., 100 w.
KID — 1320 kc, Idaho Falls, Ida., KID Broadcasting Co., 250 w, M.
KIDO—1350 kc, Boise, Idaho, Boise Broadcasting Station, 1000 w, P.
KIT—1310 kc, Yakima, Wash., C. E. Haymond, 100 w, P.
KJBS—1070 kc, San Francisco, Calif., Julius Brunton & Sons Co., 100 w, P.
KJR—970 kc, Seattle, Wash., Northwest Broadcasting System, Inc., 5000 w, P.
KLCN—1290 kc, Blytheville, Ark., C. L. Lintzenich, 50 w, C.
KLO—1400 kc, Ogden, Utah, Interstate Bdcstg. Corp., 500 w, M.
KLPM — 1420 kc, Minot, N. D., John B. Cooley, 100 w, C.
KLRA—1390 kc, Little Rock, Ark., Arkansas Broadcasting Co., 1000 w.
KLS — 1440 kc, Oakland, Calif., Warner Bros., 250 w, P.
KLX—880 kc, Oakland, Calif., Tribune Pub. Co., 500 w, P.
KLZ—560 kc, Denver, Colo., Reynolds Radio Co., Inc., 1000 w, M.
KMA—930 kc, Shenandoah, Iowa, May Seed & Nursery Co., 500 w, C.
KMAC—1370 kc, San Antonio, Texas, W. W. McAllister, 100 w, C.
KMBC—950 kc, Kansas City, Mo., Midland Broadcasting Co., 1000 w, C.
KMED—1310 kc, Medford, Ore., Mrs. W. J. Virgin, 100 w, P.
KMJ—1210 kc, Fresno, Calif., J. McClatchy Co., 100 w, P.
KMLB—1200 kc, Monroe, La., Liner's Bdcstg. Station, Inc., 100 w, C.

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

WCRW—1210 kc, Chicago, Ill., Clinton R. White, 100 w, C.
WCSC—1360 kc, Charleston, S. C., Lewis Burk, 500 w, E.
WCSH—940 kc, Portland, Me., Congress Square Hotel Co., 1000 w, E.
WDAE—1220 kc, Tampa, Fla., Tampa Publishing Co., 1000 w, E.
WDAF—610 kc, Kansas City, Mo., Kansas City Star Co., 1000 w, C.
WDAG—1410 kc, Amarillo, Texas, National Radio & Broadcasting Corp., 250 w, C.
WDAH—1310 kc, El Paso, Texas, W. S. Bledsoe, 100 w, M.
WDAS—1370 kc, Philadelphia, Pa., WDAS Broadcasting Station, Inc., 100 w, E.
WDAY—940 kc, Fargo, N. D., WDAY, Inc., 1000 w, C.
WDBJ—930 kc, Roanoke, Va., Times-World Corp., 250 w, E.
WDBO—1120 kc, Orlando, Fla., Orlando Broadcasting Co., 250 w, E.
WDEL—1120 kc, Wilmington, Del., WDEL, Inc., 250 w, E.
WDEV—1420 kc, Waterbury, Vt., H. C. Whitehill, 50 w.
WDGY—1180 kc, Minneapolis, Minn., Dr. Geo. W. Young, 1000 w, C.
WDIX—1420 kc, Texarkana, Ark., North Mississippi Broadcasting Corp., 100 w, C.
WDOD—1280 kc, Chattanooga, Tenn., WDOD Bdcstg. Corp., Inc., 1000 w, C.
WDRC—1330 kc, Hartford, Conn., Doolittle Radio Corp., 500 w, E.
WDSU—1250 kc, New Orleans, La., Jos. H. Uhalt, 1000 w, C.
WDZ—1070 kc, Tuscola, Ill., James L. Bush, 100 w.
WEAF—660 kc, New York, N. Y., National Broadcasting Co., Inc., 50,000 w, E.
WEAI—1270 kc, Ithaca, N. Y., Cornell Univ., 1000 w, E.
WEAN—780 kc, Providence, R. I., Shepard Broadcasting Service, 250 w, E.
WEAO—570 kc, Columbus, Ohio, Ohio State University, 750 w, E.
WEBC—1290 kc, Superior, Wis., Head of The Lakes Broadcasting Co., 1000 w, C.
WEBQ—1210 kc, Harrisburg, Ill., First Trust & Savings Bank, 100 w, C.
WEBR—1310 kc, Buffalo, N. Y., Howell Broadcasting Co., 100 w, E.
WEDC—1210 kc, Chicago, Ill., Emil Denemark, Inc., 100 w.
WEEI—590 kc, Boston, Mass., Edison Elec. Illum. Co., 1000 w, E.
WEEU—830 kc, Reading, Pa., Berks Bdcstg. Co., 1000 w.
WEHC—1350 kc, Emory, Va., Emory and Henry College, 500 w, E.
WEHS—1420 kc, Evanston, Ill., WEHS, Inc., 100 w, C.
WELL—1420 kc, Battle Creek, Mich., Enquirer-News Co., 100 w, E.
WENR—870 kc, Chicago, Ill., Great Lakes Radio Broadcasting Co., 50,000 w, C.
WEPS—See under WORC.
WERE—1420 kc, Erie, Pa., Erie Dispatch-Herald, 30 w, E.
WEVD—1300 kc, Brooklyn, N. Y., Debs Memorial Radio Fund, 500 w, E.
WEW—760 kc, St. Louis, Mo., St. Louis University, 1000 w, C.
WEXL—1310 kc, Royal Oak, Mich., Royal Oak Broadcasting Co., 50 w, E.
WFAA—800 kc, Dallas, Texas, Dallas News and Journal, 50,000 w, C.
WFAM—1200 kc, La Porte, Ind., South Bend Tribune, 100 w, C.
WFAN—610 kc, Philadelphia, Pa., Keystone Broadcasting Co., Inc., 500 w, E.
WFBC—1200 kc, Knoxville, Tenn., First Baptist Church, 50 w, E.
WFBE—1200 kc, Cincinnati, Ohio, Post Publ. Co., 100 w, E.
WFBG—1310 kc, Altoona, Pa., William F. Gable Co., 100 w, E.
WFBL—1360 kc, Syracuse, N. Y., The Onondaga Co., Inc., 1000 w, E.
WFBM—1230 kc, Indianapolis, Ind., Indianapolis, Power & Light Co., 1000 w, C.
WFBR—1270 kc, Baltimore, Md., Baltimore Radio Show, Inc., 1000 w, E.
WFDF—1310 kc, Flint, Mich., Frank D. Fallain, 100 w, E.
WFDV—1500 kc, Rome, Ga., Dolies Goings, 100 w, E.
WFDW—1420 kc, Anniston, Ala., R. C. Hammett, 100 w, C.
WFEA—1430 kc, Merrimack, N. H., New Hampshire Bdcstg. Co., 500 w, E.
WFI—560 kc, Philadelphia, Pa., Strawbridge & Clothier, 500 w, E.
WFIW—940 kc, Hopkinsville, Ky., WFIW, Inc., 1000 w, C.
WFLA—620 kc, Clearwater, Fla., Clearwater Chamber of Commerce and St. Petersburg Chamber of Commeree, 250 w, E.

WFOX—1400 kc, Brooklyn, N. Y., Paramount Broadcasting Corp., 500 w.
WGAL—1310 kc, Lancaster, Pa., WGAL, Inc., 100 w, E.
WGAR—1450 kc, Cleveland, Ohio, WGAR Broadcasting Co., 500 w, E.
WGBB—1210 kc, Freeport, N. Y., Harry H. Carman, 100 w, E.
WGBC—See under WNBR.
WGBF—630 kc, Evansville, Ind., Evansville on the Air, Inc., 500 w, C.
WGBI—880 kc, Scranton, Pa., Scranton Broadcasters, Inc., 250 w, E.
WGCM—590 kc, Gulfport, Miss., Great Southern Land Co., Inc., 1000 w, C.
WGCP—1250 kc, Newark, N. J., May Radio Broadcast Corp., 250 w, E.
WGES—1360 kc, Chicago, Ill., Oak Leaves Broadcasting Corp., 500 w, C.
WGH—1310 kc, Newport News, Va., Hampton Roads Broadcasting Corp., Inc., 100 w, E.
WGL—1370 kc, Ft. Wayne, Ind., Allen-Wayne Co., 100 w, C.
WGMS—See under WLB.
WGN—720 kc, Chicago, Ill., Tribune Co., 25,000 w, C.
WGR—550 kc, Buffalo, N. Y., Buffalo Broadcasting Corp., 1000 w, E.
WGST—890 kc, Atlanta, Ga., Georgia School of Technology, 250 w, E.
WGY—790 kc, Schenectady, N. Y., General Electric Co., 50,000 w, E.
WHA—940 kc, Madison, Wis., University of Wisconsin, 750 w, C.
WHAD—1120 kc, Milwaukee, Wis. Marquette University, 250 w, C.
WHAM—1150 kc, Rochester, N. Y., Stromberg-Carlson Tel. Mfg. Co., 5000 w, E.
WHAP—1300 kc, New York, N. Y., Defenders of Truth Society, Inc., 1000 w, E.
WHAS—820 kc, Louisville, Ky., The Courier Journal Co. & Louisville Times Co., 10,000 w, C.
WHAT—1310 kc, Philadelphia, Pa., Independence Broadcasting Co., 100 w, E.
WHAZ—1300 kc, Troy, N. Y., Rensselaer Polytechnic Institute, 500 w, E.
WHB—860 kc, Kansas City, Mo., WHB Broadcasting Co., 500 w, C.
WHBC—1200 kc, Canton, Ohio, St. John's Catholic Church, 10 w, E.
WHBD—1370 kc, Mt. Orab, Ohio, F. P. Moler, 100 w, E.
WHBF—1210 kc, Rock Island, Ill., Beardsley Specialty Co., 100 w, C.
WHBL—1410 kc, Sheboygan, Wis., Press Pub. Co., 500 w, C.
WHBQ—1370 kc, Memphis, Tenn., Station WHBQ, Inc., 100 w, C.
WHBU—1210 kc, Anderson, Ind., Anderson Bdcstg. Corp., 100 w, C.
WHBY—1200 kc, Green Bay, Wis., St. Norbert's College, 100 w, C.
WHDF—1370 kc, Calumet, Mich., Upper Michigan Brdcstg. Co., 100 w, C.
WHDH—830 kc, Boston, Mass., Matheson Radio Co., Inc., 1000 w, E.
WHDI—1180 kc, Minneapolis, Minn., Dr. G. W. Young, 500 w, C.
WHDL—1420 kc, Tupper Lake, N. Y., Tupper Lake Broadcasting Corp., 100 w, E.
WHEC—1440 kc, Rochester, N. Y., WHEC, Inc., 500 w, E.
WHFC—1420 kc, Cicero, Ill., WHFC, Inc., 100 w, C.
WHIS—1410 kc, Bluefield, W. Va., Daily Telegraph Printing Co., 250 w, E.
WHK—1390 kc, Cleveland, Ohio, Radio Air Service Corp., 1000 w, E.
WHN—1010 kc, New York, N. Y., Marcus Loew Booking Review, 250 w, E.
WHO—1000 kc, Des Moines, Iowa, Central Broadcasting Co., 50,000 w, C.
WHOM—1450 kc, Jersey City, N. J., New Jersey Broadcasting Corp., 250 w, E.
WHP—1430 kc, Harrisburg, Pa., WHP, Inc., 500 w, E.
WIAS—1420 kc, Ottumwa, Iowa, Poling Electric Co., 100 w, C.
WIBA—1280 kc, Madison, Wis., Capital Times Co., 500 w, C.
WIBG—930 kc, Elkins Park, Pa., WIBG, Inc., 25 w, E.
WIBM—1370 kc, Jackson, Mich., WIBM, Inc., 100 w.
WIBO—560 kc, Chicago, Ill., Nelson Bros. Bond and Mortgage Co., 1000 w, C.
WIBU—1210 kc, Poynette, Wis., W. C. Forrest, 100 w, C.
WIBW—580 kc, Topeka, Kan., Topeka Broadcasting Assn., Inc., 1000 w, C.

WIBX—1200 kc, Utica, N. Y., WIBX, Inc., 100 w, E.
WICC—600 kc, Bridgeport, Conn., Bridgeport Broadcasting Station, Inc., 500 w, E.
WIL—1200 kc, St. Louis, Mo., Missouri Broadcasting Co., 100 w, C.
WILL—890 kc, Urbana, Ill., University of Illinois, 250 w, C.
WILM—1420 kc, Wilmington, Del., Delaware Broadcasting Co., Inc., 100 w, E.
WINS—1180 kc, New York, N. Y., American Radio News Corp., 500 w, E.
WIOD—1300 kc, Miami, Fla., Isle of Dreams Broadcasting Co., 500 w, E.
WIP—610 kc, Philadelphia, Pa., Gimbel Bros., Inc., 500 w, E.
WIS—1010 kc, Columbia, S. C., South Carolina Broadcasting Co., Inc., 500 w, E.
WISJ—See under WIBA.
WISN—1120 kc, Milwaukee, Wis., Evening Wisconsin Co., 250 w, C.
WJAC—1310 kc, Johnstown, Pa., Johnstown Automobile Co., 100 w, E.
WJAG—1060 kc, Norfolk, Neb., Norfolk Daily News, 1000 w, C.
WJAK—1310 kc, Marion, Ind., The Truth Pub. Co., Inc., 50 w.
WJAR—890 kc, Providence, R. I., The Outlet Co., 250 w, E.
WJAS—1290 kc, Pittsburgh, Pa., Pittsburgh Radio Supply House, 1000 w, E.
WJAX—900 kc, Jacksonville, Fla., City of Jacksonville, 1000 w, E.
WJAY—610 kc, Cleveland, Ohio, Cleveland Radio Broadcasting Corp., 500 w, E.
WJBC—1200 kc, LaSalle, Ill., Kaskaskia Broadcasting Co., 100 w, C.
WJBI—1210 kc, Red Bank, N. J., Monmouth Broadcasting Co., 100 w, E.
WJBK—1370 kc, Highland Park, Mich., J. F. Hopkins, 50 w, C.
WJBL—1200 kc, Decatur, Ill., Commodore Broadcasting Co., 100 w, C.
WJBO—1420 kc, New Orleans, La., Valdemar Jensen, 100 w, C.
WJBU—1210 kc, Lewisburg, Pa., Bucknell University, 100 w, E.
WJBW—1200 kc, New Orleans, La., C. Carlsen, Jr., 30 w, C.
WJBY—1210 kc, Gadsden, Ala., Gadsden Broadcasting Co., 100 w, C.
WJDX—1270 kc, Jackson, Miss., Lamar Life Ins. Co., 1000 w, C.
WJJD—1130 kc, Chicago, Ill., WJJD, Inc., 20,000 w, C.
WJKS—1360 kc, Gary, Ind., Johnson-Kennedy Radio Corp., 1000 w, C.
WJMS—1420 kc, Ironwood, Mich., Johnson Music Store, 100 w.
WJR—750 kc, Detroit, Mich., The Goodwill Station, Inc., 10,000 w, E.
WJSV—1460 kc, Alexandria, Va., WJSV, Inc., 10,000 w.
WJTL—1370 kc, Oglethorpe University, Ga., 100 w, E.
WJW—1210 kc, Mansfield, Ohio, Mansfield Broadcasting Association, 100 w, E.
WJZ—760 kc, New York City, N. Y., National Broadcasting Co., 30,000 w, E.
WKAQ—890 kc, San Juan, Porto Rico, Radio Corp. of Porto Rico, 250 w, E.
WKAR—1040 kc, East Lansing, Mich., Michigan State College, 1000 w, E.
WKAV—1310 kc, Laconia, N. H., Laconia Radio Club, 100 w, E.
WKBB—1310 kc, Joliet, Ill., Sanders Bros., 100 w, C.
WKBC—1310 kc, Birmingham, Ala., R. B. Broyles Furniture Co., 100 w, C.
WKBF—1400 kc, Indianapolis, Ind., Indianapolis Broadcasting Corp., 500 w, C.
WKBH—1380 kc, LaCrosse, Wis., WKBH, Inc., 1000 w, C.
WKBI—1420 kc, Chicago, Ill., WKBI, Inc., 100 w, C.
WKBN—570 kc, Youngstown, Ohio, WKBN Bdcstg. Corp., 500 w, E.
WKBS—1310 kc, Galesburg, Ill., Permil N. Nelson, 100 w, C.
WKBV—1500 kc, Connersville, Ind., Knox Battery & Electric Co., 100 w, C.
WKBW—1480 kc, Buffalo, N. Y., WKBW, Inc., 5000 w, E.
WKBZ—1500 kc, Ludington, Mich., K. L. Ashbacker, 50 w.
WKJC—1200 kc, Lancaster, Pa., Lancaster Bdcstg. Service, Inc., 100 w, E.
WKRC—550 kc, Cincinnati, Ohio, WKRC, Inc., 1000 w, E.
WKY—900 kc, Oklahoma City, Okla., WKY Radiophone Co., 1000 w, C.
WKZO—590 kc, Berrien Springs, Mich., WKZO, Inc., 1000 w, C.
WLAC—1470 kc, Nashville, Tenn., Life & Casualty Ins. Co., 5000 w, C.

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

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

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

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

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

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

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

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

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

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

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

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

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

WLSI—See under WPRO.

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

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

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

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

WMAC—See under WSYR.

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

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

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

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

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

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

WMBF—See under WIOD.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WOAN—See WREC.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WORK—1000 kc, York, Pa., York Bdcstg. Co., 1000 w, E.

WOS—630 kc, Jefferson City, Mo., Mo. State Marketing Bur., 500 w, C.

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

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

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

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

WPAP—See under WQAO.

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

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

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

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

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

WPOR—See under WTAR.

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

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

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

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

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

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

WQBC—1360 kc, Vicksburg, Miss., Delta Broadcasting Co., 500 w, C.

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

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

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

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

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

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

WRBL—1200 kc, Columbus, Ga., WRBL Radio Station, Inc., 100 w, E.

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

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

WRC—950 kc, Washington, D. C., National Broadcasting Co., 1000 w, E.

WRDO—1370 kc, Augusta, Me., WRDO, Inc., 100 w, E.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WSB—740 kc, Atlanta, Ga., Atlanta Journal Co., 50,000 w, E.

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

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

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

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

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

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

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

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

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

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

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

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

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

WSUN—See under WFLA.

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

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

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

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

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

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

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

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

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

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

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

WTEL—1310 kc, Philadelphia, Pa., Foulkrod Radio Eng. Co., 100 w, E.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

U. S. Broadcasting Stations by Frequencies

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

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

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

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

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

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

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

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

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

640 Kilocycles, 468.5 Meters:
WAIU, KFI, WOI

650 Kilocycles, 461.3 Meters:
WSM, KPCB

660 Kilocycles, 454.3 Meters:
WEAF, WAAW

670 Kilocycles, 447.5 Meters:
WMAQ

680 Kilocycles, 440.9 Meters:
WPTF, KPO, KFEQ

690 Kilocycles, 434.5 Meters—Canadian Wave:

700 Kilocycles, 428.3 Meters:
WLW

710 Kilocycles, 422.3 Meters:
WOR, KMPC

720 Kilocycles, 416.4 Meters:
WGN

730 Kilocycles, 410.7 Meters—Canadian Wave:

740 Kilocycles, 405.2 Meters:
WSB, KMMJ

750 Kilocycles, 399.8 Meters:
WJR, KGU

760 Kilocycles, 394.5 Meters:
WJZ, WEW, KVI

770 Kilocycles, 389.4 Meters:
KFAB, WBBM, WJBT

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

790 Kilocycles, 379.5 Meters:
WGY, KGO

800 Kilocycles, 374.8 Meters:
WBAP, WFAA

810 Kilocycles, 370.2 Meters:
WPCH, WCCO

820 Kilocycles, 365.6 Meters:
WHAS

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

840 Kilocycles, 356.9 Meters—Canadian Wave:

850 Kilocycles, 352.7 Meters:
KWKH, WWL

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

870 Kilocycles, 344.6 Meters:
WLS, WENR, WBCN

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

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

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

910 Kilocycles, 329.5 Meters—Canadian Wave:

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

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

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

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

960 Kilocycles, 312.3 Meters—Canadian Wave:

970 Kilocycles, 309.1 Meters:
KJR, WCFL

980 Kilocycles, 305.9 Meters:
KDKA

990 Kilocycles, 302.8 Meters:
WBZ, WBZA

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

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

1020 Kilocycles, 293.9 Meters:
KYW, KFKX, WRAX

1030 Kilocycles, 291.1 Meters—Canadian Wave:

1040 Kilocycles, 288.3 Meters:
WKAR, KTHS, KRLD

1050 Kilocycles, 285.5 Meters:
KNX, KFKB

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

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

1080 Kilocycles, 277.6 Meters:
WBT, WCBD, WMBI

1090 Kilocycles, 275.1 Meters:
KMOX

1100 Kilocycles, 272.6 Meters:
WPG, WLWL, KGDM

1110 Kilocycles, 270.1 Meters:
WRVA, KSOO

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

1130 Kilocycles, 265.3 Meters:
WOV, KSL, WJJD

1140 Kilocycles, 263.0 Meters:
WAPI, KVOO

1150 Kilocycles, 260.7 Meters:
WHAM

1160 Kilocycles, 258.5 Meters:
WWVA, WOWO

1170 Kilocycles, 256.3 Meters:
WCAU

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

1190 Kilocycles, 252.0 Meters:
WOAI

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1460 Kilocycles, 205.4 Meters:
WJSV, KSTP

1470 Kilocycles, 204.0 Meters:
KGA, WTNT, WLAC

1480 Kilocycles, 202.6 Meters:
KFJF, WKBW

1490 Kilocycles, 201.6 Meters:
WCKY, WCHI

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

U. S. Broadcasting Stations Listed by States

ALABAMA

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

ALASKA

Anchorage, KFQD
Juneau, KFIU
Ketchikan, KGBU

ARIZONA

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

ARKANSAS

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

CALIFORNIA

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

COLORADO

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

CONNECTICUT

Bridgeport, WICC
Hartford, WTIC, WDRC
Storrs, WCAC

DELAWARE

Wilmington, WDEL, WILM

DISTRICT OF COLUMBIA

Washington, NAA, WMAL, WRC, WOL

FLORIDA

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

GEORGIA

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

HAWAII

Honolulu, KGU, KGMB

IDAHO

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

ILLINOIS

Carthage, WCAZ
Chicago, KYW, WAAF, WCFL, WCRW, WEDC, WENR, WGES, WKBI, WPCC, WGN, WMAQ, WMBI, WBBM, WSBC, WIBO, WLS, WJJD, WCHI
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, WTAX
Tuscola, WDZ
Urbana, WILL
Zion, WCBD

INDIANA

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

IOWA

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

KANSAS

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

KENTUCKY

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

LOUISIANA

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

MAINE

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

MARYLAND

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

MASSACHUSETTS

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

MICHIGAN

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

MINNESOTA

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

MISSISSIPPI

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

MISSOURI

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

MONTANA

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

NEBRASKA

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

NEVADA

Las Vegas, KGIX
Reno, KOH

NEW HAMPSHIRE

Laconia, WKAV
Merrimack, WFEA

NEW JERSEY

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

NEW MEXICO

Albuquerque, KGGM
Raton, KGFL
State College, KOB

NEW YORK

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

NORTH CAROLINA

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

NORTH DAKOTA

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

OHIO

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

OKLAHOMA

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

OREGON

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

PENNSYLVANIA

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

PORTO RICO

San Juan, WKAQ

RHODE ISLAND

Newport, WMBA
Providence, WEAN, WPRO, WJAR

SOUTH CAROLINA

Charleston, WCSC
Columbia, WIS
Spartanburg, WSPA

SOUTH DAKOTA

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

TENNESSEE

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

TEXAS

Amarillo, KGRS, WDAG
Austin, KNOW
Beaumont, KFDM
Brownsville, KWWG
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, KTLC, KTRH, KXYZ
Lubbock, KFYO
San Angelo, KGKL
San Antonio, KTSA, KABC, WOAI, KONO, KMAC
Tyler, KGKB
Waco, WACO
Wichita Falls, KGKO

UTAH

Ogden, KLO
Salt Lake City, KDYL, KSL

VERMONT

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

VIRGINIA

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

WASHINGTON

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

WEST VIRGINIA

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

WISCONSIN

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

WYOMING

Casper, KDFN

LIST OF POLICE BROADCASTING STATIONS

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

U. S. VISUAL BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner	Call	Kilocycles	Meters	Owner
W1XAU	1,500	193.6	Short Wave & Television, Boston, Mass.	W3XAD	48,500	6.18	RCA-Victor, Camden, N. J.
W1XAV	2,950	101.8	Short Wave & Television, Boston, Mass.	W3XAD	60,000	5.00	RCA-Victor, Camden, N. J.
W2XAB	2,750	109.10	Atlantic Broadcasting, New York, N. Y.	W3XAD	2,100	142.90	RCA-Victor, Camden, N. J.
W2XBC	2,750	109.10	United Research Corp., Long Island City, N. Y.	W3XK	2,000	150.00	Jenkins Laboratories, Wheaton, Md.
W2XBU	2,000	150.00	Harold E. Smith, Beacon, N. Y.	W6X4H	2,000	150.00	Pioneer Mercantile Co., Bakersfield, Calif.
W2XCD	2,000	150.00	DeForest Radio Co., Passaic, N. J.	W6XAO	43,000	6.97	Don Lee, Inc., Los Angeles, Calif.
W2XCR	2,100	142.90	Jenkins Television, Jersey City, N. J.	W6XS	2,100	142.90	Don Lee, Inc., Los Angeles, Calif.
W2XCR	2,000	150.00	Jenkins Television, Jersey City, N. J.	W8XAV	2,100	142.90	Westinghouse, East Pittsburgh, Pa.
W2XCW	2,100	142.90	General Electric, Schenectady, N. Y.	W9XAA	2,750	109.10	Federation of Labor, Chicago, Ill.
W2XDA	1,544	194.30	Atlantic Broadcasting, New York, N. Y.	W9XAB	1,564	191.82	Federation of Labor, Chicago, Ill.
W2XDS	43,000	6.98	Jenkins Television, New York, N. Y.	W9XAO	2,000	150.00	Western Television Corp., Chicago, Ill.
W2XDS	48,500	6.19	Jenkins Television, New York, N. Y.	W9XAP	2,100	142.90	National Broadcasting, Chicago, Ill.
W2XDS	60,000	5.00	Jenkins Television, New York, N. Y.	W9XD	43,000	6.97	Journal Company, Milwaukee, Wis.
W2XF	43,000	6.97	National Broadcasting, New York, N. Y.	W9XD	48,500	6.18	Journal Co., Milwaukee, Wis.
W2XF	48,500	6.18	National Broadcasting, New York, N. Y.	W9XD	60,000	6 00	Journal Co., Milwaukee, Wis.
W2XF	60,000	5 00	National Broadcasting, New York, N. Y.	W9XG	2,750	109.10	Purdue University, W. Lafayette, Ind.
W2XR	2,850	105.30	Radio Pictures, Inc., Long Island City, N. Y.	W9XK	2,000	150	Iowa City, Iowa.
W3XAD	43,000	6.97	RCA-Victor, Camden, N. J.	W9XR	2,850	105.30	Great Lakes Broadcasting, Chicago, Ill.

U. S. RELAY BROADCASTING STATIONS

Call	Kilocycles	Meters	Owner	Call	Kilocycles	Meters	Owner
W1XAL	6,040	49.67	Short Wave Bdcstg. Corp., Boston, Mass.	W6XAF	2,938	112.10	Dept. Agriculture, Sacramento, Calif.
W1XAL	11 800	25.42	Short Wave Bdcstg. Corp., Boston, Mass.	W6XAF	5,870	51.11	Dept. Agriculture, Sacramento, Calif.
W1XAL	15,250	19.67	Short Wave Bdcstg. Corp., Boston, Mass.	W6XAL	6,080	49.34	Pacific-Western Broadcasting, Westminster, Calif
W1XAL	21,460	13 97	Short Wave Bdcstg. Corp., Boston, Mass.	W6XAL	15,250	19.67	Pacific-Western Broadcasting, Westminster, Calif
W1XAZ	9,570	31.35	Westinghouse Elec., East Springfield, Mass.	W6XAL	21,500	13.95	Pacific-Western Broadcasting, Westminster, Calif
W2XAD	15,340	19.56	General Electric, Schenectady, N. Y.	W6XN	12,850	23.35	General Electric, Oakland, Calif.
W2XAF	9,530	31.48	General Electric, Schenectady, N. Y.	W8XAL	6,060	49.50	Crosley Radio Corp., Cincinnati, Ohio
W2XAG	550	545.00	General Electric, Schenectady, N. Y.	W8XK	6,140	48.86	Westinghouse, East Pittsburgh, Pa.
W2XAG	660	455.00	General Electric, Schenectady, N. Y.	W8XK	9,570	31.35	Westinghouse, East Pittsburgh, Pa.
W2XAG	790	380.00	General Electric, Schenectady, N. Y.	W8XK	11,880	25.25	Westinghouse, East Pittsburgh, Pa.
W2XAG	1,150	260.90	General Electric, Schenectady, N. Y.	W8XK	15,210	19.72	Westinghouse, East Pittsburgh, Pa.
W2XAG	1,500	200.00	General Electric, Schenectady, N. Y.	W8XK	17,780	16.87	Westinghouse, East Pittsburgh, Pa.
W2XE	6,120	49.02	Atlantic Broadcasting, Jamaica, N. Y.	W8XK	21,540	13.93	Westinghouse, East Pittsburgh, Pa.
W2XE	11,840	25.34	Atlantic Broadcasting Co., Jamaica, N. Y.	W9XAA	6,080	49.34	Federation of Labor, Chicago, Ill.
W2XE	15,280	19.63	Atlantic Broadcasting Co., Jamaica, N. Y.	W9XAA	11,840	25.34	Federation of Labor, Chicago, Ill.
W2XZ	610	491.50	National Broadcasting, Bellmore, N. Y.	W9XAA	17,780	16.87	Federation of Labor, Chicago, Ill.
W3XAL	6,100	49.18	National Broadcasting, New York, N. Y.	W9XF	6,020	49.83	Great Lakes Broadcasting, Chicago, Ill.
W3XL	6,425	46.70	National Broadcasting, New York, N. Y.	W9XF	11,800	25.42	Great Lakes Broadcasting, Chicago, Ill.
W3XAU	6,060	49.50	Universal Broadcasting, Newton Township, Pa.	W9XF	21,500	13.95	Great Lakes Broadcasting, Chicago, Ill.
W3XAU	9,590	31.28	Universal Broadcasting, Newton Township, Pa.	W9XU	6,060	49.50	Mona Motor Oil Co., Council Bluffs, Iowa
W4XA	2,368	126.7	Miami, Fla.				

SIMPLE TIME CHART

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

← WEST

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

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

EAST →

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

FOREIGN BROADCAST STATIONS

AFRICA

Call	Location	Kc.
ZTC	Capetown	800
ZTD	Durban	732
ZTJ	Johannesburg	667

ALGERIA

Call	Location	Kc.
......	Algiers	824

ARGENTINA

Call	Location	Kc.
LP4	Buenos Aires	670
LR1	Buenos Aires	790
LR2	Buenos Aires	870
LR3	Buenos Aires	950
LR4	Buenos Aires	990
LR5	Buenos Aires	830
LR6	Buenos Aires	990
LR7	Buenos Aires	750
LR8	Buenos Aires	1150
LR9	Buenos Aires	1030
LS1	Buenos Aires	710
LS2	Buenos Aires	1190
LS3	Buenos Aires	1270
LS5	Buenos Aires	1070
LS6	Buenos Aires	1350
LS8	Buenos Aires	1230
LS9	Buenos Aires	1388
LT1	Concordia	810
12	Concordia	1327
LV2	Cordoba	911
LT7	General Pico	1411
LT2	La Plata	685
LV8	Los Molinos	
LT4	Mendoza	759
LT5	Parana	1249
LT3	Rosario	1080
LV5	Rosario	1369
LV6	Rosario	1079
LT6	San Juan	730
LP2	Villaguay	1140

AUSTRALIA

Call	Location	Kc.
5CL	Adelaide	730
5DN	Adelaide	960
5KA	Adelaide	1200
5AD	Adelaide	1310
2AY	Albury	1320
2AY	Albury	1480
3BA	Ballarat	1300
3BO	Bendigo	970
4QG	Brisbane	760
4BC	Brisbane	1145
4BH	Brisbane	1380
4BK	Brisbane	1290
2XL	Broken Hill	1365
2CA	Canberra	1050
3KZ	Carlton	1350
4CH	Charleville	1170
3GL	Geelong	1400
2GN	Goulburn	1390
2MO	Gunnedah	1330
7ZL	Hobart	580
7HO	Hobart	890
7HO	Hobart	1160
7LA	Launceston	1130
2XN	Lismore	1340
4MK	Mackay	1190
3AK	Melbourne	1500
3AR	Melbourne	610
3LO	Melbourne	800
3UZ	Melbourne	930
3DB	Melbourne	1180
3KZ	Melbourne	1350
2MV	Moss Vale	1220
2NC	Newcastle	1245
2HD	Newcastle	1110
6WF	Perth	690
6ML	Perth	1135
6PR	Perth	880
5PI	Port Pirie	1040
4RK	Rockhampton	910
2FC	Sydney	665
2BL	Sydney	855
2GB	Sydney	950
2UE	Sydney	1025
2KY	Sydney	1070
2UW	Sydney	1125
4GR	Toowoomba	1000
4TO	Townsville	1170
3TR	Trafalgar	1280
3WR	Wangaratta	1260

AUSTRIA

Call	Location	Kc.
......	Graz	851
......	Innsbruck	1058
......	Klagenfurt	662
......	Linz	1220
......	Vienna	581

BELGIUM

Call	Location	Kc.
ON4ED	Antwerp	1455
ON4GT	Bruxells	1375
ON4RB	Bruxells	590
ON4RC	Bruxells	1448
ON4FO	Bruxells	1219
ON4CE	Chatelineau	1388
ON4FG	Dampremy	1455
ON4RG	Gand	1219
ON4RW	Liege	1219
ON4BQ	Marchienne	1035
ON4EX	Ottomont	1388
ON4CF	Verviers	1455

BOLIVIA

Call	Location	Kc.
CPX	La Paz	1350

BRAZIL

Call	Location	Kc.
PRAM	Amparo	638
PRAH	Bahia	674
PRAF	Belem	842
PRAQ	Bello Horizonte	1090
PRAN	Curytiba	882
PRAZ	Franca	1111
PRAJ	Juiz de Fora	857
PRAY	Mogy das Cruzes	1000
PRAD	Pelotas	920
PRAG	Porto Alegre	706
PRAP	Pernambuco	706
PRAI	Ribeirao Preto	1070
PRAA	Rio de Janeiro	750
PRAB	Rio de Janeiro	937
PRAC	Rio de Janeiro	857
PRAX	Rio de Janeiro	1364
PRAK	Rio de Janeiro	1153
PRAS	Santos	887
PRAE	San Paolo	815
PRAR	San Paolo	1006
PRAL	San Paolo	750
PRAO	San Paolo	934

CANADA

Call	Location	Kc.
CKGW	Bowmanville	910
CJBC	Bowmanville	910
CJSC	Bowmanville	910
CPRY	Bowmanville	910
10AE	Bowmanville	1199
10BQ	Brantford	1200
CKX	Brandon	540
CNRC	Calgary	690
CFCN	Calgary	985
CJCJ	Calgary	690
CHCA	Calgary	690
CFAC	Calgary	690
10BU	Canora	1200
CHCK	Charlottetown	1010
CFCY	Charlottetown	580
CFCO	Chatham	1210
CHWK	Chilliwack	665
CKMC	Cobalt	1210
CHMA	Edmonton	580
CKUA	Edmonton	580
CJCA	Edmonton	930
CNRE	Edmonton	930
CJRW	Fleming	665
CFNB	Fredericton	1210
CHNS	Halifax	930
CNRH	Halifax	930
CHCS	Hamilton	1010
CHML	Hamilton	880
CKOC	Hamilton	1010
CFJC	Kamloops	1120
10AY	Kelowna	1200
CKOV	Kelowna	1200
CFRC	Kingston	930
CFRB	King, York Co.	960
CNRX	King, York Co.	960
CJOC	Lethbridge	1120
10CB	Liverpool	1200
CJGC	London	910
CNRL	London	910
CKPR	Midland	930
CNRA	Moncton	630
CFCF	Montreal	1031
CJRM	Moose Jaw	665
10AB	Moose Jaw	1425
CFCH	North Bay	930
CKCO	Ottawa	890
CNRO	Ottawa	600
CHWC	Pilot Butte	960
CKPR	Port Arthur	890
CFLC	Prescott	930
CKPC	Preston	1210
10BI	Prince Albert	1200
CHRC	Quebec	880
CKCI	Quebec	645
CKCV	Quebec	880
CNRQ	Quebec	880
CNRD	Red Deer	840
CKLC	Red Deer	840
CHCT	Red Deer	840
CKCK	Regina	960
CJBR	Regina	960
CNRR	Regina	960
CFQC	Saskatoon	910
CNRS	Saskatoon	910
CJOR	Sea Island	1210
CKAC	St. Hyacinthe	730
CHYC	St. Hyacinthe	730
CNRM	St. Hyacinthe	730
CFBO	St. John	890
10AK	Stratford	1200
CHGS	Summerside	1120
CJCB	Sydney	880
CNRT	Toronto	840
CPRY	Toronto	840
CFCA	Toronto	840
CKOW	Toronto	840
CKCL	Toronto	580
CKNC	Toronto	580
CFCL	Toronto	580
CNRV	Vancouver	1030
CKCD	Vancouver	730
CHLS	Vancouver	730
CKFC	Vancouver	730
CKMO	Vancouver	730
CKWX	Vancouver	730
CFCT	Victoria	630
CKCR	Waterloo	645
10BP	Wingham	1200
CKY	Winnipeg	780
CNRW	Winnipeg	780
CKIC	Wolfville	1010
CJGX	Yorkton	630

CANARY ISLANDS

Call	Location	Kc.
EAR5	Las Palmas	1071

CEYLON

Call	Location	Kc.
VPB	Colombo	600

CHILE

Call	Location	Kc.
CMAB	Santiago	625
CMAC	Santiago	804
CMAK	Santiago	1333
CMAO	Santiago	1016
CMAQ	Santiago	1224
CMAJ	Valparaiso	1034

CHINA

Call	Location	Kc.
CAB	Canton	689
XGY	Chekiang	895
COHB	Harbin	674
COMK	Mukden	723
XGZ	Nanking	606
XOPP	Pieping	937
KRC	Shanghai	869.5
KSMS	Shanghai	1088
NKS	Shanghai	952
RSC	Shanghai	1276.5
XGX	Shanghai	1071
XGAH	Shanghai	937.5
COTN	Tientsin	625
GEC	Tientsin	1000

CHOSEN

Call	Location	Kc.
JODK	Keijo	690

COLOMBIA

Call	Location	Kc.
HJN	Bogota	684.9
HKF	Bogota	1304

COSTA RICA

Call	Location	Kc.
TIRA	Electra Cartago	560
TICR	San Jose	911
TIFB	San Jose	714
TIGP	San Jose	666
TISO	San Jose	600
TITR	San Jose	1333
TITV	San Jose	999

CUBA

Call	Location	Kc.
CMBR	Arroyo Apolo	1500
CMHD	Caibarien	950
CMJA	Camaguey	1200
CMJC	Camaguey	1382
CMJE	Camaguey	856
CMJF	Camaguey	930
CMGE	Cardenas	1375
CMJA	Ciego de Avila	1017
CMHJ	Cienfuegos	645
CMGA	Colon	834
CMCG	Guanabacoa	1345
CMBR	Havana	1500
CMCW	Havana	1345
CMCQ	Havana	1150
CMBL	Havana	1500
CMCU	Havana	1285
CMBY	Havana	1225
CMCD	Havana	925
CMBC	Havana	965
CMBG	Havana	1070
CMQ	Havana	1150
CMCA	Havana	1225
CMK	Havana	730
CMW	Havana	588
CMCJ	Havana	620
CMBZ	Havana	1010
CMBI	Havana	1405
CMCB	Havana	1070
CMCH	Havana	1405
CMX	Havana	890
CMC	Havana	840
CMBT	Havana	790
CMBS	Havana	790
CMCF	Havana	890
CMCY	Havana	1345
CMW	Havana	588
CMBD	Havana	965
CMCR	Havana	1345
CMBN	Havana	1405
CMCM	Marianao	1405
CMDC	Marianao	660
CMBW	Marianao	1010
CMBQ	Marianao	1500
CMCN	Marianao	925
CMCO	Marianao	660
CMGB	Matanzas	1205
CMGF	Matanzas	977
CMGH	Matanzas	1370
CMAB	Pinar del Rio	1249
CMAC	Pinar del Rio	1375
CMHI	Santa Clara	1110
CMKC	Santiago de Cuba	1034
CMHC	Tuinicu	790

CZECHOSLOVAKIA

Call	Location	Kc.
OKR	Bratislava	1075
OKB	Brunn	878
OKK	Kosice	1024
......	Moravska-Ostrava	1141
OKP	Prague	616

DANZIG

Call	Location	Kc.
PTB	Danzig	662

DENMARK

Call	Location	Kc.
......	Copenhagen	1067
......	Kalundborg	1153

DOMINICAN REPUBLIC

Call	Location	Kc.
HIX	Santo Domingo	625

ESTONIA

Call	Location	Kc.
......	Tallinn	1013
......	Tartu	735

FINLAND

Call	Location	Kc.
......	Abo	1219
......	Bjoreubore	1219
......	Helsingfors	840
OFA	Helsinki	815
OFC	Jakobstad	1220
OFB	Lahti	167
OFF	Oulu	435
OFD	Pori	1355
OFE	Tampere	536
OFG	Turku	1220
OFH	Viipuri	1031
......	Viborg	1031

FRANCE

Call	Location	Kc.
......	Angers	1091
......	Beziers	1364
......	Biarritz	1515
......	Bordeaux	1199
......	Bordeaux	986
......	Caen	1080
......	Grenoble	914
......	Lille	1132
......	Limoges	1022
YR	Lyons	1030
YN	Lyons	641
......	Mont de Marsan	750
......	Marseilles	950
......	Montpelier	1049
......	Nice	1219
......	Nimes	1250
......	Paris	901
FPTT	Paris	671
FSGC	Paris	825
......	Paris	968
......	Rennes	1103
......	Rheims	771
......	St. Etienne	1364
FQN	St. Pierre and Miquelon Is.	572
SPTT	Strasburg	867
......	Toulon	1200
MRD	Toulouse	1175
......	Toulouse	770

GERMANY

Call	Location	Kc.
......	Aix la Chapelle	1319
......	Augsburg	536
......	Berlin 1	716
......	Berlin II	1059
......	Bremen	950
......	Breslau	923
......	Cologne	1319
......	Dresden	941
......	Flensburg	1373
......	Frankfurt	770
......	Freiburg	527
......	Gleiwitz	1157
......	Hamburg	806
......	Hanover	530
......	Heilsberg	1085
......	Kaiserslautern	1112
......	Kassel	1220

Call	Location	Kc.
......	Kiel	1292
......	Koln	1319
......	Konigsberg	1085
......	Langenberg	635
......	Leipzig	1184
......	Magdeburg	1058
......	Muehlacker	833
......	Munich	563
......	Munster	1319
......	Nurnberg	1256
......	Stettin	1058
......	Stuttgart	833

GREAT BRITAIN

Call	Location	Kc.
2BD	Aberdeen	1040
2BE	Belfast	1238
6BM	Bournemouth	1040
5WA	Cardiff	968
5GB	Daventry, Regional	193
......	Daventry	752
2DE	Dundee	1040
2EH	Edinburgh	1040
5SC	Glasgow	797
2LO	London, Regional	842
......	London	1148
5NO	Newcastle	1040
......	North Regional	995
......	North Regional	626
5PY	Plymouth	1040
6FL	Sheffield	1040
5SX	Swansea	1040

GUATEMALA

Call	Location	Kc.
TGW	Guatemala City	571

HAITI

Call	Location	Kc.
HHK	Port au Prince	920

HOLLAND

Call	Location	Kc.
......	Bloemendaal	1220
PFBI	Hilversum	1004
PH9	Huizen	1004
PCF	Scheveningen	280
......	The Hague	1000

HONDURAS

Call	Location	Kc.
JRL	San Pedro Sula	1350

HONG KONG

Call	Location	Kc.
ZBW	Victoria	845

HUNGARY

Call	Location	Kc.
HAL	Budapest	545

ICELAND

Call	Location	Kc.
TFA	Reykjavik	1999

INDIA

Call	Location	Kc.
VUB	Bombay	840
VUC	Calcutta	810
VUL	Lahore	882
VUM	Madras	769

IRISH FREE STATE

Call	Location	Kc.
6CK	Cork	750
2RN	Dublin	940

ITALY

Call	Location	Kc.
1IBA	Bari	...
IBZ	Bolzano	662
IFI	Firenze	...
IGE	Genoa	959
IMI	Milan	599
INA	Naples	905
1IPA	Palermo	554
1IRO	Rome	680
1ITO	Torino	1013
1ITR	Trieste	1211

JAPAN

Call	Location	Kc.
JQAK	Dairen	760
JOLK	Fukuoka	680
JOFK	Hiroshima	850
JOJK	Kanazawa	710
JODK	Keijyo	690
JOSK	Kokura	741
JOGK	Kumamoto	790
JONK	Nagano	635
JOCK	Nagoya	810
JOQK	Niigata	625
JOKK	Okayama	700
JOBK	Osaka	750
JOIK	Sapporo	830
JOHK	Sendai	770
JOPK	Shizuoka	780
JFAK	Taihoku	670
JOAK	Tokyo	870
JOAK	Tokyo	590

KENYA

Call	Location	Kc.
7LO	Nairobi	750

LATVIA

Call	Location	Kc.
YLZ	Riga	571

LITHUANIA

Call	Location	Kc.
RYK	Kovno	155

LUXEMBURG

Call	Location	Kc.
LOAA	Luxemburg	1344

MEXICO

Call	Location	Kc.
XFC	Aguascalientes	805
XEF1	Chihuahua	1000
XFF	Chihuahua	923
XEJ	Ciudad Juarez	1000
XETZ	Coyoacan	1500
XEQ	Ciudad Juarez	750
XEA	Guadalajara	1000
XETC	Jalapa	1000
XEY	Merida	1000
XEFC	Merida	1050
XEX	Mexico City	1190
XEN	Mexico City	711
XEB	Mexico City	1030
XFG	Mexico City	638
XEG	Mexico City	1360
XF1	Mexico City	818
XEO	Mexico City	940
XFX	Mexico City	860
XEW	Mexico City	910
XEX	Mexico City	1210
XEZ	Mexico City	780
XFZ	Mexico City	860
XEK	Mexico City	990
XEM	Mexico City	1300
XETA	Mexico City	1140
XEFA	Mexico City	1250
XETQ	Mexico City	1230
XET	Monterrey	690
XEH	Monterrey	1132
XEFB	Monterrey	1270
XEI	Morelia	1000
XEFE	Nuevo Laredo	1000
XEP	Nuevo Laredo	1400
XEE	Oaxaca	1000
XEV	Puebla	1000
XEFS	Queretaro	1000
XED	Reynosa	965
XEL	Saltillo	1000
XFA	Tacubaya	500
XFA	Tacubaya	600
XES	Tampico	890
XEFD	Tiajuana	1020
XEC	Toluca	1000
XETG	Torreon	1000
XETB	Torreon	1380
XEU	Vera Cruz	1000
XETF	Vera Cruz	630
XFE	Villahermosa	804
XER	Villa Acuna	735

MONACO

Call	Location	Kc.
......	Monaco	1266

MOROCCO

Call	Location	Kc.
CNO	Casablanca	983
......	Rabat	414

NEWFOUNDLAND

Call	Location	Kc.
VOGT	Bell Island	890
VONA	St. Johns	950
VOWR	St. Johns	675
VOX	St. Johns	1400
8RA	St. Johns	950

NEW ZEALAND

Call	Location	Kc.
1YA	Auckland	910
1ZR	Auckland	1090
1ZJ	Auckland	1320
1ZQ	Auckland	1188
3YA	Christchurch	980
3ZC	Christchurch	1199
2ZU	Dannevirke	1100
4YA	Dunedin	650
4ZB	Dunedin	1079
4ZO	Dunedin	1078
4ZM	Dunedin	1078
4ZL	Dunedin	1219
2ZE	Eketahuna	1210
2ZJ	Gisborne	1150
3ZR	Greymouth	820
1ZH	Hamilton	630
2ZI	Hastings	1330
2ZL	Hastings	1330
4ZP	Invercargill	1160
4ZI	Invercargill	1160
1ZM	Manurewa	1210
2ZD	Masterton	1180
2ZH	Napier	1260
2YB	New Plymouth	1230
2ZF	Palmerston North	1049
2ZO	Palmerston North	1120
2ZP	Wairoa	820
2ZK	Wanganui	600
2ZR	Wanganui	600
2YA	Wellington	719
2ZW	Wellington	1120

NORWAY

Call	Location	Kc.
LKA	Alesund	671
LKB	Bergen	824
LKD	Bodo	662
LKF	Fredriksstad	837
LKH	Hamar	511
LKK	Kristianssand	1274
LKN	Notodden	671
LKO	Oslo	280
LKP	Porsgrund	662
LKR	Rjuken	671
LKS	Stavanger	1247
LKM	Tromso	662
LKT	Trondelag	608

PERU

Call	Location	Kc.
OAX	Lima	790
OA4M	Lima	1428

PHILIPPINE ISLANDS

Call	Location	Kc.
KZRC	Cebu	937
KZRM	Manila	618

POLAND

Call	Location	Kc.
......	Krakow	959
......	Kattowitz	734
......	Lodz	1229
......	Lwow	779
......	Poznan	896
......	Wilna	779

PORTUGAL

Call	Location	Kc.
CT1AA	Lisbon	1056
CT1AN	Lisbon	1056
CT1BO	Lisbon	1056
CT1DH	Lisbon	1056
CT1EB	Lisbon	1056
CT1GL	Lisbon	909
PRP1	Oporto	1249
......	Oporto	1448

ROUMANIA

Call	Location	Kc.
......	Bucharest	759

SALVADOR

Call	Location	Kc.
RUS	Salvador	664

SAMOA

Call	Location	Kc.
5ZA	Apia	940

SIAM

Call	Location	Kc.
HSP1	Bangkok	857
HSP3	Bangkok	938
HS7PJ	Bangkok	923
HS7PJ	Bangkok	810
HS11PJ	Bangkok	882

SPAIN

Call	Location	Kc.
EAJ18	Almeria	1195
EAJ13	Barcelona	1119
EAJ1	Barcelona	860
EAJ15	Cartagena	1219
EAJ7	Madrid	707.5
EAJ2	Madrid	750
EAJ19	Oviedo	1119
EAJ8	San Sebastian	662
EAJ5	Seville	815

SWEDEN

Call	Location	Kc.
SBE	Boden	250
SCA	Boras	1301
SCB	Eskilstuna	1220
SCC	Falum	932
SCD	Gavle	1471
SBB	Goteborg	932
SCE	Halmstad	1389
SCG	Halsingborg	1299
SBH	Horby	1167
SCF	Hudiksvall	1111
SCH	Jonkoping	1490
SCI	Kalmar	1220
SCJ	Karlskrona	1531
SCK	Karlstadt	1373
SCL	Kiruna	1220
SCM	Kristinehamm	1481
SCN	Malmberget	688
SBC	Malmo	1299
SBG	Motala	222
SCO	Norrkoping	1111
SCV	Orebro	1266
SCW	Ornskoldsvik	1373
SBF	Ostersund	770
SCP	Saffle	1220
SBA	Stockholm	688
SBD	Sundsvall	553
SCQ	Trollhattan	1112
SCR	Uddevalla	1058
SCS	Umea	1301
SCT	Uppsala	662
SCU	Varberg	1060

SWITZERLAND

Call	Location	Kc.
......	Beromunster	653
......	Geneva	395
......	Lausanne	441
......	Sottens	743

TUNISIA

Call	Location	Kc.
TUA	Tunis	235

TURKEY

Call	Location	Kc.
TAE	Angora	193
TAL	Istanbul	250
......	Osmanieh	250

UNION OF SOVIET SOCIALIST REPUBLICS

Call	Location	Kc.
RW19	Achkhabad	334
RW60	Alma-Alta	310
RW36	Arkhangelsk	770
RW35	Astrakhan	434.8
RW8	Bakou	238
RW8	Bakou	245
RW43	Bakou	238
RW30	Dnepropetrovsk	511
RW21	Erivan	404
RW40	Gomel	621
RW23	Groznyi	676
RW14	Irkoutsk	187
RW31	Ivanovo-Voznesensk	604
RW46	Karaganda	687
RW17	Kazan	551
RW17	Kazan	644
RW54	Khabarovsk	1052
RW54	Khabarovsk	320
RW4	Kharkov	320
RW20	Kharkov	704
RW9	Kiev	368
RW9	Kiev	290
RW33	Krasnodar	650
RW66	Krasnoiarsk	333
RW53	Leningrad	300
RW70	Leningrad	860
RW27	Makhatch Kala	796
RW10	Minsk	428.6
RW1	Moscow	203
RW2	Moscow	416.7
RW37	Moscow	793
RW39	Moscow	707
RW58	Moscow	273
RW58	Moscow	268
RW49	Moscow	230
RW51	Naltchik	748
RW42	Nijni-Novgorod	394
RW6	Novosibirsk	238
RW13	Odessa	666
RW44	Omsk	471
RW45	Orenbourg	461
RW22	Oufa	444
RW22	Oufa	617
RW67	Oukhta	354
RW56	Penza	640
RW29	Petrozavodsk	468
RW29	Petrozavodsk	779
RW24	Platigorsk	468
RW55	Pokrovsk	730
RW12	Rostov-sur-le-Don	353
RW16	Samara	521
RW16	Samara	404
RW18	Samarkand	343
RW3	Saratov	340
RW52	Simferopol	630
RW52	Simferopol	725
RW24	Smolensk	531
RW47	Stalinabad	421
RW26	Stalino	811
RW32	Stavropol	608
RW38	Sverdlovsk	157
RW5	Sverdlovsk	364
RW41	Syktyvkar	560
RW11	Tachkent	256
RW74	Tcheboksary	680
RW7	Tiflis	280
RW48	Tomsk	645
RW63	Verkhneoudinsk	350
RW64	Vladikavkag	752
RW28	Vladivostok	636
RW28	Vladivostok	725
RW25	Voronej	385
RW25	Voronej	450

URUGUAY

Call	Location	Kc.
CX6	Montevideo	650
CX10	Montevideo	730
CX12	Montevideo	770
CX14	Montevideo	810
CX16	Montevideo	850
CX18	Montevideo	890
CX20	Montevideo	930
CX22	Montevideo	970
CX24	Montevideo	1010
CX26	Montevideo	1050
CX30	Montevideo	1130
CX32	Montevideo	1170
CX34	Montevideo	1210
CX36	Montevideo	1250
CX38	Montevideo	1290
CX40	Montevideo	1330
CX42	Montevideo	1370
CX44	Montevideo	1410
CX46	Montevideo	1450
CX48	Montevideo	1490
CW40	Paysandu	1340
CW44	Paysandu	1420
CW32	Salto	1180
CW34	Salto	1220
CW36	Salto	1260
CW38	Salto	1300
CW30	Tucuarembo	1140

UNION OF SOUTH AFRICA

Call	Location	Kc.
ZTC	Capetown	810
ZTD	Durban	731
ZTJ	Johannesburg	666
......	Pretoria	1000

VENEZUELA

Call	Location	Kc.
1BC	Caracas	960

FOREIGN SHORT WAVE PHONE STATIONS

YUGOSLAVIA

Call	Location	Kc.
......	Belgrade	696
......	Ljubljano	569
......	Zagreb	977

AFRICA

Call	Location	Kc.
F8KR	Algiers	6,667

ARGENTINA

Call	Location	Kc.
LSOR	Buenos Aires	9,810
LSX	Buenos Aires	10,382

AUSTRALIA

Call	Location	Kc.
VK3ME	Melbourne	9,510
VK3LO	Melbourne	9,369
VK3UZ	Melbourne	8,820
VK2BL	Sydney	9,230
VK2FC	Sydney	10,520
VK2ME	Sydney	9,590
VK2ME	Sydney	10,527
VK2ME	Sydney	16,330

AUSTRIA

Call	Location	Kc.
UOR2	Vienna	11,801
UOR2	Vienna	6,072

BRAZIL

Call	Location	Kc.
PPU	Rio de Janeiro	6,122
PPU	Rio de Janeiro	19,270

BRITISH COLONIES

Call	Location	Kc.
VRY	Georgetown, Guiana	6,726
VS3AB	Johore Baru	7,055
VS1AB	Singapore	7,260
VQ7LO	Nairobi	6,000
VQ7LO	Nairobi	6,134
VQ7LO	Nairobi	9,616

CANADA

Call	Location	Kc.
VE9GW	Bowmanville, Ont.	6,095
CGE	Calgary, Alta.	7,550
CKS	Calgary, Alta.	7,550
VE9CG	Calgary, Alta.	6,110
VE9CA	Calgary, Alta.	6,030
CGA	Drummondville, Que.	9,335
VE9DR	Drummondville, Que.	11,780
VE9CF	Halifax, N. S.	6,050
CFH	Halifax, N. S.	9,030
VE9CL	Middlechurch, Man.	6,148
VE9DN	Montreal, Que.	6,005
VE9DN	Montreal, Que.	9,580
VE9DN	Montreal, Que.	11,895
VE9BA	Montreal, Que.	6,130
VE9BA	Montreal, Que.	11,705
VE9BA	Montreal, Que.	15,190
VE9OS	Montreal, Que.	2,100
VE9AF	Montreal, Que.	2,850
VE9AK	Red Deer, Alta.	2,830
VE9BJ	St. John, N. B.	6,090
VE9AR	Saskatoon, Alta.	2,850
VE9RM	Toronto, Ont.	2,004
VE9CS	Vancouver, B. C.	6,148
VE9BZ	Vancouver, B. C.	2,750

CANARY ISLANDS

Call	Location	Kc.
EAR58	Teneriffe	7,211

CHINA

Call	Location	Kc.
XCTE	Shanghai	5,000

COLOMBIA

Call	Location	Kc.
HKA	Barranquilla	6,160
HKD	Barranquilla	5,837
HKD	Barranquilla	6,050
HKC	Bogota	6,275
HKF	Bogota	7,616
HKF	Bogota	8,692
HKF	Bogota	7,143
HKT	Manizales	7,139
HKN	Medellin	11,712

COSTA RICA

Call	Location	Kc.
TI4NR	San Jose	10,240
TI4NR	San Jose	9,734
TIRA	Electra Cartago	6,080
TIRA	Electra Cartago	9,590

CUBA

Call	Location	Kc.
CM6DW	Cienfuegos	7,300
CM2LA	Havana	10,013
CM2MK	Havana	9,360
CM2MK	Havana	7,184

CZECHOSLOVAKIA

Call	Location	Kc.
OKIMPI	Prague	5,169

DENMARK

Call	Location	Kc.
OXO-OXZ	Copenhagen	6,057
OXO-OXZ	Copenhagen	9,488
OXO-OXZ	Copenhagen	15,300

DOMINICAN REPUBLIC

Call	Location	Kc.
HIX	Santo Domingo	4,610

DUTCH EAST INDIES

Call	Location	Kc.
PLE	Bandoeng	9,410
PLE	Bandoeng	18,860
IBR	Bandoeng	5,170
PK1AA	Batavia	3,998
PLF	Malabar	17,640
PK4PA	Palembang	59,964
PK2AF	Djocjacorta, Java	5,996
PK6KZ	Makassar	11,993
PK2AG	Semerang, Java	7,890
PK3AN	Surabaya, Java	6,040
....	Surabaya	2,143
PK3CH	Surabaya	6,662
....	Tandjong Priok	6,045
....	Tandjong Priok	9,579
....	Tandjong Priok	15,336

ECUADOR

Call	Location	Kc.
....	El Prado	7,538

EGYPT

Call	Location	Kc.
SUS	Cairo	9,110

FIJI

Call	Location	Kc.
VPD	Suva	14,420

FRANCE

Call	Location	Kc.
YR	Lyons	7,463
FL	Paris (Eiffel Tower)	6,124
F8GC	Paris	4,262
....	Paris	7,317
FYA	Paris (Pontoise)	15,235
FYA	Paris (Pontoise)	11,899
FYA	Paris (Pontoise)	11,308

FRENCH COLONIES

Call	Location	Kc.
FM8KR	Constantine	7,009
FM8KR	Constantine	3,750

GERMANY

Call	Location	Kc.
DJC DJA DJD DJB DJE	Konigs Wusterhausen	6,020 9,560 11,760 15,200 17,760

GREAT BRITAIN

Call	Location	Kc.
GBK	Bodmin	18,105
GBK	Bodmin	9,200
G5SW	Chelmsford	11,750
GBX	Rugby	16,164
GBS	Rugby	18,310
GBW	Rugby	18,138
GBW	Rugby	14,493
GBU	Rugby	12,290
GBX	Rugby	12,195
GBS	Rugby	12,195
GBS	Rugby	9,020
GBS	Rugby	6,993
G2MN	Sonning-on-Thames	14,320

GUATEMALA

Call	Location	Kc.
TGGA	Guatemala City	10,708
TGGA	Guatemala City	9,370
TGW	Guatemala City	6,661
TGX	Guatemala City	9,516

HOLLAND

Call	Location	Kc.
PBF5	Hague	6,438
PCJ	Hilversum	9,590
PHI	Huizen	17,775
PCK	Kootwijk	18,400
PCV	Kootwijk	17,836

HONDURAS

Call	Location	Kc.
HRR	Tegucigalpa	6,170
HRB	Tegucigalpa	6,005

HUNGARY

Call	Location	Kc.
HAT	Szekesfehervar	9,125

INDIA

Call	Location	Kc.
VUC	Calcutta	11,870

INDO-CHINA

Call	Location	Kc.
F3ICD	Chi-hoa	6,119
FZR	Saigon	12,010
FZG	Saigon	13,010

ITALY

Call	Location	Kc.
I1AX	Rome	6,667
I2RO	Rome	11,810
I2RO	Rome	3,750
....	Turin	3,750
HVJ	Vatican City	5,965
HVJ	Vatican City	15,112

JAPAN

Call	Location	Kc.
JHBB	Hirasio	7,995
JIAA	Kemikawa	8,105
JFAB	Taipeh, Taiwan	7,590

MADAGASCAR

Call	Location	Kc.
....	Tananarive	5,552

MADEIRA

Call	Location	Kc.
CT3AG	Funchal	6,383

MEXICO

Call	Location	Kc.
XDA	Mexico City	14,630
XDA	Mexico City	9,375
XDA	Mexico City	6,818
XDA	Mexico City	5,857
XDA	Mexico City	11,763
XFD	Mexico City	6,667
XFD	Mexico City	9,091
XFD	Mexico City	11,111
X26A	Nuevo Laredo	7,616

MOROCCO

Call	Location	Kc.
F8MC	Casablanca	10,710
F8MC	Casablanca	6,875
....	Rabat	6,877
....	Rabat	12,830
....	Rabat	9,300

NEWFOUNDLAND

Call	Location	Kc.
VO8Z	St. Johns	6,800

NEW ZEALAND

Call	Location	Kc.
ZL3ZC	Christchurch	6,000
ZLW	Wellington	10,990
ZL2XX	Wellington	4,776

PHILIPPINE ISLANDS

Call	Location	Kc.
KA1XR	Manila	12,245
KZRM	Manila	11,840
KZRM	Manila	9,570
KZRM	Manila	6,140

POLAND

Call	Location	Kc.
....	Poznan	9,836

PORTUGAL

Call	Location	Kc.
CT1AA	Lisbon	6,995
CT1BO	Lisbon	10,710

ROUMANIA

Call	Location	Kc.
YO1	Bucharest	13,950

SHIP PHONE STATIONS

Call	Location	Kc.
GMJQ	SS. Belgenland	17,650
GMJQ	SS. Belgenland	13,040
GMJQ	SS. Belgenland	8,570
GMJQ	SS. Belgenland	4,762
DDDX	SS. Bremen	11,710
DDDX	SS. Bremen	7,560
IBDX	SS. Electra (Marconi's Yacht)	11,240
....	SS. Hamburg	13,040
GDLJ	SS. Homeric	12,380
GDLJ	SS. Homeric	4,754
WSBN	SS. Leviathan	8,830
WSBN	SS. Leviathan	6,637
WSBN	SS. Leviathan	4,392
WSBN	SS. Leviathan	3,429
GFWV	SS. Majestic	17,590
GFWV	SS. Majestic	13,228
GFWV	SS. Majestic	4,430
GFWV	SS. Majestic	4,180
GLSQ	SS. Olympic	12,387
GLSQ	SS. Olympic	16,456
GLSQ	SS. Olympic	8,840

SIAM

Call	Location	Kc.
HS2PJ	Bangkok	10,167
HSP2	Bangkok	9,500
HSP2	Bangkok	7,300

SPAIN

Call	Location	Kc.
EAJ25	Barcelona	6,000
EAR25	Barcelona	6,124
EAM	Madrid	9,772
EAR100	Madrid	6,976
EAR125	Madrid	7,025

SWEDEN

Call	Location	Kc.
SAS	Karlsborg	11,760
SBG	Motala	3,030
SBG	Motala	6,065

SWITZERLAND

Call	Location	Kc.
HB9OC	Berne	9,130
HB9XD	Zurich	9,380
HB9XD	Zurich	7,229
HB9XD	Zurich	3,488

TUNISIA

Call	Location	Kc.
F8KR	Constantine	7,005

UNION OF SOVIET SOCIALIST REPUBLICS

Call	Location	Kc.
RW15	Khabarovsk	4,273
RW3KAA	Leningrad	8,333
....	Leningrad	11,111
....	Leningrad	10,526
RW62	Minsk	6,420
RW61	Moscow	51,724
RW38	Moscow	5,515
RW59	Moscow	6,000
RW54	Moscow	4,273
RW50	Moscow	11,924
RW69	Odessa	1,900
RW65	Peredvijka	3,560
RW71	Petropavlovsk Kamtchatski	5,000
RW19	Tomsk	8,111

UNION OF SOUTH AFRICA

Call	Location	Kc.
ZTJ	Johannesburg	6,098

VENEZUELA

Call	Location	Kc.
YV2BC	Caracas	6,061
YV4BV	Valencia	11,700

YUGOSLAVIA

Call	Location	Kc.
....	Belgrade	10,000

Building Small Power Transformers

HOW many times have you wished that you could have a power transformer just the way you wanted it without having to buy one which did not meet your specifications to the letter? Perhaps the voltages were not sufficiently high or the filament windings would not handle the number of tubes you wished to load on it. The following discussion will show you how simply the job may be done at small expense and with the exercise of a little care. There is nothing mysterious about designing a transformer, and once one is made, there is the inevitable thrill of personal achievement. Though a bit tedious, hand winding is the cheapest method unless transformers are to be made on a large scale. Any good winder will do, though we recommend the Goodell-Pratt as serving the purpose very well. This winder may be mounted on a board with the revolution counter, a rod over which the wire is fed, and a spindle for the wire spool.

Let us consider the theoretical aspects first so that we may derive an empirical formula or chart which may be read instantly for all of the information we may need. Fundamental relations give us the formula

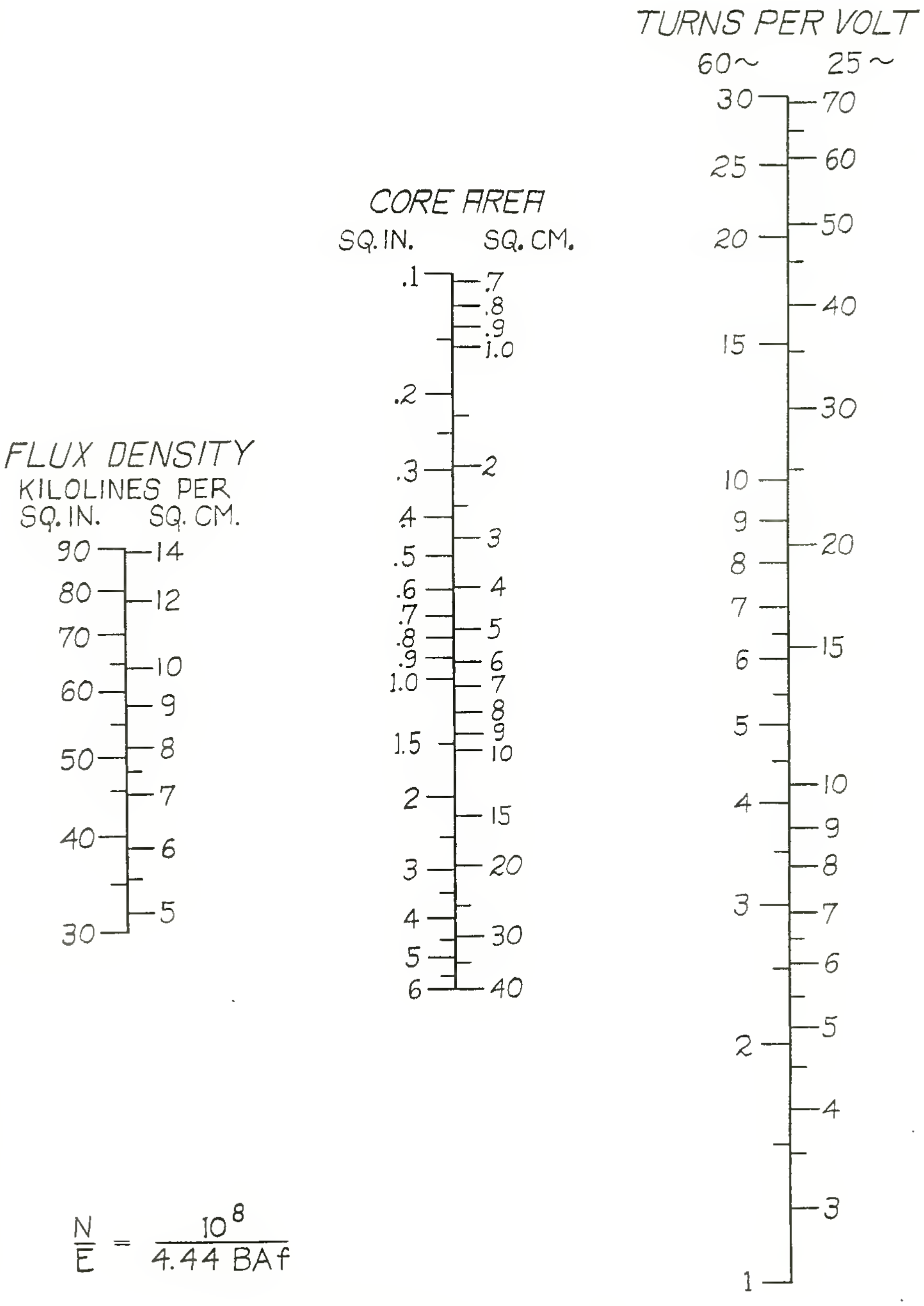
$$N = \frac{E \times 10^8}{4.44BAf}$$

where N is the number of turns
B is the flux density
A is the cross section area of the core
f is the frequency in cycles per second
E is the voltage

By substitution, the monographic chart shown in Figure 1 was evolved. It is only necessary to use a straight-edge to determine the turns-per-volt when the frequency (usually 60 cycles or 25 cycles) of the power line is known and the area of the core cross section measured. From this, the turns-per-volt may be determined for all of the windings, since all of them cut the same number of flux lines. We may assume then, neglecting voltage drop due to the resistance of the windings, that the voltage developed per turn is the same whether in a secondary or a primary winding. Figure 1 is a reprint of the chart given in *Service Schematics*. We shall now design a transformer with a straight-edge. The type of silicon steel laminations determines the kilolines flux per square inch we may use. Temperature rise (due to losses in the steel) will be the limiting factor in this case. Since we know the width of the center piece of the laminations and the thickness of the stack we wish to use, it is an easy matter to determine the core area, being the width of the center section multiplied by the thickness of the stack. Due to scale, burrs, etc., this area is never used without first compensating for the difference between a laminated area and a solid one. For most purposes, the effective core area may be taken as 85% of the measured area in inches, assuming the laminations to be absolutely tight when bolted. It is not good practice to insert all of the *E* sections from one side and butt all of the *I* sections on the other side as shown in Figure 3a. They should be interleaved as in Figure 3b.

Materials Necessary

All of the windings are of enameled copper wire, the gage depending on the current carried through each winding. A rectangular insulating



TRANSFORMER CHART

Figure 1

tubing is used for the start of the transformer coil. This may be made up of layers of paper, or may be of bakelite, etc. It should be between a sixteenth and an eighth of an inch in thickness. The inside size should allow a little clearance for the laminations to be used, but should not be too large, since the coil must be rigid with reference to the core to prevent mechanical hum. To make the coil tight on the core, thin wedges are driven between the inside of the tube and the laminations. It would be well to use a layer of varnished cambric over the tube before the first layer of wire is wound.

Between layers, glassine paper must be used, of .0015 or .002 inches in thickness. This is the type of paper formerly used for wrapping cigarette packages, and is almost transparent. Cellophane is not suitable for this purpose. Many of the larger department stores use glassine paper of sufficient quality for such purposes in wrapping books, and it may be procured from them without much difficulty. This paper is not quite the same as that used by transformer manufacturers, but it stands up well.

It is well to use spaghetti tubing for the covering of the enameled wire leads, because the enamel itself is hardly sufficient insulation, especially at very high voltages. Between turns it is sufficient, since the induced voltage per turn is only a fraction of a volt, but at other points it would not be entirely safe to depend on it alone. Adhesive tape (not friction tape) serves to start and finish windings, as well as for holding the cambric in place.

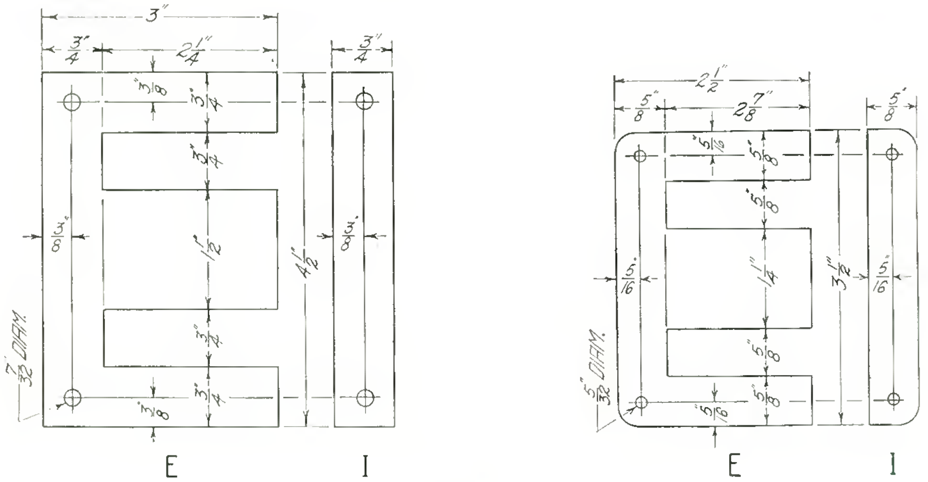


Figure 2

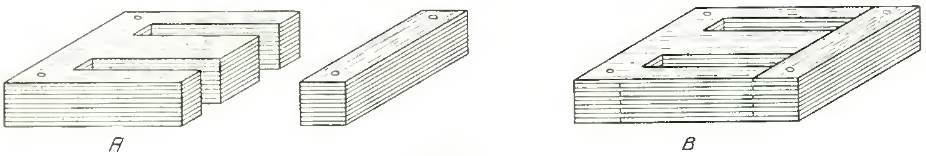


Figure 3

In high voltage transformers to be used with rectifier tubes, after the primary is wound, a static shield must be used to prevent transfer from the primary to the secondary windings of line disturbances and the like. This may be done by using a piece of very thin brass or copper (.0005 or .001 inches thick) and making one turn about the primary, over a layer of varnished cambric. Under no circumstances should the shield metal touch the shield itself at the end, or a short-circuited turn would result and burn up the transformer. Between filament windings, and over the secondary high-voltage winding, varnished cambric is used instead of glassine paper because the larger gages of wire would tear it. When finished, three or four layers of heavy gummed paper, such as is used in sealing boxes, should be pasted around the outside of the coil as tightly as possible. The coil should then be immersed for at least half an hour in a hot bath of a mixture of beeswax and rosin so that it will be saturated and prevent subsequent moisture absorption. After the coil has cooled sufficiently, it may be laminated, tightened on the core, and tests made to make sure there are no short or open circuits. Never apply voltage to a coil without all of the laminations in it since the current is limited only by the d-c resistance and a very small inductance.

Constructional Details

First of all the core tube should be cut so that it is just a bit shorter, about a sixteenth of an inch, than the window length of the *E* lamination. The window is defined as the slot in the lamination which is occupied by the coil when the transformer is completely assembled. This tube should then be tightened in the winding machine. One layer of varnished cambric should then be wrapped around it, starting with a piece of tape, and ending in a like manner. Care should be taken to determine the two sides of the transformer coil which will not be within the laminations. All taps and leads and tape should be used only on these two sides of the coil, since it will be greater in width on these two sides because of the leads and joints and would not fit in the window area, not to mention the difficulty which would be encountered in extricating the leads from the inside of the core.

The primary should be wound first. To start, place a piece of spaghetti covering over about six inches of the end of the wire, allowing about an inch or two of the wire to protrude. This may be bent back on the spaghetti to prevent pulling through the tubing when the first turns are wound. Make a right angle bend, and tape as shown in figure 4. By bringing the lead across the whole coil, the first layer wound will hold it tightly and prevent slipping while winding. Set the revolution counter to zero and wind the first layer, allowing three-sixteenths to a quarter of an inch at the ends so that the core cannot come near the edges of the layers of wire wound and ground them. When one layer is wound, insert a layer of glassine paper and wind back again, repeating with a layer of the paper for each layer of wire, the paper being the full width of the coil. The paper strips, which will increase in length as the coil becomes larger, need overlap only an inch. It will be found unavoidable to have

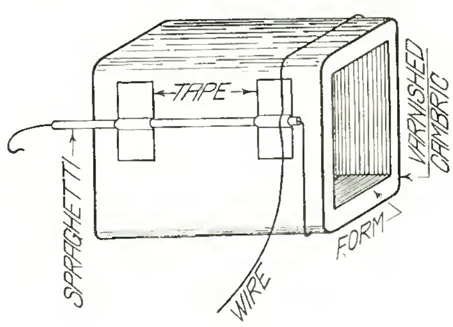
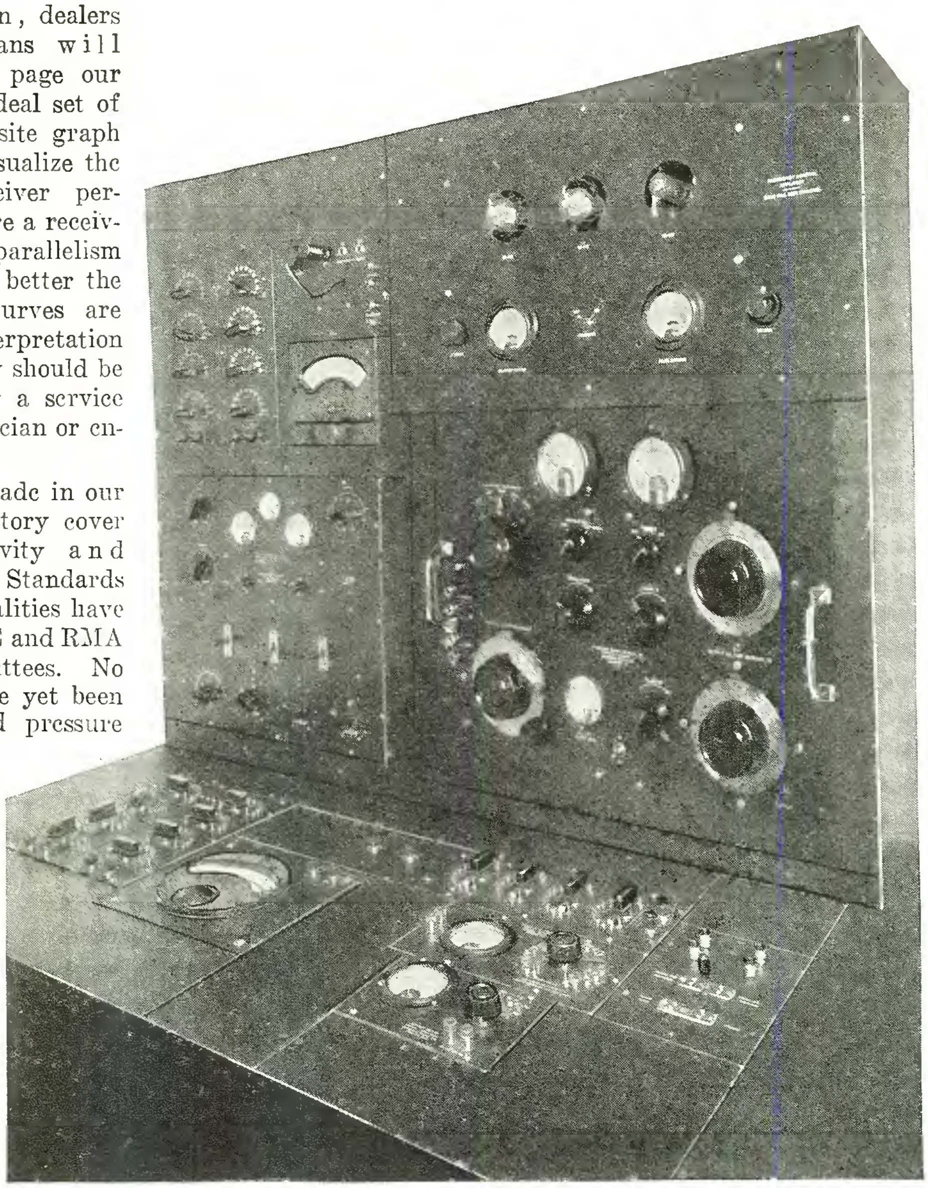


Figure 4

some spaces between turns occasionally. This in no way affects the operation of the transformer, being deleterious only in that space is wasted and an extra layer may be necessary to get the correct number of turns. At the finish of the winding, put a piece of spaghetti over the end of the wire, allowing the same lengths as at the start, and tape as at the beginning to hold the wire firmly in place. Never

(*Continued on page* 38)

Receiver Performance Curve Section



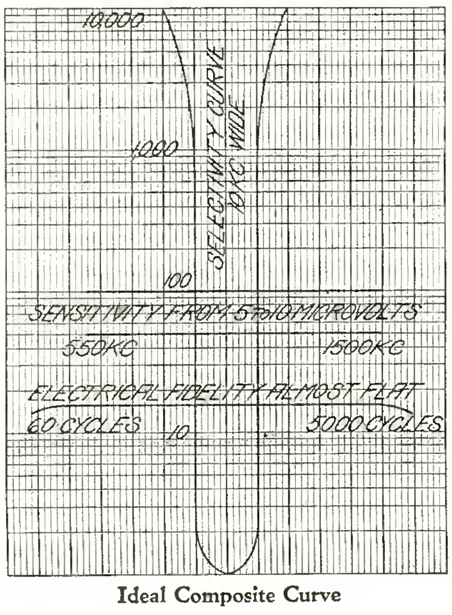
SERVICE men, dealers and technicians will find on this page our conception of an ideal set of curves. The composite graph may be used to visualize the best possible receiver performance. The more a receiver's curves near parallelism with the ideal, the better the receiver. These curves are not capable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

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

Definitions of the three major characteristics of a receiver are:

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

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



Ideal Composite Curve

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

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

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

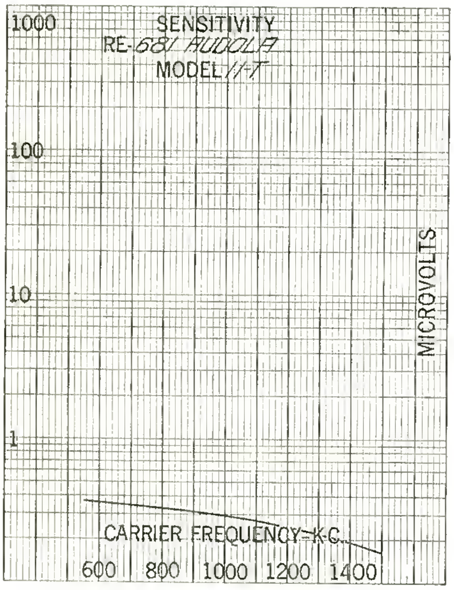
Audiola Model 11-T

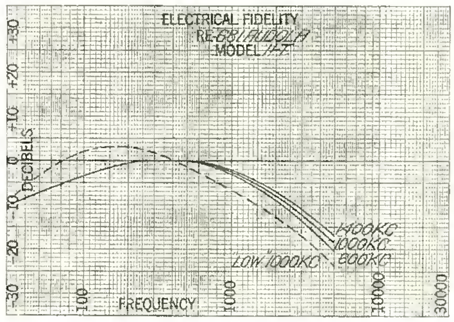
AUDIOLA'S model 11-T superheterodyne curves given in these columns were made from data taken in this laboratory.

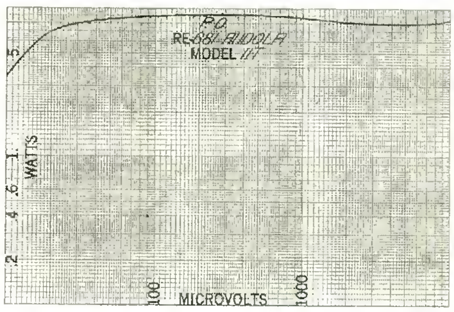
Antenna input was through the dummy antenna standard of 20 uh, 200 uuf, and 25 ohms, coupled to the standard signal generator. The push-pull pentodes employed as the power stage were capacitatively coupled to the output indicating device. Their optimum plate load of 14,000 ohms was a non-inductive resistor. An output level of .05 watts of audio power was used as the standard except for the power overload curve. To prevent errors due to impedance reflection, the voice coil circuit of the output transformer was broken.

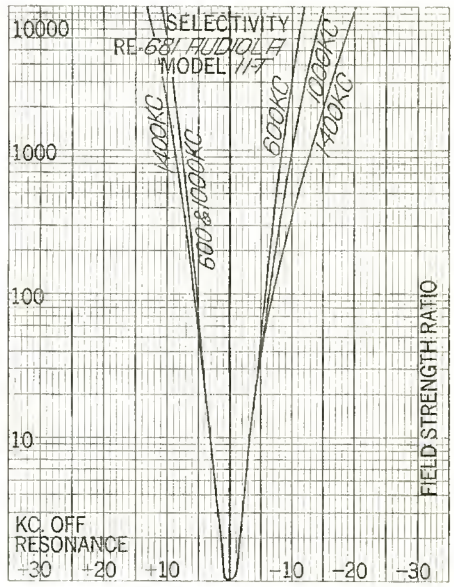
For all measurements, the tubes used were received with the chassis, the tuned circuits were unaltered from factory adjustment, and the volume control was adjusted for maximum receiver sensitivity. A line current drain of 1.08 amperes was recorded with an impressed a-c voltage of 117 volts.

The great sensitivity of this receiver is evident from the curve of column one which gives an average value of .279 microvolts absolute, equivalent to .07 microvolts per meter with a standard height antenna. The resultant noise levels are high, but not at sensitivities ordinarily employed. An image ratio of 20,000 times was measured at a receiver dial setting of 1000 kc. Due to the action of the automatic volume control, the power overload curve is very nearly flat, having a maximum audio power value of 9.10 watts output. No consideration is made of the harmonics present in the waveform across the primary of the output transformer. Under the selectivity curves of column three are the tabulated band widths.





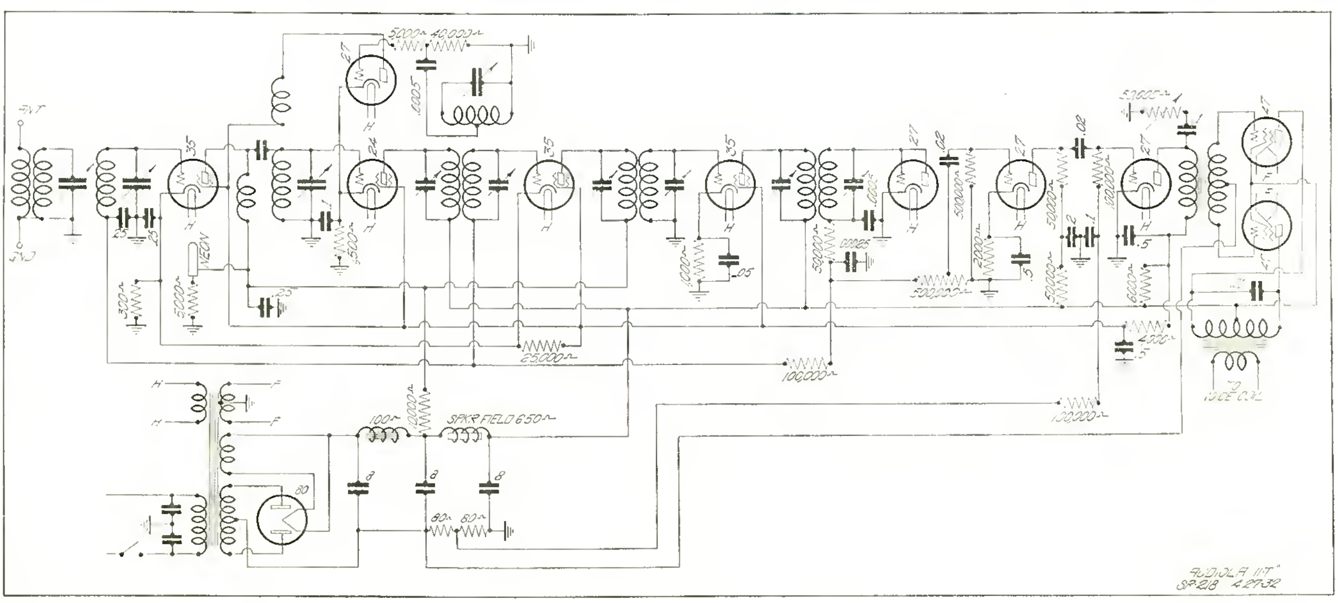




Below is the complete schematic wiring diagram of this receiver. Tubes required for operation consist of, a 235 r-f, 224 first detector, 227 oscillator, 235 second i-f, 235 third i-f, 227 diode second detector giving automatic volume control effects, a 227 first audio, 227 second audio, push-pull 247 pentodes, and a 280 rectifier for high voltage supply.

Band Widths

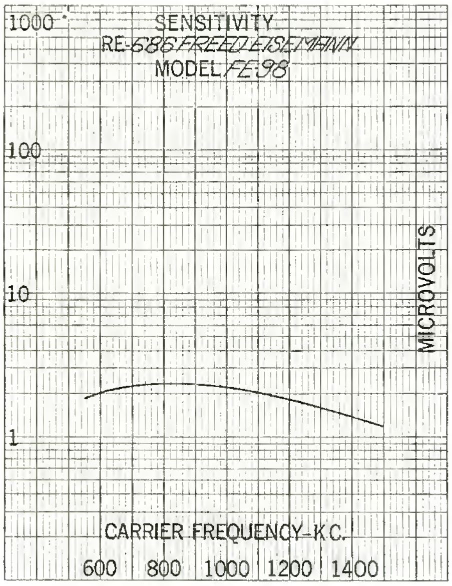
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	6.5	6.5	6.5
100	11.5	12	13
1000	16	18	21.5
10000	22.5	25.5	33



Freed-Eisemann Model FE-98

FREED-EISEMANN model FE-98, recently measured in our laboratory, produced the included overall performance curves as indicative of its performance.

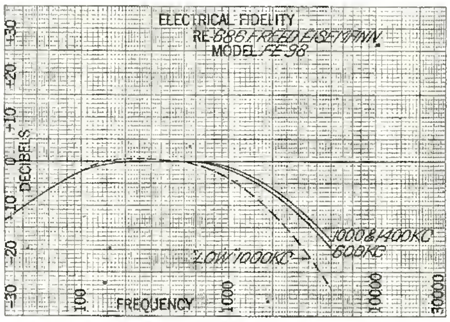
A standard dummy antenna of 20 uh, 200 uuf and 25 ohms served to couple the output of the standard signal generator to the antenna circuit of the receiver. The parallel 247 pentodes were matched with a non-in-

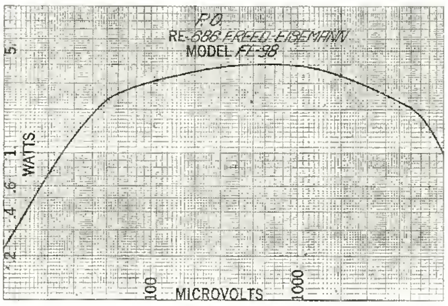


ductive load resistance of 3500 ohms, while the plates were capacitatively coupled to the output tube voltmeter. A standard audio output level of .05 watts was maintained for all measurements but that of power overload. The voice coil circuit was opened during tests to prevent primary circuit loading by the secondary.

For all measurements, the volume control was turned to its maximum position, tubes were furnished with the chassis, and no changes were made in circuit alignment from factory adjustment. An a-c line voltage of 116 volts resulted in a primary current of .86 amperes for the power transformer.

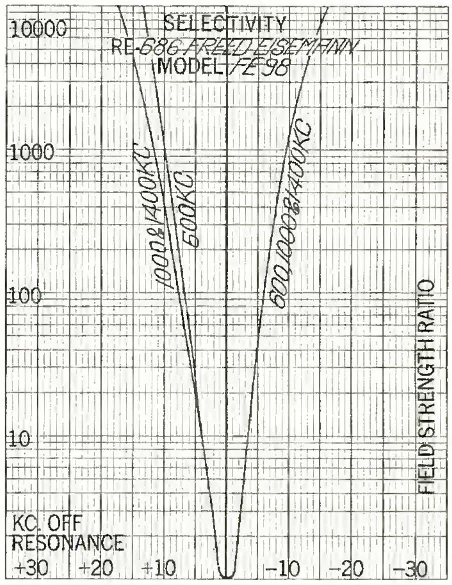
An average sensitivity value of 1.91 microvolts absolute is taken from the sensitivity curve of column one. This value corresponds to .48 microvolts per meter when using the standard antenna effective height of four me-





ters. At 600 kc the minimum noise level of 6.3% was measured, while the maximum was found at 1400 kc with a value of 49%. With the receiver tuned to 1000 kc, the image ratio measured 3760 times. A maximum power output of 4.00 watts of audio power is taken from the power overload curve of column two. This value does not take into consideration the harmonics generated in the audio system at such a high power level, however. Under the selectivity curves from which they were taken, in column three, are the band widths in tabular form.

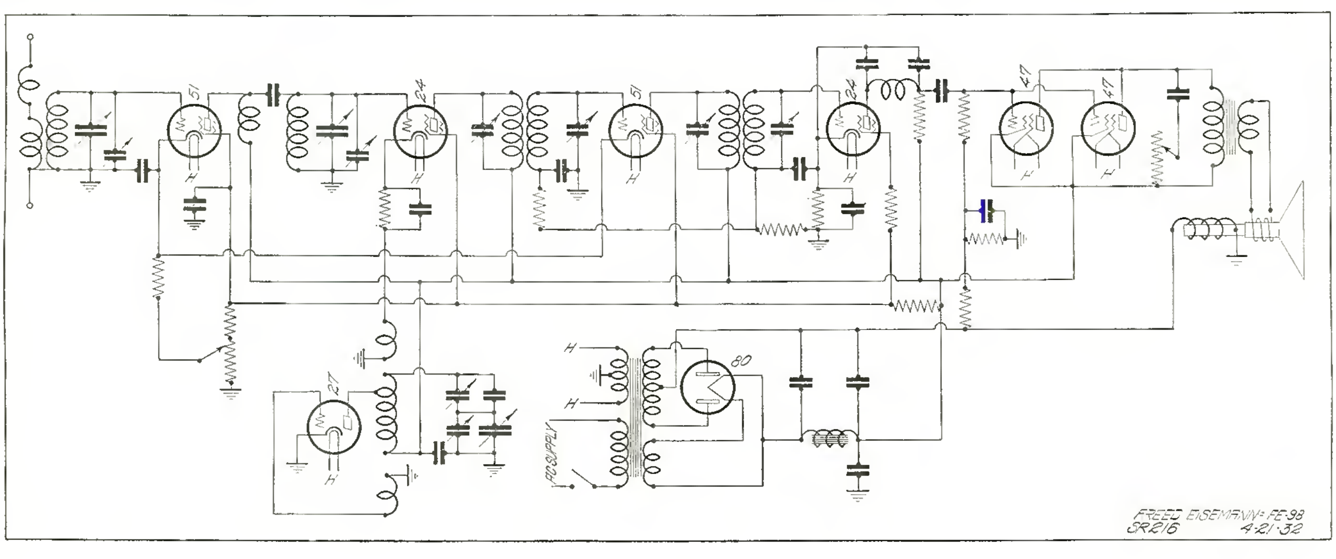
At the bottom of the page is the schematic wiring diagram of the FE-98 superheterodyne. The eight required tubes are, a 551 r-f, 224 first detector, 227 oscillator, 551 second



i-f, 224 second detector, resistance coupled to the parallel 247 power pentode output tubes, and a 280 full wave rectifier. The speaker field is used in the negative return of the high voltage system.

Band Widths

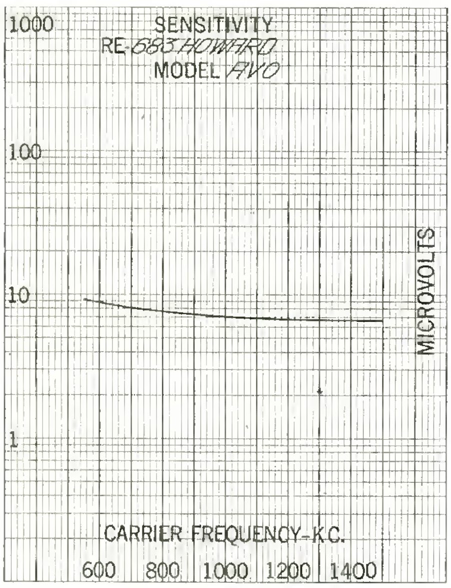
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	7.5	7.5	7.5
100	13	14	14
1000	19.5	21	21
10000	29.5	33.5	33.5



Howard Model AVO

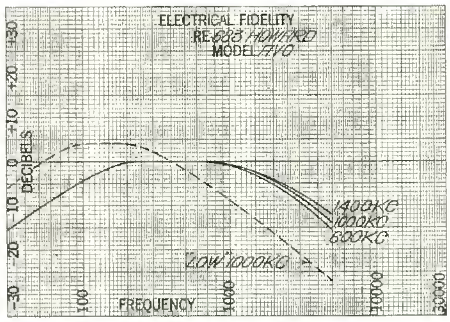
HOWARD'S model AVO superheterodyne gave the included performance curves upon measurement in our laboratory. A supplementary power overload curve will be found at the bottom of page 55 of this issue.

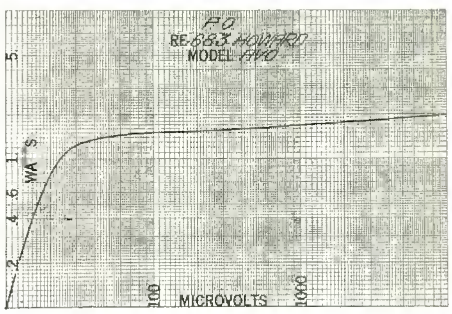
Signal generator output was fed to the antenna input circuit by means of a standard dummy antenna of 20 uh, 200 uuf and 25 ohms. The single 247 power pentode used in the output stage was matched with a non-inductive load resistance of 7000 ohms. Its plate was capacitatively coupled to the output indicating device. A standard output level of .05 watts of audio power was maintained for all but the power overload measurements. To prevent loading of the primary of the output transformer, the secondary circuit was opened during all tests.



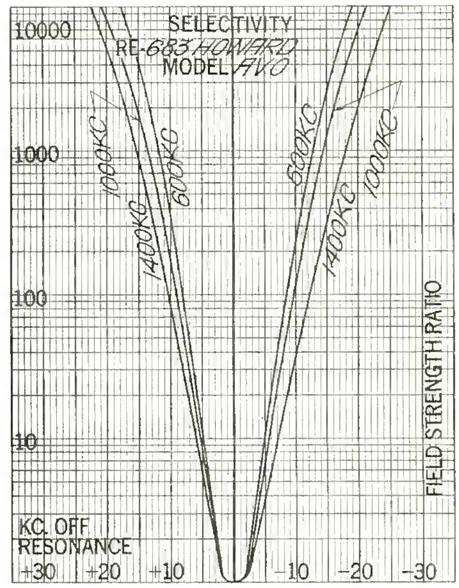
An a-c line voltage of 117 made the primary load of the power transformer 1.00 ampere. Tubes were furnished with this receiver, no changes were made in the alignment of tuned circuits from factory adjustment, and the volume control was turned to its maximum position for all measurements.

Average sensitivity, taken from the curve of column one, gives a value of 7.57 microvolts absolute, equivalent to 1.89 microvolts per meter assuming that a standard four-meter antenna is used. Noise levels, considering the sensitivity, were very low, the maximum of 3% occurring at 1400 kc, and the minimum of 2.2% at 600 kc. The measured image ratio, with the receiver tuned to 1000 kc, was 1260 times. The automatic volume control tube brought the output up to 1.94 watts at an input of 10000 microvolts, the maximum used in testing. However, no account is taken of the harmonics produced and found in the output wave form at this audio level. Under the selectivity curves of column three will be found the tabulated band widths.



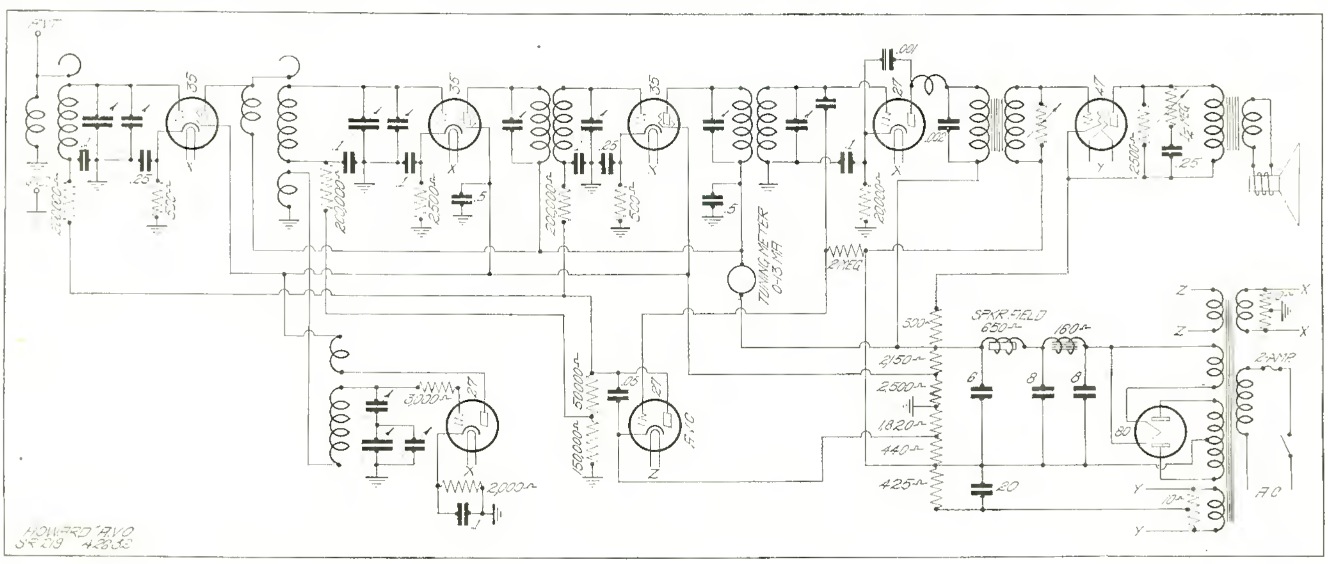


Below is the complete schematic wiring diagram of the AVO superheterodyne. The tubes required for operation are, a 235 r-f, 235 first detector, 227 oscillator, 235 second i-f, 227 automatic volume control tube, 227 second detector, 247 power pentode, and a 280 rectifier. Manual volume level setting is accomplished with a variable resistance unit across the grid circuit of the power tube.



Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9.5	11	13
100	16.5	19	23
1000	24.5	28	33
10000	36.5	42	47.5

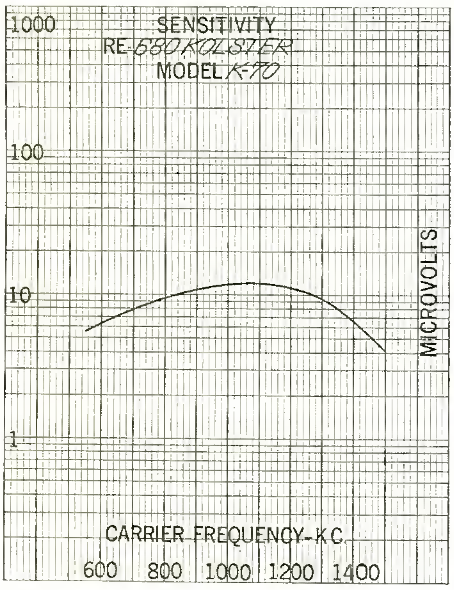


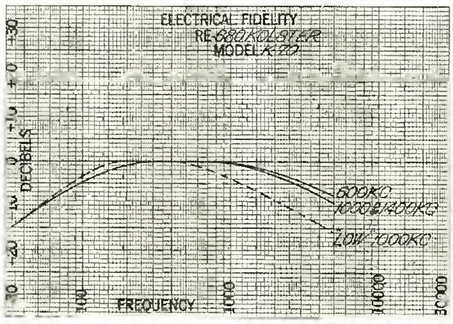
Kolster Models K-70, 72

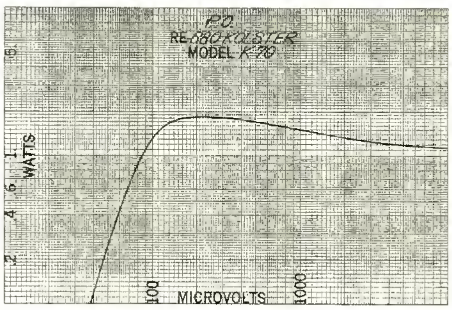
KOLSTER models K-70 and 72, now merchandised by the Westinghouse Electric and Manufacturing Company, when measured in our laboratory gave the overall performance curves shown.

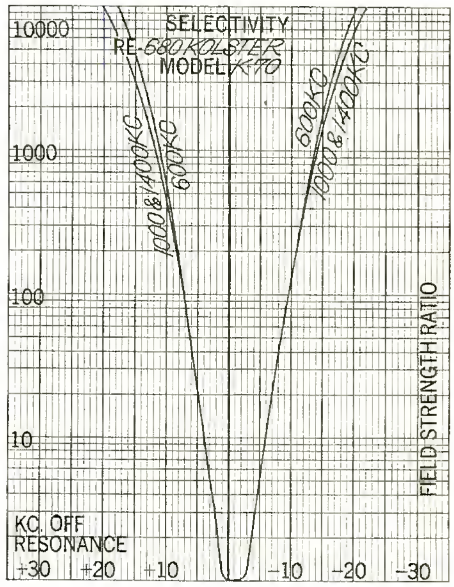
Receiver input was by means of the dummy antenna standard of 20 uh, 200 uuf and 25 ohms. The single 247 pentode used in the power output stage was matched with a non-inductive load resistance of 7000 ohms, while the plate was capacitatively coupled to the output indicating tube voltmeter which gave the voltage necessary for .05 watts of audio power. The voice coil circuit was broken to eliminate a loading effect from the secondary to the primary.

Line drain of the receiver was .96 amperes with an impressed a-c voltage of 119 volts. Tubes were furnished with the receiver by the manufacturer, the volume control was adjusted for maximum receiver sensitivity, and no changes were made in the alignment of tuned circuits for all measurements.







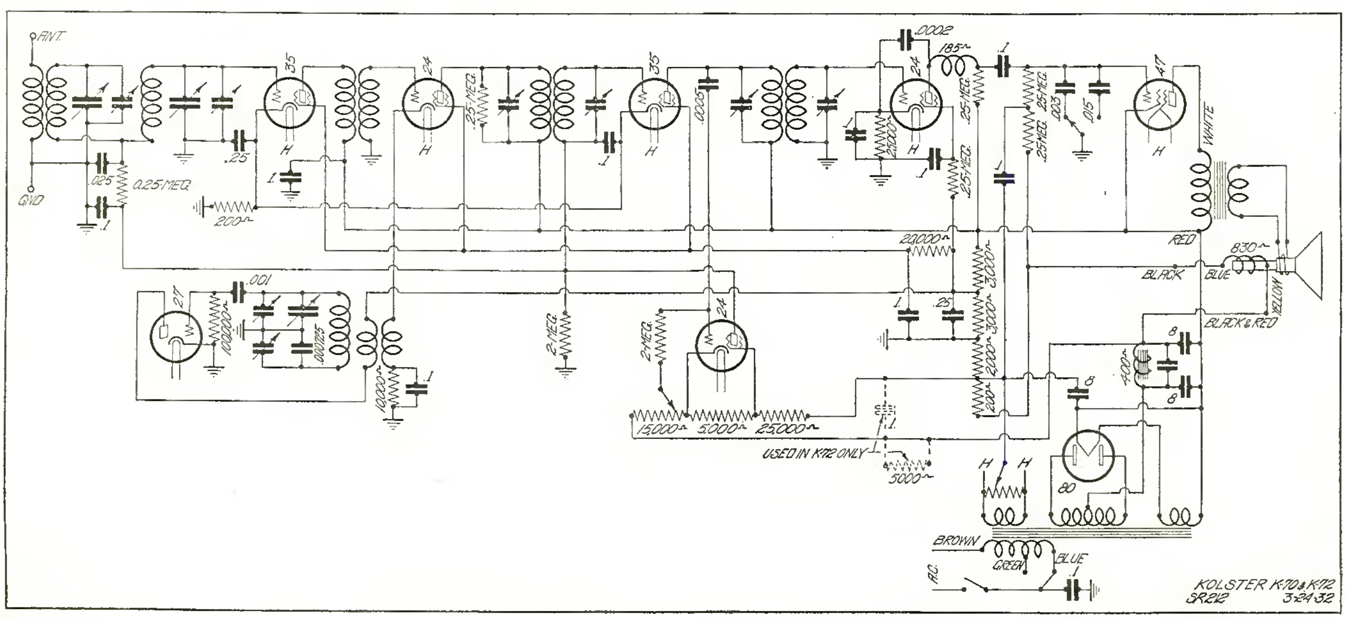


From the sensitivity curve of column one, the average is taken to be 9.42 microvolts absolute, equivalent to 2.35 microvolts per meter when employing a standard antenna height. Maximum noise level was measured at 600 kc, and had a value of 56.2%, while the minimum occurred at 1000 kc with a value of 28.2%. With the receiver tuned to 1000 kc, the image ratio was measured as 1890 times. From the power overload curve of column two, maximum audio output is read as 1.86 watts, remaining almost flat due to the action of the automatic volume control. Under the selectivity curves of column three are the band widths in tabular form.

A complete schematic wiring diagram of this superheterodyne will be found at the bottom of this page. The eight required tubes are, a 235 r-f, 224 first detector, 227 oscillator, 235 i-f, 224 automatic volume control tube, 224 second detector, 247 power pentode output tube, and a 280 type full wave rectifier which supplies the required high voltage supply to the receiver and speaker field.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	10	10	10
100	17	17	17
1000	25	26	26
10000	37.5	41.5	41.5



Ozarka Model 93-B

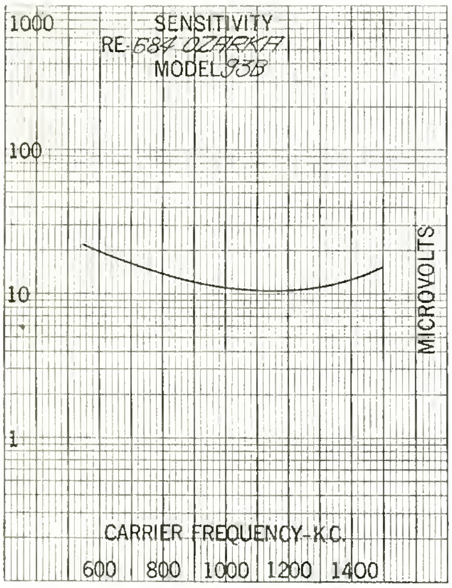
LABORATORY measurements on the Ozarka model 93-B made recently gave the performance curves included on this page.

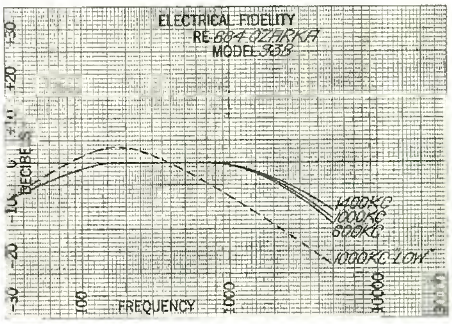
A standard dummy antenna of 20 uh, 200 uuf and 25 ohms served to couple the signal from the standard signal generator to the antenna system of this superheterodyne. A non-inductive load resistance of 7000 ohms was used across the plate circuit of the 247 pentode output tube to match its optimum impedance value. The plate was capacitatively coupled to the output meter which indicated the standard power output level of .05 watts except for the power overload curve. In order to prevent errors due to the reflection of the secondary impedance to the primary circuit of the output transformer, the voice coil circuit was disconnected during tests.

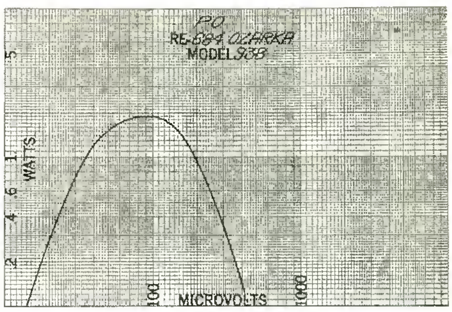
For all measurements, the volume control was adjusted for maximum receiver sensitivity, no changes were made in the alignment of the tuned circuits from factory adjustment, and the tubes used were those furnished as standard equipment with the receiver. A line voltage of 117 volts a-c resulted in a drain of .62 amperes.

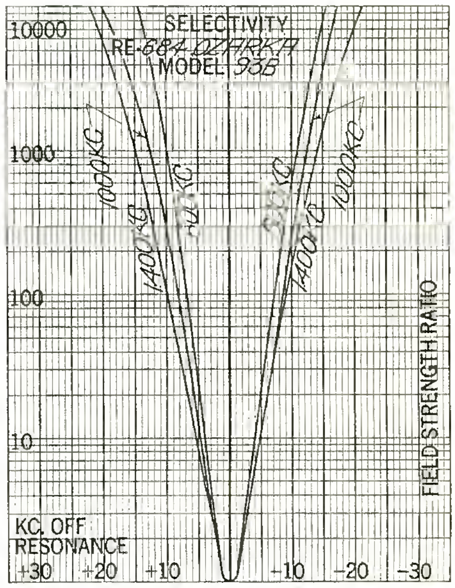
In column one is the sensitivity curve which gives an average value of 14.7 microvolts absolute corresponding to 3.675 microvolts per meter, assuming that a standard height antenna is employed. The maximum noise level was recorded at 600 kc and had a value of 25%. The minimum was found at 1400 kc with a value of 9%. For the image ratio measurement, the receiver was tuned to 1000 kc. The ratio was found to be 1100 times. From the power overload curve in column two, the maximum audio power output is seen to be 1.89 watts, although this value does not take into consideration the harmonics present in the audio wave form. Tabulated band widths will be found under the selectivity curves in column three.

A detailed schematic wiring diagram of this superheterodyne will be found below these columns. The tubes required for operation consist of a 235 r-f, 235 first detector, 227 oscillator, 235 second i-f, 227 second detector, 247 output power pentode, and a 280 full wave rectifier for receiver B supply voltage.



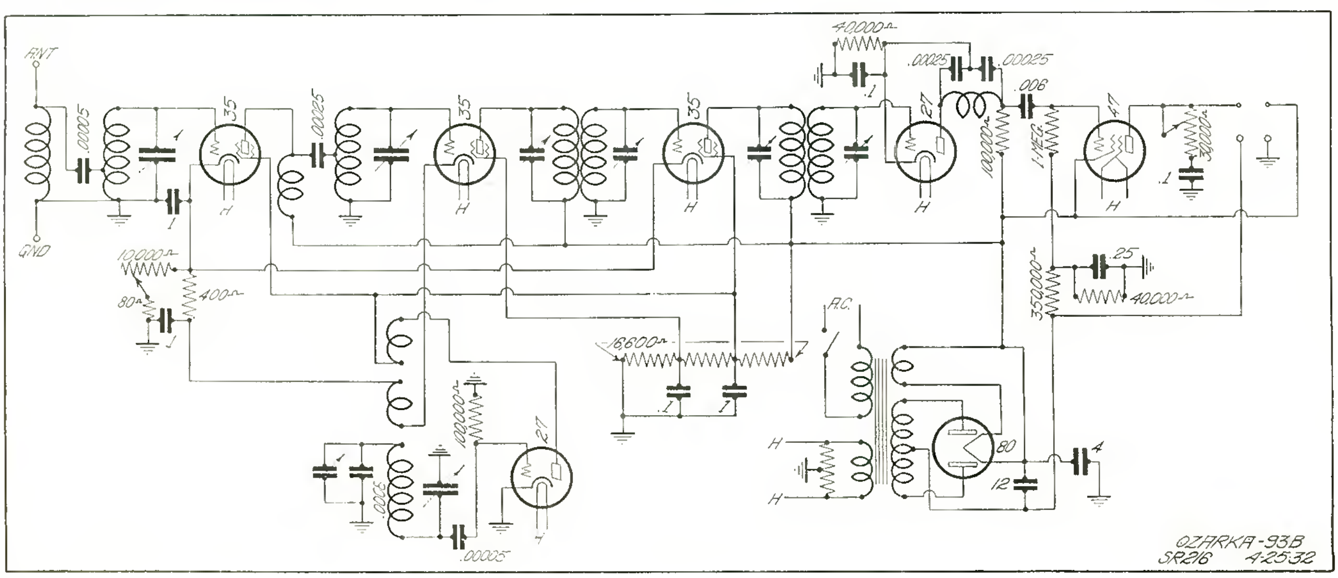






Band Widths

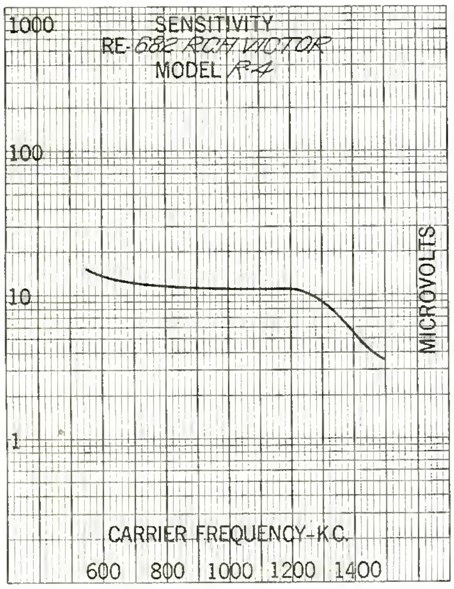
Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	8	9	10
100	14.5	17	19
1000	20.5	25	29
10000	30	35.5	43



RCA-Victor Model R-4

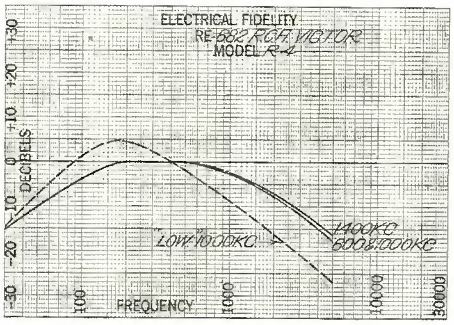
WHEN measurements were made in our laboratory recently on the RCA-Victor Superette Model R-4, the curves shown on this page were produced.

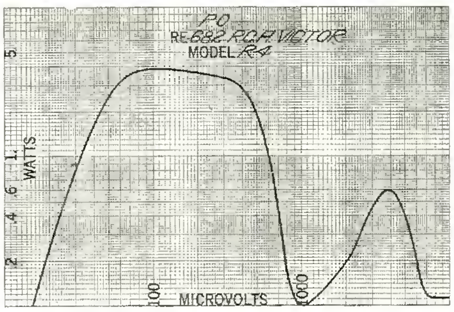
For input to the antenna circuit of this superheterodyne, the signal from



the standard signal generator was coupled by means of the dummy antenna standard of 20 uh, 200 uuf, and 25 ohms. To match the optimum operating impedance of the single 247 pentode employed in the audio output stage, a non-inductive load resistance of 7000 ohms was connected across its plate circuit. The plate was in turn coupled to the output tube voltmeter which read the voltage corresponding to the standard of .05 watts of audio power. During measurements, the voice coil of the dynamic speaker was disconnected to prevent its loading effect on the primary circuit of the output transformer.

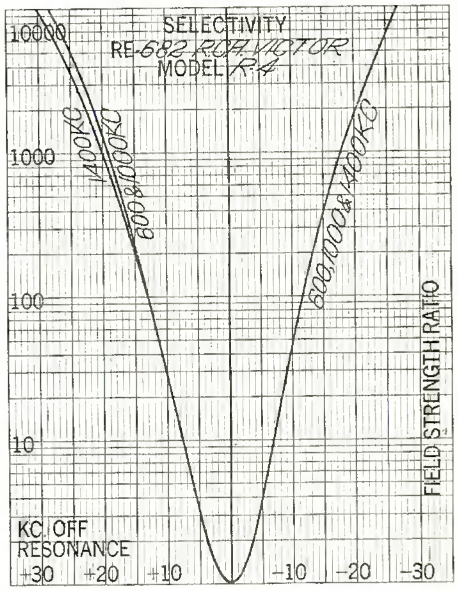
A line voltage of 115 volts a-c resulted in a receiver drain of .74 amperes line current. Tubes as furnished by the manufacturer with the set were used, the volume control was turned to its maximum position, and no adjustments were made on the tuned circuits to disturb the manufacturer's alignment.





From the sensitivity curve of column one, the average sensitivity is found to be 10.86 microvolts absolute, which value corresponds to 2.71 microvolts per meter when a standard height antenna is used. Noise level maximum and minimum values were respectively, 17.2% at 1400 kc, and 6.2% at 600 kc. At 1000 kc the image ratio was found to be 4450 times. Audio power output reached a maximum value of 3.84 watts as seen from the power overload curve of column two. This value does not take into consideration the harmonics present in the waveform of the signal voltage across the primary of the output transformer. Under the selectivity curves from which they were taken will be found the band widths in tabular form.

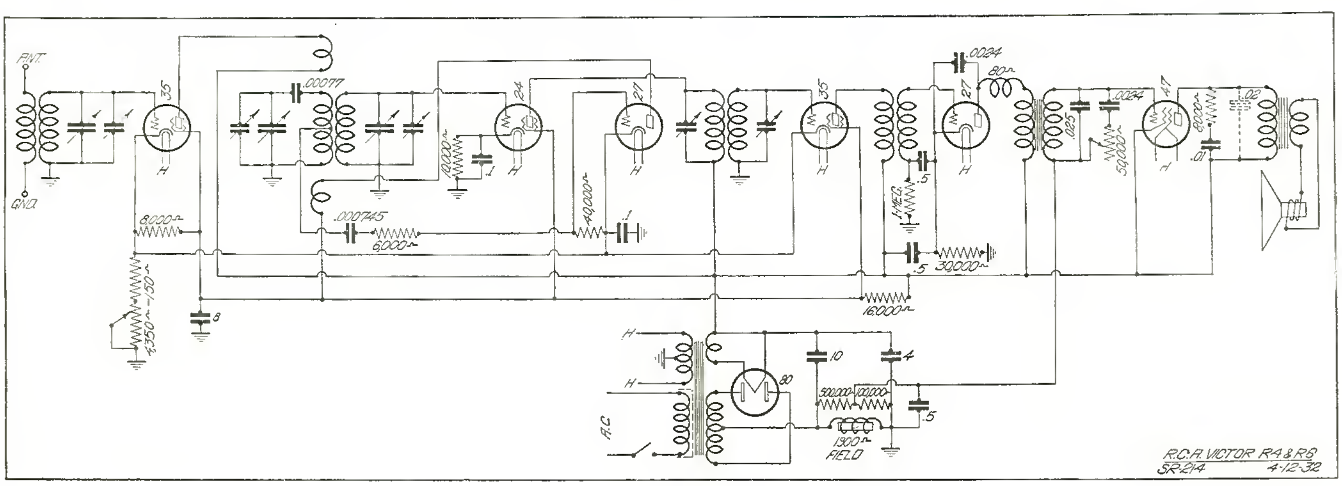
At the bottom of the page is the complete schematic wiring diagram of



the RCA-Victor model R-4. Required tubes are a 235 r-f, 224 first detector, 227 oscillator, 235 i-f, 227 second detector, 247 output pentode power tube, and a 280 full wave rectifier for complete receiver high voltage supply. Bias for the pentode is obtained from a tapped bleeder circuit in parallel with the speaker field which is used as a filter choke in the negative return lead. No other filter choke is employed.

Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	14.5	14.5	14.5
100	25	25	25
1000	37	37	38
10000	54.5	54.5	56.5



Silver-Marshall Model R

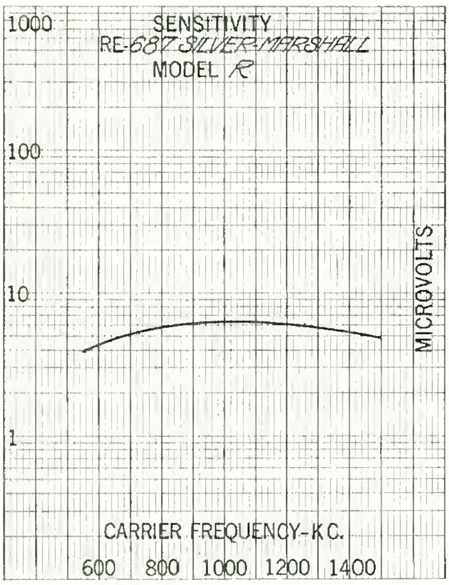
UPON measurement in our laboratory, the Silver-Marshall model R gave the performance curves printed on this page. It is notable that this broadcast-police wave superheterodyne employs full-wave second detection.

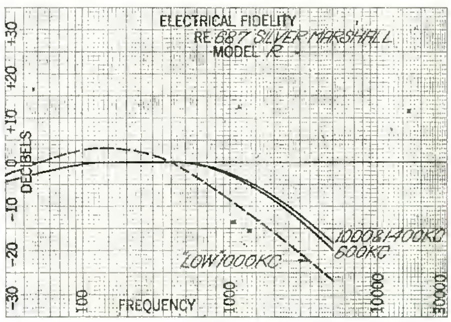
Input to the receiver antenna circuit was by means of the dummy antenna standard of 20 uh, 200 uuf and 25 ohms. The parallel 247 power pentodes were matched with a 3500 ohm non-inductive resistor connected across their plates, the latter having been capacitatively coupled to the output voltmeter. A level of .05 watts of audio power was maintained for all tests but that of power overload. The voice coil circuit was broken to prevent primary loading of the output transformer by the secondary circuit.

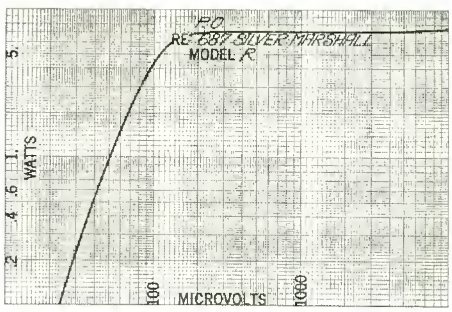
The line drain was 1.16 amperes with an impressed voltage of 119 volts a-c. No changes were made in the factory alignment of the tuned circuits, the volume control was adjusted for maximum receiver sensitivity, and the tubes used in testing were those accompanying the receiver.

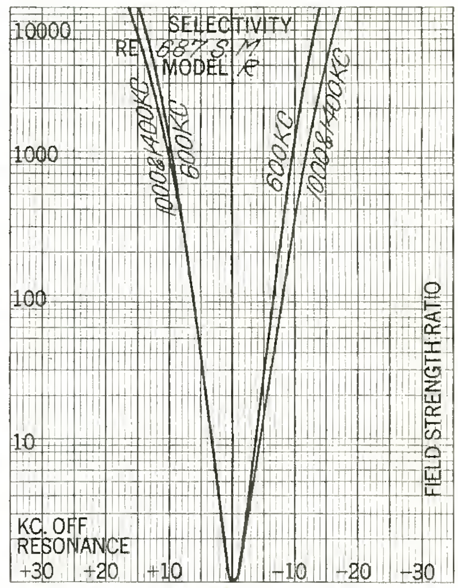
In column one, the sensitivity curve gives the average sensitivity as 5.41 microvolts absolute, equivalent to 1.35 microvolts per meter assuming that the standard height antenna is employed. Maximum and minimum noise levels were 54.4% at 600 kc, and 41.6% at 1000 kc respectively. An image ratio of 16,700 times was recorded with the receiver tuned to 1000 kc. A maximum audio output of 7.38 watts is taken from the power overload curve of column two. This is at the maximum input used, i. e., 10000 microvolts. Harmonics present at this high level have not been taken into consideration in the measurements. Under the selectivity curves of column three are the band widths in tabular form.

A detailed schematic wiring diagram of the model R is shown below. Required tubes are, a 224 first detector, 227 oscillator, 551 second i-f, 551 third i-f, 227 automatic volume control tube, two 227 second detectors, parallel 247 pentodes, and a 280 rectifier.



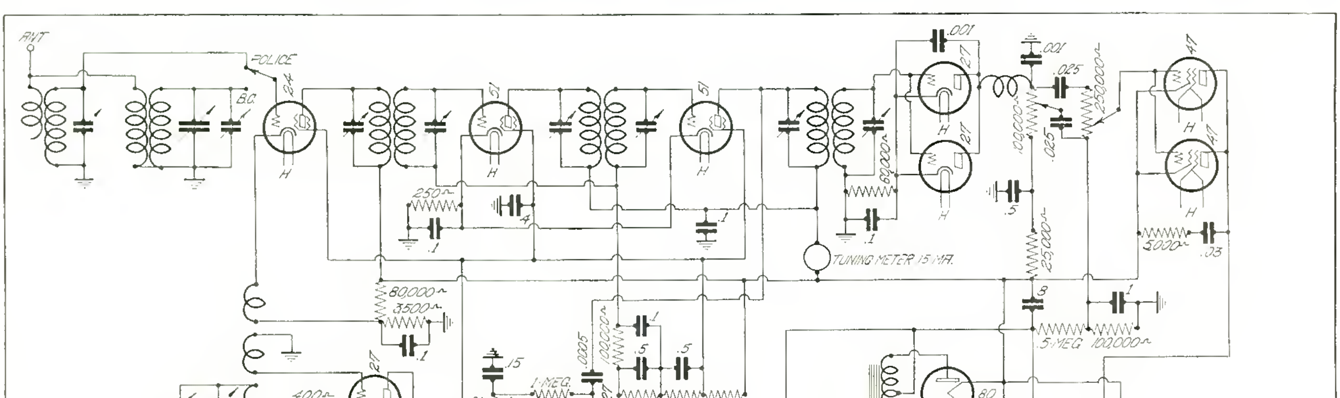






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	7	7.5	7.5
100	13	14	14
1000	19.5	22.5	22.5
10000	28.5	33.5	33.5



Sears, Roebuck & Co., Silvertone 1462

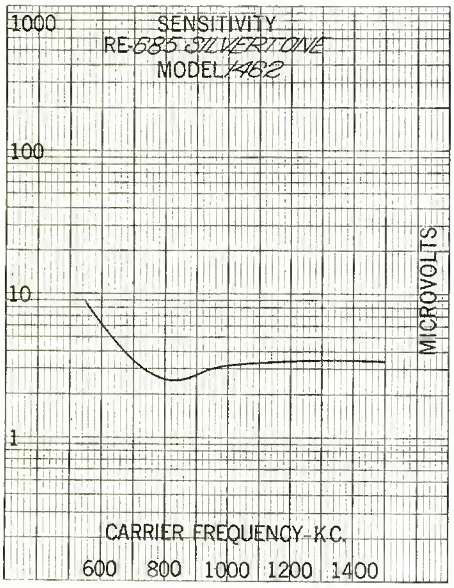
CURVES of the Silvertone model 1462, sold by Sears, Roebuck and Company, were made by this laboratory and given on this page.

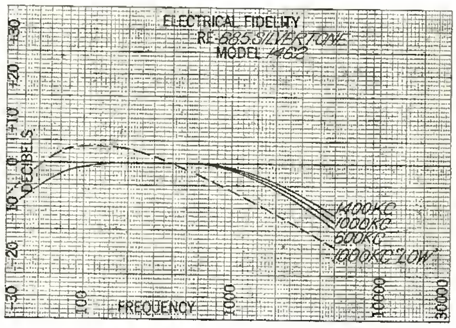
Antenna input was by means of the standard dummy antenna of 20 uh, 200 uuf, and 25 ohms. The plate load of the single pentode was a resistance of 7000 ohms. The plate of the tube was capacitatively coupled to the output meter which indicated the standard power output of .05 watts for all measurements except that of power overload. To prevent undesirable load reflection from the secondary to the primary of the output circuit, the voice coil circuit was broken.

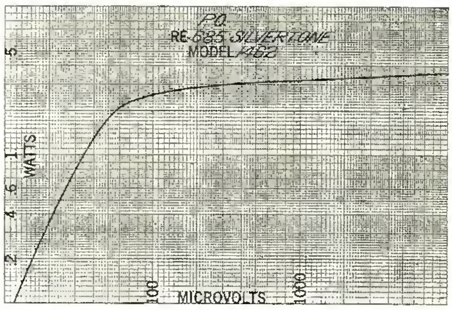
During all measurements, the volume control was at maximum, the tubes employed were furnished as standard equipment with the set, and no changes were made in circuit alignment. A line drain of .77 amperes was measured with an a-c line voltage of 118 volts.

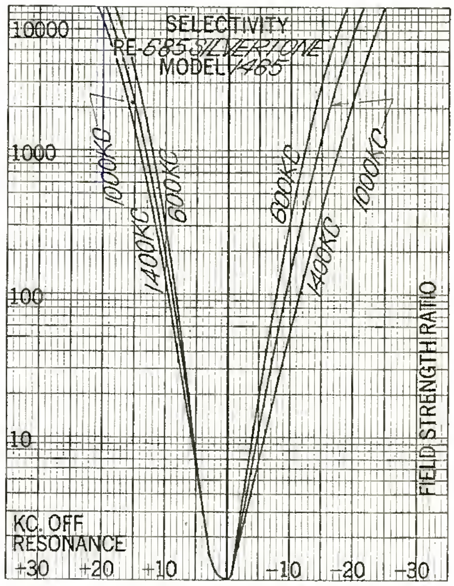
From the sensitivity curve of column one the average is taken as 3.60 microvolts absolute which is equivalent to .90 microvolts per meter. At 600 kc the minimum noise level is 8.4% was measured, while the maximum occurred at 1400 kc with a value of 49%. With the receiver tuned to 1000 kc the image ratio measured 12,533 times. A maximum audio power output of 3.55 watts was found at the greatest signal input used, i. e., 10000 microvolts. This figure does not, however, take into account the harmonics produced. Band widths are found under the selectivity curves.

Below is the schematic wiring diagram. Tubes necessary are, a 235 r-f, 227 oscillator, 235 first detector, 235 i-f, 227 automatic volume control, 224 second detector, 247 pentode, and a 280 rectifier.



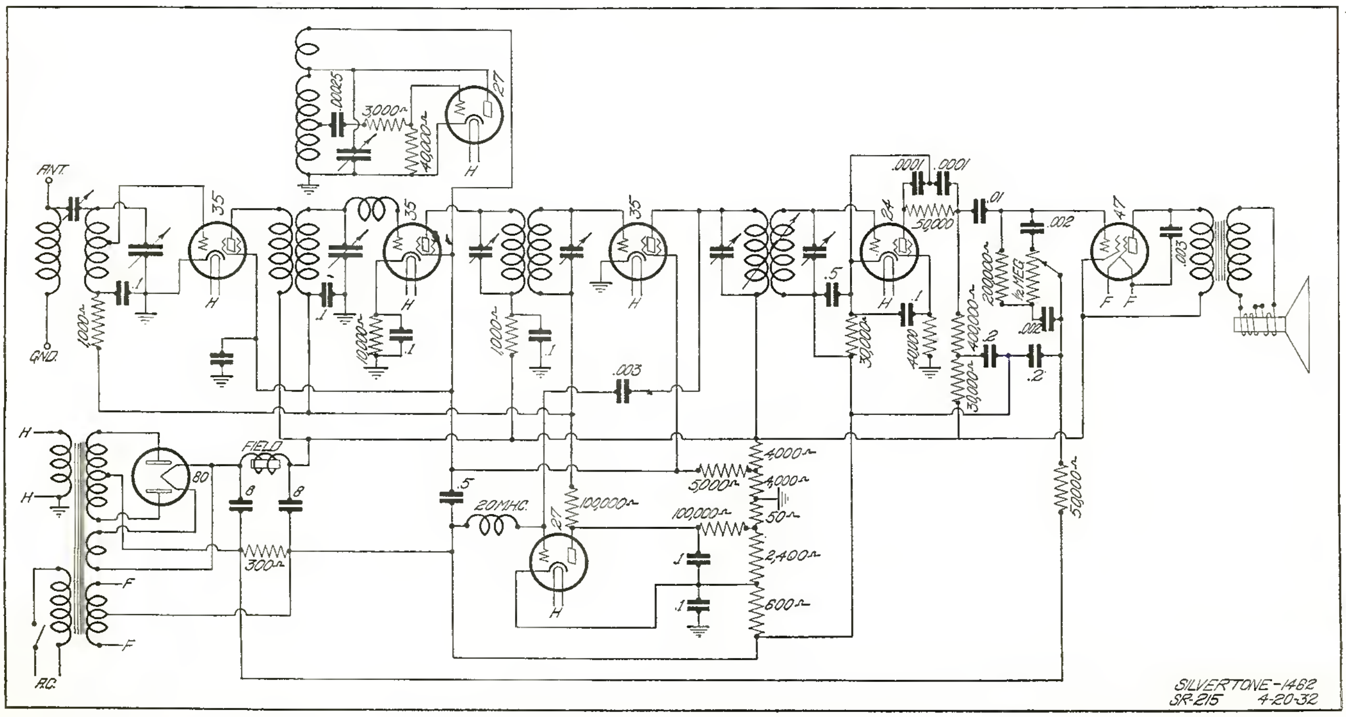






Band Widths

Times Field Strength	*Kilocycles width* 600 kc.	1000 kc.	1400 kc.
10	9.5	10.5	12
100	16.5	18.5	21
1000	24.5	27.5	31.5
10000	37.5	41	46



Service *and* Repair

SCHEMATICS PUBLISHED TO DATE

Model	*Published*	*Drawing No.*
A. C. Dayton		
Navigator	November, 1929	SR24
Acme Mfg. Co.		
AC7	March, 1929	SR3
AC4	March, 1929	SR4
All-American Mohawk		
Lyric 90	November, 1930	SR74
Lyric 6	March, 1929	SR1
Lyric 8	March, 1929	SR2
Lyric J	October, 1931	SR128
Lyric B-7	December, 1931	SR165
Lyric S-8	January, 1932	SR170
Lyric S-6	April, 1932	SR204
Lyric S-7	May, 1932	SR167
Amrad		
70	November, 1929	SR22
81	March, 1930	SR44
84	January, 1931	SR106
Apex		
48	November, 1930	SR80
31 (U. S. Radio)	January, 1931	SR108
10B (U. S. Radio)	March, 1932	SR191
7-A (U. S. Radio)	April, 1932	SR189
Atwater-Kent		
38	January, 1930	SR28
55, 55C (Cap.)	September, 1930	SR51
55, 55C (Ind.)	September, 1930	SR52
66	March, 1931	SR114
H-2	December, 1931	SR131
Audiola		
Series 31 (t.r.f.)	November, 1930	SR79
Super 31	March, 1931	SR111
Junior	March, 1931	SR112
13-S7	February, 1932	SR181
Balkeit		
A	September, 1929	SR12
L-8	May, 1932	SR210
Bosch		
48	November, 1930	SR73
58	January, 1931	SR109
60	March, 1931	SR117
28-29	November, 1929	SR21
Auto	November, 1930	SR94
7DC	November, 1931	SR160
31	March, 1932	SR198
20	April, 1932	SR193
5	May, 1932	SR194
Bremer-Tully		
7-70	September, 1929	SR10
81-82	November, 1930	SR75
S81-82	October, 1931	SR126
Brunswick		
3KRO	November, 1929	SR23
15, 22, 32 and 42	November, 1930	SR86
S14	November, 1930	SR71
11, 12, 16	October, 1931	SR148
17, 24	December, 1931	SR164
E	February, 1932	SR183
Colonial		
31AC	January, 1930	SR29
33 and 34 a-c	November, 1930	SR95
47-48	December, 1931	SR160
Crosley		
Roamio	September, 1930	SR67
40S, 41S, 42S, 82S	September, 1930	SR57
608 Gembox	March, 1930	SR41
705 Showbox	March, 1929	SR6
Jewelbox 704B	March, 1929	SR5
77	November, 1930	SR83
53, 54, 57	January, 1931	SR103
120	October, 1931	SR133
121-1	November, 1931	SR149
124	December, 1931	SR150
125	January, 1932	SR174
127	March, 1932	SR187
27	May, 1932	SR188
Dayfan		
5080	September, 1929	SR11
Delco		
Auto Radio	September, 1930	SR66
Edison		
R4, R5, C4	November, 1930	SR49
R6, R7	January, 1931	SR99
Erla		
Duo Concerto R-2	January, 1930	SR33
Eveready		
50	March, 1931	SR50
Fada		
7AC	September, 1929	SR13
35-35Z	November, 1930	SR70
KW28-29	December, 1931	SR158
Federal		
H	November, 1929	SR19
Freed-Eisemann		
NR80	November, 1929	SR20
Freshman		
2-N-12	September, 1929	SR14
General Electric		
H-32	January, 1932	SR166
S-22	January, 1932	SR137
K-62	March, 1932	SR168
General Motors		
A	November, 1930	SR68
120-A	November, 1931	SR116
S3A	November, 1931	SR154
S9A	January, 1932	SR173
S-10A	February, 1932	SR179
Gilfillan Bros.		
100	January, 1930	SR32
Graybar		
600	March, 1930	SR42
Grebe		
7AC	November, 1929	SR17
AH1	November, 1930	SR96
Gulbransen		
Nine-in-Line	March, 1930	SR40
161	March, 1931	SR110
10, 13	February, 1932	SR175
23	March, 1932	SR186
Hammarlund		
Comet	April, 1932	SR200
Howard		
S. G. A.	September, 1930	SR56
Green Diamond 8	September, 1929	SR16
H	October, 1931	SR145
SG-B	November, 1931	SR130
O	December, 1931	SR163
AVH	March, 1932	SR177
DL	April, 1932	SR203
Jesse French, Jr.		
G	March, 1931	SR118
Kellogg		
523-528	November, 1930	SR77
Kennedy		
20	March, 1930	SR48
26	November, 1930	SR81
10	January, 1931	SR38
30-32	November, 1931	SR129
52	February, 1932	SR184
56	March, 1932	SR185

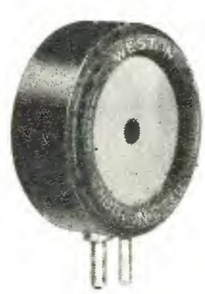
Model	*Published*	*Drawing No.*
King		
J	January, 1930	SR31
Kolster		
K20, K22, K25 and K27	September, 1929	SR8
K21, K23, K24 and K28	March, 1930	SR45
K-43	November, 1930	SR72
K80	November, 1931	SR159
90, 92	February, 1932	SR182
Kylectron		
70	November, 1930	SR65
Majestic		
70	September, 1929	SR7
90B	September, 1930	SR55
130-A	November, 1930	SR84
50	January, 1931	SR98
20	October, 1931	SR124
60	October, 1931	SR138
15	November, 1931	SR157
25	February, 1932	SR178
Perfectone		
7-T-38	May, 1932	SR209
Philco		
86-82	November, 1929	SR26
95	September, 1930	SR60
90-90A	November, 1931	SR156
112	January, 1932	SR172
70	April, 1932	SR202
51, 51-A	May, 1932	SR208
Pilot		
148	February, 1932	SR176
Radiette		
F14	January, 1931	SR104
Radiola		
60	January, 1930	SR30
66	September, 1930	SR64
44	January, 1931	SR102
18	October, 1931	SR127
RCA-Victor		
R-7	October, 1931	SR137
R50-55	December, 1931	SR166
R11	January, 1932	SR168
43	May, 1932	SR206
Scott		
31	December, 1931	A-1
Sentinel		
11, 12, 15, 16	March, 1931	SR115
106B	March, 1931	SR113
108A	October, 1931	SR146
108	November, 1931	SR123
111	November, 1931	SR155
Silver		
36A	January, 1931	SR105
30B	September, 1930	SR53
30	January, 1930	SR35
35-A	November, 1930	SR82
782	October, 1931	SR120
726SW	October, 1931	SR144
D-E	November, 1931	SR152
F	December, 1931	SR140
G	January, 1932	SR153
A	February, 1932	SR169
J	April, 1932	SR196
Q	May, 1932	SR207
Slagle (Continental)		
9	January, 1930	SR27
R-20	March, 1930	SR46
Sonora		
5R	November, 1929	SR25
Sparton		
AC89	September, 1929	SR9
589	September, 1930	SR63
600, 610, 620	March, 1931	SR91
25-26	December, 1931	SR161
10	February, 1932	SR180
15	March, 1932	SR192
Splitdorf		
E175	January, 1930	SR36
Steinite		
261	September, 1929	SR15
70, 80, 95	November, 1930	SR76
600, 605, 630, 635	November, 1931	SR132
Stewart-Warner		
950	September, 1930	SR62
Series 900	January, 1930	SR34
R100	January, 1931	SR85
102A	October, 1931	SR147
R-102A	March, 1932	SR195
Stromberg-Carlson		
846	September, 1930	SR54
635-636	November, 1929	SR18
12-14	November, 1930	SR93
10-11	November, 1931	SR134
19-20	November, 1931	SR151
22	April, 1932	SR201
29	May, 1932	SR211
Transformer Corp.		
50	November, 1930	SR78
80-81	October, 1931	SR139
Temple		
8-60, 8-80, 8-90	March, 1930	SR37
SG 8-61, 8-81, 8-91	October, 1931	SR125
Transitone		
Auto Radio	November, 1930	SR69
Trav-Ler		
C	March, 1931	SR120
U. S. Radio		
37	March, 1930	SR39
26P	October, 1931	SR143
99A	January, 1932	SR171
Universal Auto Radio		
70	April, 1932	SR205
Victor		
R32, RE45, R52	September, 1930	SR61
R35, R39, RE57	January, 1931	SR101
Wells-Gardner		
50 (Arcadia)	April, 1932	SR199
Westinghouse		
WR-5	November, 1930	SR92
WR-4	January, 1931	SR107
WR10-12	November, 1931	SR137
WR15	January, 1932	SR168
Zaney-Gill		
54	March, 1931	SR119
Zenith		
52, 53, 54, 522, 532 and 542	March, 1930	SR43
71, 72, 73 and 77	November, 1930	SR97
A, B, C, D	November, 1931	SR141
91, 92	March, 1932	SR190

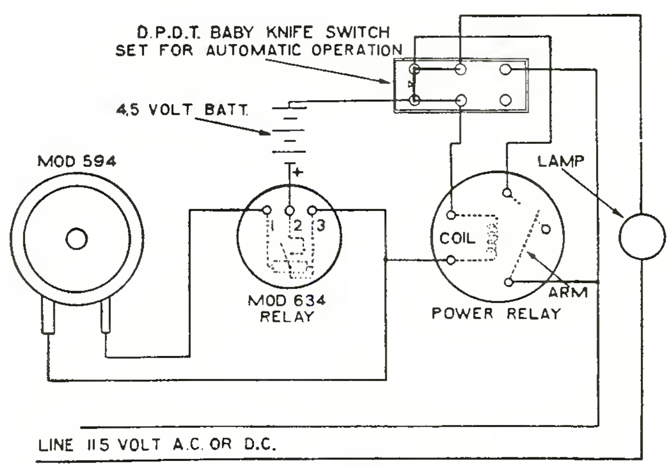
Photronic Cell Experiments

IT is often desirable in the home to have at least one living room or porch lamp lighted in the evening, not only as an ornament, but also to guard against intruders, who might be tempted to enter a dark house. During holidays and at other times when a home is likely to be unoccupied, some automatic means of turning on a lamp at night forms a great convenience. The Weston Type 1 Photronic Relay, which is really operated by the changing intensity of light, may be used as a switch to close a lighting circuit at dusk and, if left undisturbed, to open it again at dawn.

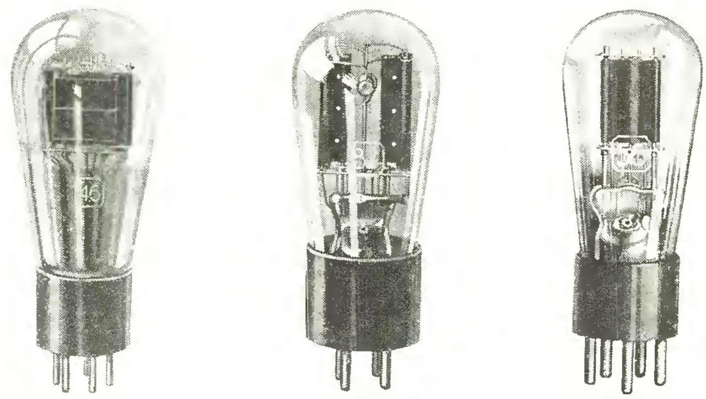
Referring to the diagram, the small (plus) prong of the Photronic Cell is connected to the No. 1 terminal of the Miniature Relay, and the larger prong goes to terminal No. 3. Leads from studs 2 and 3 are connected to the terminals of the Power Relay coil with a 4½ volt "C" battery in series as shown. One side of the lamp circuit, which should not exceed 100 watts, is in series with the Power Relay arm and the contact point which remains on closed circuit when the coil is not energized. The inside of this relay may be reached by unscrewing the two small thumb nuts and lifting off

(*Continued on page* 40)





TUBE DEVELOPMENTS



SPECIAL features of five new tubes are described briefly in the following paragraphs. The 46 is designed particularly for service in Class B audio amplifier circuits of a-c operated receivers. A pair of these tubes in a Class B output stage is capable of supplying economically a reserve of power to meet requirements for an extended volume range. The 46 is constructed so that its two grids may be connected in the circuit to make the tube applicable either to the output or the driver stage of a Class B amplifier.

The 56 is a general purpose triode of the a-c heater type and is recommended for service as detector, amplifier or oscillator.

The 57 is a triple-grid amplifier detector which makes use of a suppressor and a radically new construction to obtain superior performance capabilities.

The 58 is a triple-grid super-control amplifier similar in construction to the 57, but designed to operate effectively over a large range of signal voltages, either with manual or automatic volume control circuits.

The 82 is designed especially for supplying a-c receivers with d-c power of uniform voltage independent of variations in the direct current demand. This feature makes this tube uniquely suitable for use in receivers employing Class B power amplifiers.

The design of the 56, 57, and 58 is characterized by relatively low heater power consumption, small size, and excellent characteristics. Both the 57 and the 58 have the unique feature of having the suppressor lead brought out to its own terminal.

Radio engineers will appreciate the flexible adaptability of these five new types in providing unique opportunities for the development of improved receiver circuits. These new types are recommended for use only in receivers designed for their characteristics.

After thorough research and investigation of various types of transmitting tubes, including both American and European, and with the culmination of extensive laboratory tests, the Arcturus Radio Tube Company, Newark, is now manufacturing two mercury vapor rectifiers, known as types E766 and E772, as well as the types E703-A, E711, and E745, 50 watt tubes.

(Continued on next page)

46 Characteristics

Class "B" Amplifier

Operating Conditions and Characteristics:

Filament Voltage		2.5 Volts A.C.
Plate Voltage	300	400 Max. Volts
Grid Voltage (both grids tied together)	0	0 Volts
Plate Current	4	6 Milliamperes
Peak Plate Current	150	200 Milliamperes
Load Resistance per Tube	1300	1450 Ohms
Max. Signal Voltage	40	41 Volts RMS
Max. Continuous Power Output (2 tubes)*	16	20 Watts
Max. Plate Dissipation (avg. per tube)	10	10 Watts

Class "A" Amplifier

Operating Conditions and Characteristics:

Filament Voltage	2.5 Volts A.C.
Plate Voltage	250 Max. Volts
Grid Voltage (grid adjacent to plate tied to plate)	—33 Volts
Amplification Factor	5.6
Plate Resistance	2380 Ohms
Mutual Conductance	2350 Micromhos
Plate Current	22 Milliamperes
Load Resistance (Optimum for max. undistorted power output)**	6400 Ohms
Max. Undistorted Power Output	1.25 Watts

*Power measured across indicated value of resistor in plate circuit of each tube, with indicated signal applied through 250 ohm resistance in the grid circuit.

**Approximately twice this value is recommended for load of driver for Class B stage.

56 Characteristics

Heater Voltage	2.5 Volts A.C. or D.C.
Heater Current	1.0 Ampere
Direct Interelectrode Capacitances	
Grid-Plate	3.2 uuf
Grid-Cathode	3.2 uuf
Plate-Cathode	2.2 uuf
Maximum Overall Length	4¼ Inches
Maximum Diameter	1 9/16 Inches
Bulb	S-12
Base	Small 5-Pin

Amplifier (Class A)

Operating Conditions and Characteristics:

Heater Voltage	2.5 Volts
Plate Voltage	250 Volts, Maximum
Grid Voltage*	—13.5 Volts
Amplification Factor	13.8
Plate Resistance	9500 Ohms
Mutual Conductance	1450 Micromhos
Plate Current	5 Milliamperes

*If a grid coupling resistor is used, its maximum value should not exceed 1.0 megohm.

Detector

Operating Conditions as Biased Detector:

Heater Voltage	2.5 Volts
Plate Voltage	250 Volts Maximum
Grid Voltage*	—20 Volts Approx.
Plate Current	(Adjusted to 0.2 ma. with no a-c input signal)

Tube Developments

(Continued from page 31)

56 Characteristics
(Continued)

Operating Conditions as Grid Leak Detector:
- Heater Voltage .... 2.5 Volts
- Plate Voltage .... 45 Volts
- Grid Condenser Capacity.....0.00025 uf
- Grid Leak Resistance......... 1 to 5 Megohms

Oscillator

Operating Conditions as Oscillator:
- Heater Voltage ....2.5 Volts
- Plate Voltage .... 90 Volts, Maximum
- Grid Voltage .... 0 Volts

*If a grid coupling resistor is used, its maximum value should not exceed 1.0 megohm.

Amplifier

- Heater Voltage .... 2.5 Volts
- Plate Supply Voltage ..... 250 Volts
- Grid Voltage .... —9 Volts Approx.
- Plate Load ....50000-100000 Ohms
- Plate Current .... 1-2 Milliamperes

A grid coupling resistor in excess of 1.0 megohm should not be used.

57 Characteristics

- Heater Voltage .... 2.5 Volts A.C. or D.C.
- Heater Current .... 1.0 Ampere

Direct Interelectrode Capacitances:
- Effective Grid-Plate... 0.010 uuf Maximum (with shield can)
- Input .... 5.2 uuf
- Output .... 6.8 uuf

- Overall Length ....4 19/32 to 4 27/32 Inches
- Maximum Diameter .... 1 9/16 Inches
- Bulb .... ST-12 (Dome Shape)
- Cap .... Small Metal
- Base .... Small 6-Pin

Amplifier (Class A)

Operating Conditions and Characteristics:
- Heater Voltage .... 2.5 Volts
- Plate Voltage .... 250 Volts Maximum
- Screen Voltage .... 100 Volts Maximum
- Grid Voltage .... —3 Volts
- Amplification Factor .... Greater than1500
- Plate Resistance ..Greater than 1.5 Megohms
- Mutual Conductance ....1225 Micromhos
- Grid Voltage for Cathode Current Cut-off .... 7 Volts Approx.
- Plate Current .... 2.0 Milliamperes
- Screen Current .... 1.0 Milliampere Max.

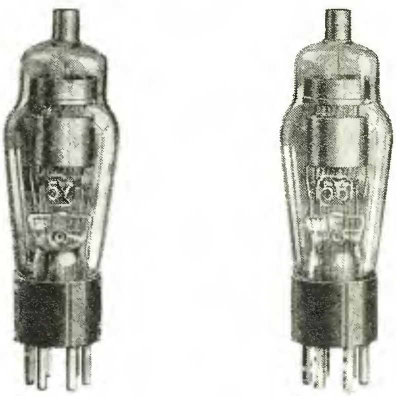
Detector

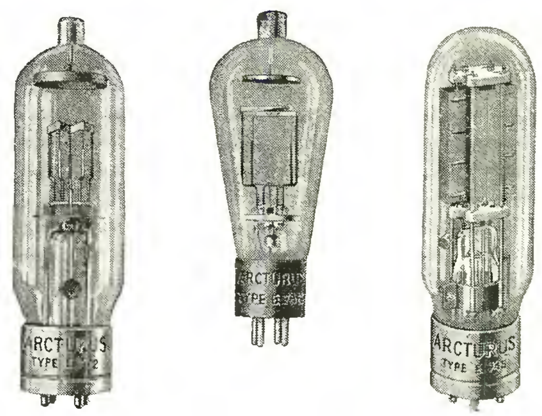
Operating Conditions as Biased Detector:
- Heater Voltage ....2.5 Volts
- Plate Voltage ....250 Volts Maximum
- Screen Voltage ....100 Volts Maximum
- Grid Voltage ....—6 Volts Approx.
- Plate Load—250,000 ohms or 500 henry choke shunted by a .25 megohm resistor. For resistance load, plate supply voltage will be voltage at plate plus voltage drop in load caused by specified plate current.
- Plate Current—Adjusted to approximately 0.1 milliampere with no a-c input signal.

58 Characteristics

- Heater Voltage .... 2.5 Volts A.C. or D.C.
- Heater Current .... 1.0 Ampere

Direct Interelectrode Capacitances
- Effective Grid-Plate.. 0.010 uuf Maximum (with shield-can)
- Input .... 5.2 uuf





- Output .... 6.8 uuf
- Overall Length ....4 19/32 to 4 27/32 Inches
- Maximum Diameter .... 1 9/16 Inches
- Bulb .... ST-12 (Dome Shape)
- Cap .... Small Metal
- Base .... Small 6-Pin

Amplifier (Class A)

Operating Conditions and Characteristics:
- Heater Voltage ....800000 Milliamperes Max.
- Plate Voltage .... 2.5 Volts
- Screen Voltage .... 250 Volts Maximum
- Grid Voltage .... 100 Volts Maximum
- Amplification Factor .... —3 Volts Minimum
- Plate Resistance 1280
- Mutual Conductance ....800000 Ohms
- Mutual Conductance .... 1600 Micromhos
  - At —40 Volts Bias........ 10 Micromhos
  - At —50 Volts Bias........ 2 Micromhos
- Plate Current .... 8.2 Milliamperes
- Screen Current .... 3.0 Milliamperes Max.

1st Detector in Superheterodyne Circuit

Operating Conditions with Variable Grid Bias:
- Heater Voltage .... 2.5 Volts
- Plate Voltage .... 250 Volts Maximum
- Screen Voltage .... 100 Volts Maximum
- Grid Voltage (with 9-Volt Oscillator Peak Swing)...........—10 Volts Minimum

NOTE.—With an oscillator peak swing of 1 volt less than the grid bias, these values are not critical and may be chosen to meet receiver design requirements.

The 82 is a full-wave, mercury-vapor rectifier tube of the hot-cathode type for use in suitable rectifying devices designed to supply d-c power from an a-c power line. It is particularly recommended for supplying power of uniform voltage to receivers in which direct current requirements are subject to considerable variation. The excellent voltage regulation characteristic of the 82 is due to its low and practically constant voltage drop for any current

(Continued on page 48)

Progress in Recording Sound

By J. E. Otterson
President, Electrical Research Products, Inc.*

FIFTY odd years ago it was possible to hear only that speech which was uttered in an audible tone in the immediate vicinity of the listener. Today it is possible to speak in a normal, conversational tone in Australia and be heard in New York. It is also possible to speak in a normal, conversational tone in Australia and hear one's own voice three-tenths of a second later after it has traveled around the world. It is possible to speak to ships at sea and to ships in the air. It is possible to speak to passengers on moving trains. A doctor in Chicago has listened to the heart beat of a patient in a hospital in Baltimore and diagnosed his heart malady.

These things have been made possible by the development of the science of telephony. The word "telephony" is derived from certain Greek words meaning "distant sound." The characteristic of telephony is a separation in space between the speaker and the listener. The scientific problems presented to the Telephone engineer are those relating to the transmission and amplification of sound, and the solution of these problems involves comprehensive research in the fields of electricity and acoustics.

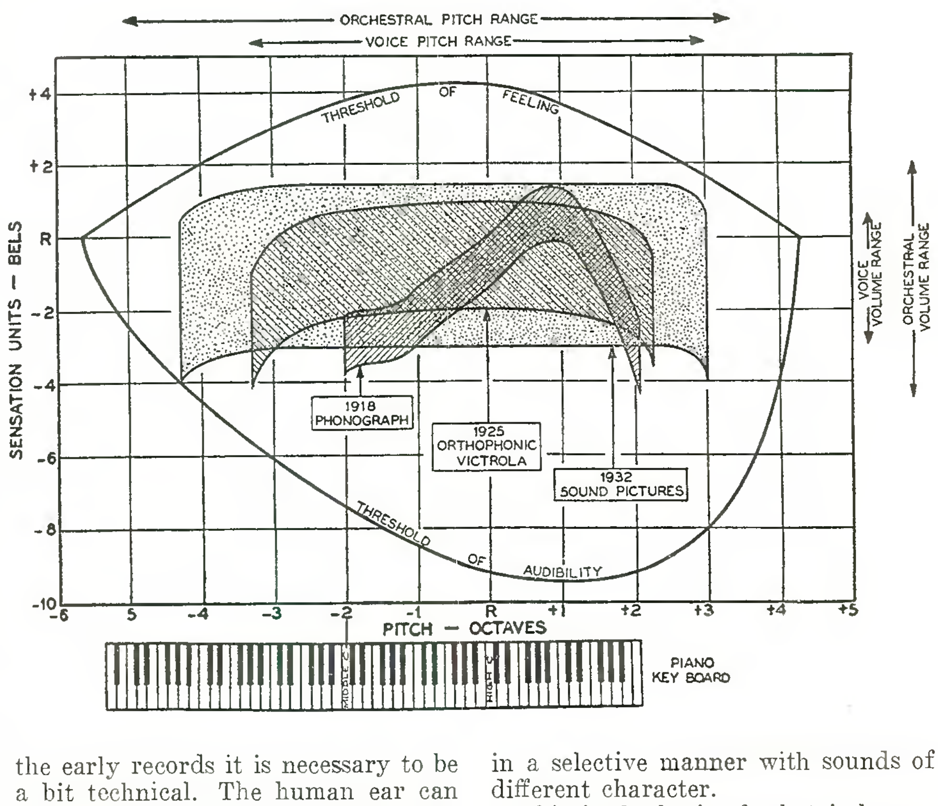
In pursuing this research a new science, a new art, was evolved. We refer to the electrical recording and reproduction of sound. This new science is dependent upon the same laws as the science of telephony and to a large extent makes use of the same facilities. In operation, however, it differs very fundamentally from telephony. Since, whereas in telephony there is a separation in space between speaker and listener, in this new science there is a separation in time, and the recorded voice may be heard at any time after the original speech.

If we may be permitted to coin a word, we should like to refer to this recording and subsequent reproduction of sound as the science of "postephony," which we think may be freely translated as meaning "later sound" or "sound after."

The combined science of telephony and "postephony" is the basis of one of the four or five largest businesses in the world, involving as it does transmission, recording, amplification, reproduction and reception of sound, and embracing the telephone business, the radio business, the phonograph business and the talking motion picture business.

The term "canned music" was appropriate to describe the early efforts to record sound, since it carried with it not only the suggestion of stored-up sound but a certain "tinny" quality that was characteristic of these early efforts. Our efforts since may be said to have been directed toward getting rid of the can, and this effort has been successful in large measure not only in a physical sense but in a psychological sense as well, since with the improvement in quality that has resulted the public prejudice against canned music has for the most part disappeared.

In order to understand why present day sound records are better than the early records it is necessary to be a bit technical. The human ear can hear sounds having a frequency range from fifty cycles per second to ten thousand cycles per second. The old fashioned phonograph produced only the middle band of these frequencies and eliminated the high notes and the low notes. In these circumstances all voices sounded more or less alike and all had that quality of tinniness associated with the canning process. Our present day instruments are perfect enough to record and reproduce all of the frequencies which the human ear can hear with a resulting improvement in naturalness.



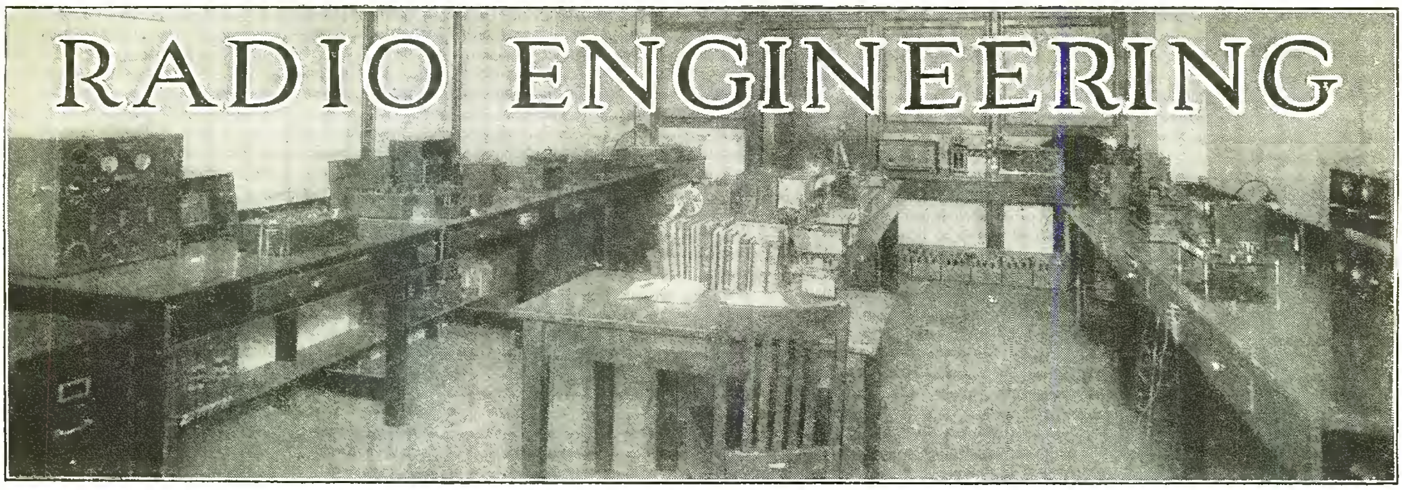
We think of noise as unpleasant sound. In the struggle toward perfection in this art it has been necessary to give study to the suppression of noise. When sound is amplified to fill a large theater or auditorium, or a room such as this, noises which were not noticeable at lower levels became objectionable. When we say that it has been possible in large measure to eliminate the noises or unpleasant sounds while amplifying the pleasant sounds, it would appear that we are indicating that the instruments of modern postephony have the quality of good taste. This, of course, could not be true but they do have the scientific property of dealing to some extent sufficient for practical purposes in a selective manner with sounds of different character.

This is the basis of what is known as Western Electric Noiseless Recording developed during the past two years. You may have noticed that present day talking motion pictures are much more noiseless than those of four years ago in that they are comparatively free of extraneous, unpleasant sounds suggestive of mechanical instrumentalities.

When listening directly to sound, the ear unconsciously rejects those noises which permeate the atmosphere

(*Continued on page* 42)

*Excerpts from an address, "A Decade of Progress in the Recording and Reproducing of Sound," given before the Electrical Association of New York in March.



Practical Filter Design

PART I

WHILE it is probably true that the subject of simple wave filters and their design is of great general interest, many readers may have found that the pages of published works on the subject are veritable nests of mathematical symbols —necessarily so, perhaps, but, for all that, too precise for the purposes of those who are less interested in mathematical theory. Admitting, to start with, that even in the pages of this account there may be found certain evident out-croppings of symbolic notation, we hasten to add that much attention has been given to explanation of the nature and value of each of the symbols as it appears, so that anyone who understands the fundamental processes of multiplication, division, and possibly of square root, may proceed with confidence.

Any filter may be regarded as a kind of transmission line circuit, inasmuch as currents are admitted at two input terminals and are transmitted to two output terminals. During the transmission of these currents, there are certain losses in power, the losses in direct current being usually due only to the resistance of the conducting wire, while losses in alternating current are due to inductive and capacity reactances as well as the resistance of the filter. Depending on the size and arrangement of the elements making up the filter, it is found that alternating currents of some frequencies suffer large energy losses, while currents of other frequencies are transmitted with almost no loss. On the basis of loss-frequency characteristics, we can make the following brief classification of the common types of simple filters.

High Pass Filters. These filters transmit, at considerable loss, frequencies between zero and a calculated frequency called the cut-off frequency, while all frequencies above this cut-off frequency are transmitted with relatively small loss.

Low Pass Filters. These transmit with very little attenuation (loss), frequencies between zero and the cut-off frequency, but cause appreciable losses to frequencies above the cut-off frequency.

Band Pass Filters allow the frequencies lying in the band between two given cut-off frequencies f_1 and f_2 to pass with very little loss, while frequencies below f_1 and above f_2 are effectively cut off.

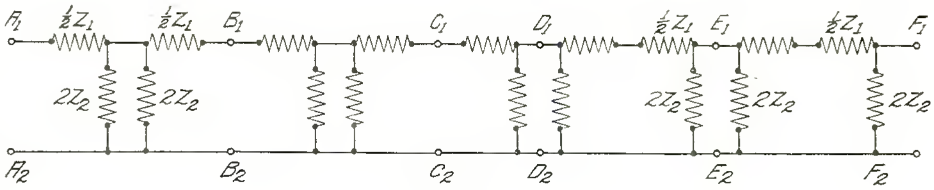


FIG-1

Band Elimination Filters bar the passage of frequencies between f_1 and f_2, but permit frequencies below f_1 and above f_2 to pass with very little attenuation.

Since it is evident that in every transmission line, even one whose terminal equipment has been removed, there are always series resistances and inductance reactances between the source of energy and the distant terminal, also shunt leakance and capacitance between the transmitting wires themselves, it has been found particularly useful to represent a transmission line as shown in Figure 1.

Assuming that the series and shunt impedances of the original transmitting line were uniformly distributed (as must be the case in a well designed line), an increasingly large number of uniform ladder like sections may be derived by making the value of the unit series impedance Z_1 as small as we choose. Each of these sections is symmetrical, and is identical with the section joining it. Thus, if currents entered A_1A_2 and came out at B_1B_2, or had they entered B_1B_2 and come out at C_1C_2, they should, in either case, have traversed a symmetrical section which, because of its resemblance to the letter T, is called a T section. However, if they had entered D_1D_2 and had come out at E_1E_2 or F_1F_2, they should have traversed one or two symmetrical π sections, so called because they resemble the Greek letter π (Pi). As far as the actual nature of the line is concerned, it makes no difference whether it is regarded as being made up of T sections or π sections. What determines the choice of sections is usually the nature of the terminating equipment. If the electrical circuit structure of the load can be represented by a T section, then it will be well to calculate the transmission line as if it were made up of T sections. As a rule, where the terminating equipment is a pure resistance or an impedance whose absolute magnitude is the only known quantity, it is advisable to use T sections. However, if the phase differences are known, or the designer feels otherwise justified, π sections may be more practical. A line which is made up of π sections can be made to behave in every respect like a line made of T sections if the first and last π sections are connected to the terminating equipment by an L or half section. This will be described later.

It has been found that power is most efficiently transferred from the source of energy to the load when the effective impedance of the source of supply is equal to the effective impedance of the load. We must be careful, therefore, to make the impedance of each filter section equal to the impedance of the section following it, since each section may be regarded as a source of current supply to the section following it. Furthermore, this recurrent impedance, called the characteristic impedance, must be made equal to the final terminal impedance, or impedance of the load.

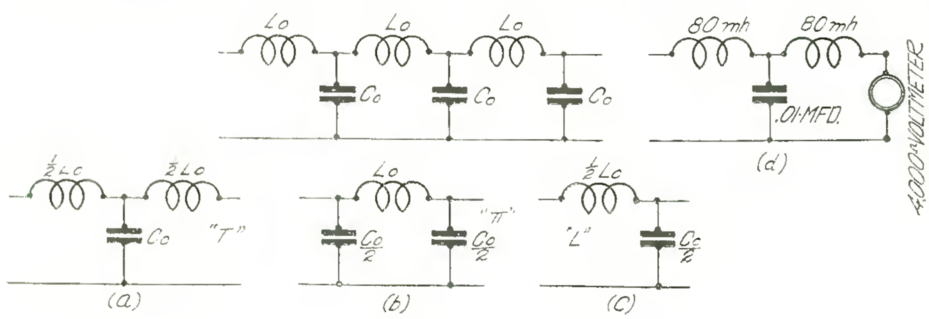


FIG.-2

If we were to look at one of the end terminals of a line made up of π sections, we should find that the terminating element is a shunt impedance Z_2, whereas the terminating element of a T structure is a series arm $\frac{1}{2}Z_1$. In view of this difference, we might also show that the ratio of the voltage to the current at the terminals of a π structure is not the same as the ratio of the voltage to the current at the terminals of a T structure. Since we know from Ohm's Law that the ratio of the voltage to the current is the impedance. i.e.,

$$\frac{E}{I} = Z \text{ (or R for direct current)},$$

we are simply saying that the impedance of the terminals of a π structure is not necessarily the same as that at the terminals of a T structure. We must be judicious, therefore, in our choice of the kind of section which is to match the terminating impedance. In order to minimize this difficulty, the filters described in this article are designed on the basis of what is to be the impedance of the terminal structure (the source of current at one end or the load at the other), rather than what appears to be the characteristic impedance of either T or π sections.

Low Pass Filter

In figure 2 we have the basic structure of a low pass filter. This filter, as we have observed before, passes low frequencies up to a certain desired cut-off frequency, and causes considerable losses to frequencies above this cut-off point. When the cut-off frequency and the terminal impedance are known, we shall be able to obtain, by substitution in simple formulas, the values of the basic elements L_o and C_o, and may promptly derive T, π, and half sections by inserting these values as shown in 2 a, b, and c.

If we have decided at what frequency we wish to have the cut-off f_c, and know the impedance of the terminating structure, which we call Z_o, then

$$L_o = \frac{Z_o}{\pi f_c} \quad \text{and} \quad C_o = \frac{1}{\pi f_c Z_o}$$

where π is the familiar constant 3.1416
L_o is the inductance in henrys of the coil required
C_o is the capacity in farads of the condenser required

If, on the other hand, we have a filter whose basic element values are known, and we wish to find the cut-off frequency and the most efficient terminal impedance for this particular filter, we have,

$$f_c = \frac{1}{\pi\sqrt{L_o C_o}} \quad \text{and} \quad Z_o = \sqrt{\frac{L_o}{C_o}}$$

By way of example, let us assume that we have a circuit in which voice frequency currents are being used to modulate other currents of radio frequency. Suppose it is necessary to insert a high frequency voltmeter in this circuit in order to keep a visual check on the voice frequency power level. It is conceivable that stray induced radio frequency currents might enter the voltmeter, and being of comparable magnitude to the voice currents, might cause a constant high reading of the voltmeter. To prevent this we must design a low pass filter which will efficiently transmit currents of voice frequency, say up to 8,000 cycles, but will inflict heavy losses on frequencies above 8,000 cycles. We find that the impedance of the voltmeter (which is regarded as the load impedance) is 4,000 ohms, and is almost pure resistance. Since we have decided that 8,000 cycles is to be the cut-off frequency, f_c, we have only to substitute in the formulas given above to get:

$$L_o = \frac{Z_o}{\pi f_c} = \frac{4000}{3.1416 \times 8000}$$

$L_o = .159$ henrys

$$C_o = \frac{1}{\pi f_c Z_o} = \frac{1}{3.1416 \times 4000 \times 8000}$$

$C_o = .00000001$ farad

There are 1,000 millihenrys to one henry, so for L_o we move the decimal point to the right three places (the number of naughts in 1,000) and get the expression $L_o = 159$ millihenrys. There are 1,000,000 microfarads to one farad, so for C_o we move the decimal point six (the number of naughts in 1,000,000) places to the right and get the expression $C_o = .01$ microfarads.

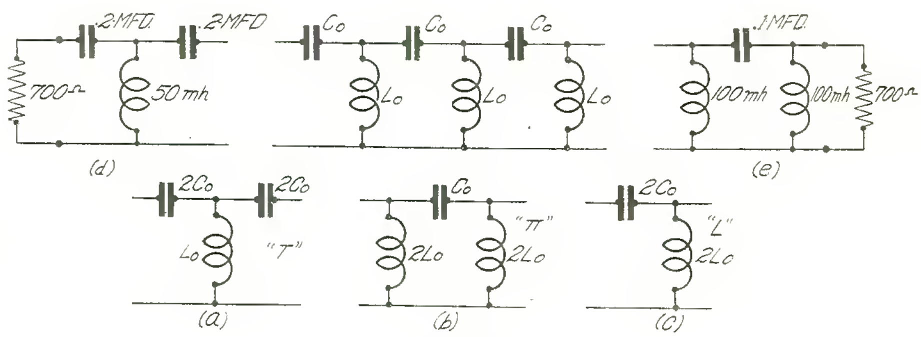


FIG.-3

(*Continued on page* 41)

Jewell 563 Modulated Oscillator

By F. L. Sprayberry

MOST service men think of an oscillator as having a very limited field of application whereas it is really a very versatile instrument. It not only may be used to furnish an accurate modulated signal for the purpose of aligning the tuning circuits of a modern receiver, but it may also be used to indicate best grid bias for maximum gain, the proper coupling of circuits, number of primary turns, condition of tubes, best value of voltage and currents, best condition for detection and in addition to these it has many other practical uses.

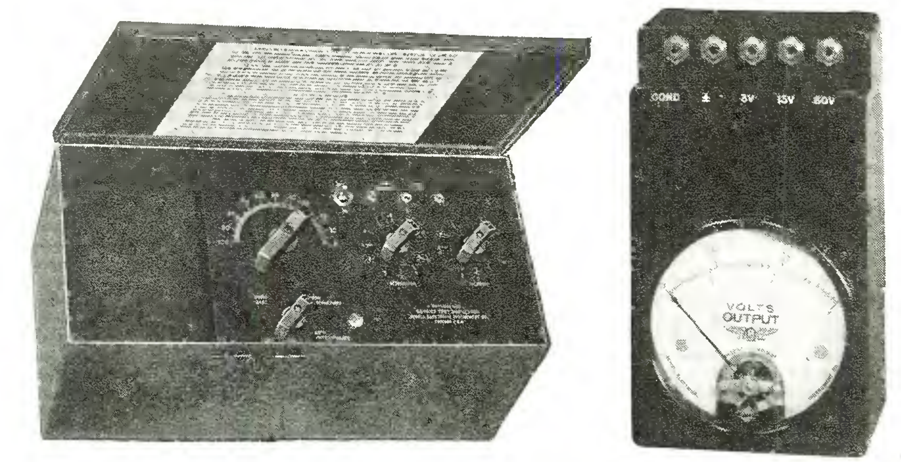
In fact, one of the largest receiver manufacturers in the country is recommending that tubes be tested in the receiver in connection with a modulated signal and output indicator. This manufacturer realizes that the best test that can be given a tube by the service man is one involving the tube under actual working conditions. Details of this test will be given later. The Jewell 563 modulated oscillator is ideally suited to furnish the signal for such tests. It is reasonable in price and comparatively small and compact in size so that it is not difficult to carry around from job to job. A compartment is also provided for the 559 output indicator. It has the further advantage that it may be recalibrated by the service man at a main division on the dial. If you have an occasion to work on a large number of superheterodyne receivers, having any intermediate frequency other than 175 kc., it is quite possible that the calibration will be such as to be at an intermediate point on the dial, as for instance 12.5 on the dial may represent 180 kc. However, it would be much more convenient to have 10 represent this value. In view of this the manufacturers have provided an adjustment so that the service man may recalibrate the oscillator for any standard intermediate frequency and this frequency falls at an exact main division on the dial. Ordinarily the factory calibration is such that 175 kc. falls at a main division, as that frequency is most commonly used.

The oscillator is calibrated on three frequency bands. For the broadcast band it is between 500 and 1500 kc., for the low intermediate band it is between 130 and 180 kc. and for the high intermediate band it is between 175 and 275 kc. Thus every frequency band found in the modern broadcast receiver is adequately covered. The oscillator may be accurately adjusted to give any frequency in the range of these bands. Coupling between oscillator and receiver is accomplished by means of a special shielded lead so the coupling medium will not radiate energy to exposed portions of the receiver wiring. This shielded lead also prevents the coupling system from picking up any other stray frequency from another source and feeding it into the input of the receiver. As the oscillator itself is well shielded only the correct frequency may be fed to the input of the receiver.

No oscillator is of practical value to the service man unless some kind of output indicating device is used. The Jewell 559 output indicator is recommended for use in connection with the 563 oscillator. However, if the Jewell 444 analyzer is available the output indicator of it may be used. In case an older type Jewell analyzer is at hand the milliammeter of it may be connected in series with the plate circuit of the detector to act as an output indicating device.

The milliammeter method is applicable to most receivers; however, it does not take into consideration the amplification of the a-f tubes. Also, if for instance the r-f or i-f circuits are out of alignment badly or if there is a defective tube or other abnormal condition present, a very weak signal only may get through to the detector tube and it may not have the strength to properly actuate the needle of the milliammeter. However, in the case of a regular output indicator the signal applied to it is amplified considerably and unless the receiver is absolutely dead, a reading of sufficient magnitude will be obtained on the output indicator. The use of the milliammeter also precludes the testing of the audio tubes. Therefore, it is easily seen that an output indicator which will read voltage across the output of the receiver is most desirable. In this case it is always possible to determine the condition of the audio tubes and better matching for the push-pull tubes is obtained.

The Jewell 559 output indicator has three ranges and covers adequately all conditions met in the service field. The low range is for connection directly across the terminals of a low impedance (8-15 ohm) dynamic speaker voice coil. The intermediate range is used for circuits of intermediate impedance such as the 500 ohm circuits to remotely located speakers. The high range is for connection from the plate of the output



tube (2000 ohms either tube of a push pull pair) to ground or across a magnetic speaker.

The service man of experience will perhaps remember numerous cases where there were complaints of loss of sensitivity and selectivity. The usual routine tests show that nothing is found to be wrong. In nine cases out of ten the only trouble is that the tuning condensers are slightly out of alignment. This is particularly true of receivers which have been in use for a year or more. To prove that such a condition exists, try out the next receiver that comes in for repair. If the receiver will operate at all, couple the oscillator to it and connect the output indicator properly. Then proceed to adjust the tuning condensers (directions for which will be given later) in the usual manner. In all probability you will find that as each tuning section is adjusted, an increased reading will be obtained on the output indicator, proving that the tuning circuits were slightly out of adjustment. Quite a bit of money may be made by the service man on making this adjustment alone. Offer to do

(*Continued on page* 40)

Globe About Cathode Ray Television

So much has been said and so little shown regarding the cathode ray tube that many hopes have been built up pending its introduction. Yet to those intimately familiar with the workings of both the cathode ray and the lens disc scanning systems, it becomes increasingly evident that until television broadcasters go to a greater number of lines, the latter system possesses many advantages which should not be overlooked.

In the first place, the real merits of the refined lens disc scanning system are realized by very few engineers and experimenters. The crude plain-hole disc, used in combination with the flat plate neon lamp, fails to provide the results now being obtained with the properly constructed lens disc and efficient neon crater lamp. The plain-hole disc produces relatively small images lacking in brilliancy. When enlarged by means of a magnifying lens, the images lack detail as well. Also, the scanning lines are too much in evidence in the form of an over-all pattern. To obtain a fair sized image, a bulky disc is required, making for an awkward cabinet job.

With the refined lens disc, however, a marked improvement is scored in mechanical scanning. First of all, the amount of light available for the construction of the images is several thousand times greater than with the plain-hole disc, because of the more intense luminosity of the crater lamp as well as the greater amount of light passed by the lenses. Thus it becomes possible to project a spot of light on a screen, which feature is hardly feasible with the plain-hole disc and flat plate neon lamp combination. By means of projection, large images are obtained. With a 14-inch disc, for instance, a good 4x5 inch image may be projected, while with a 20-inch disc an 8x10-inch image is entirely practicable. The lens disc of course must be properly made, with lenses carefully matched as to size and diameter, and accurately mounted so as to place their respective spots at the proper lines. With a precise lens disc, together with the improved crater lamp, a bright, detailed image is obtained, practically free from any trace of screen.

Due to the cost of the lens disc, most television receivers so far offered to the public have employed a plain-hole disc. Therefore, the entertainment possibilities of present-day television have been practically unknown to the public until now, when, at last, moderate priced lens disc receivers are becoming available. With reasonable production schedules, a good lens disc television receiver is available at the

(Continued on page 55)

WESTERN ELECTRIC FREQUENCY MONITORING UNIT

WITH the Federal Radio Commission's General Order No. 116, compelling broadcasters to remain within 50 cycles of their assigned wave lengths, to go into effect June 22nd, a device has been perfected by which stations can maintain a constant check on their frequencies and consequently correct their transmitters the instant it becomes necessary. The device is a "frequency monitoring" unit, designed for the Western Electric Company by Bell Telephone Laboratories.

The impulses from the transmitter are introduced into the monitoring unit, passed through a stage of amplification and into a detector tube. The unit contains a quartz crystal oscillator which oscillates at the assigned carrier frequency. The output from this oscillator is also passed through a stage of amplification and fed into the same detector. The output of the detector contains the beat note or difference frequency. This difference frequency is registered on a visual indicator kept under observa-

Monitoring Unit

The monitoring unit is small and compact, measuring only 12¼ by 13½ by 17 inches. Up to the present, more elaborate equipment has been needed to test the frequencies of transmitters. Most stations have been having periodic tests made by laboratories where such equipment is available. Now the Radio Commission order will not only compel strict adherence to assigned frequencies but also require that stations themselves have a method of checking their frequencies.

The monitoring unit can be connected into any stage of the transmitter or used entirely apart from it by means of an antenna. This flexibility is made possible by the fact that the input may come from either a modulated or unmodulated source without affecting the accuracy of the device.

tion by the station's technician.

A self-restoring button mounted on the front of the panel permits a small temporary displacement of the frequency of the monitoring oscillator. From this the operator sees on the same indicator whether the deviation shown is high or low with respect to that of the monitoring equipment.

Complete power supply for the vacuum tubes and crystal heater is included in the unit. The unit is entirely A.C. operated and the power source may be either the 110 or 220 volt, 50 to 60 cycle A.C., supply. The only power connection necessary to set the unit in operation is by cord and plug to the commercial power source.

In addition to being used directly on the transmitter under test, the monitoring unit may be connected to any but superheterodyne sets.

Building Small Power Transformers

(*Continued from page* 19)

finish a winding at the very edge from which the lead emerges, since it will pull out easily. Either cross the coil to the opposite end, or space the winding on the last layer or two so that it will fall at least half an inch from the edge.

Now start a layer of varnished cambric with a piece of tape and finish in the same manner. Cut the thin piece of brass or copper to be used as the static shield to cover the winding but not the full width of the entire coil. It had best be an eighth of an inch less at each edge to prevent its touching the core at any point. Solder the lead to it, and fasten the end with a piece of tape. Wind one turn, and have it long enough to overlap the beginning of the turn by about half an inch. Start another layer of varnished cambric well before the end of the metal to make certain the shield does not touch itself at the finish, and complete the layer of cambric to entirely cover the metal shield so that none is exposed to the next winding which will be the high-voltage secondary of fine wire.

This wire for the high-voltage secondary winding will be of small size, and care must be used in winding it to prevent frequent breaking. If a break does occur, scrape carefully, solder smoothly, and make the joint come on one of the faces which will not be under the laminations. Tear a small piece of glassine paper and put it under the joint, and another over it to add extra insulation. A small space in the winding should be left each side of the splice to prevent any danger of shorting to adjacent turns. After the first layer, use glassine paper between layers as in the case of the primary winding. Also limit the winding width to the same end clearances as in the case of the primary coil. Since this wire is so fine, it is not advisable to use it for the leads. Instead, a piece of well insulated hookup wire should be soldered to the ends, and small pieces of varnished cambric placed above and below the joint before taping in place at the beginning, tap, and end of the winding. Do not be afraid to use varnished cambric, since it is the best insulation in common use, having a better rating than even mica for the same thickness of material. Spaghetti need not be used over these insulated leads unless extra precautions are desired to be observed.

To prevent confusion of leads, it is well to make out a little table by insulation colors for the high voltage leads and center taps of the filaments which will also be of insulated hookup wire. If more than one filament winding uses the same size of wire, tabs of adhesive tape with letters or numbers written on them in pencil or ink may be used to denote the different windings.

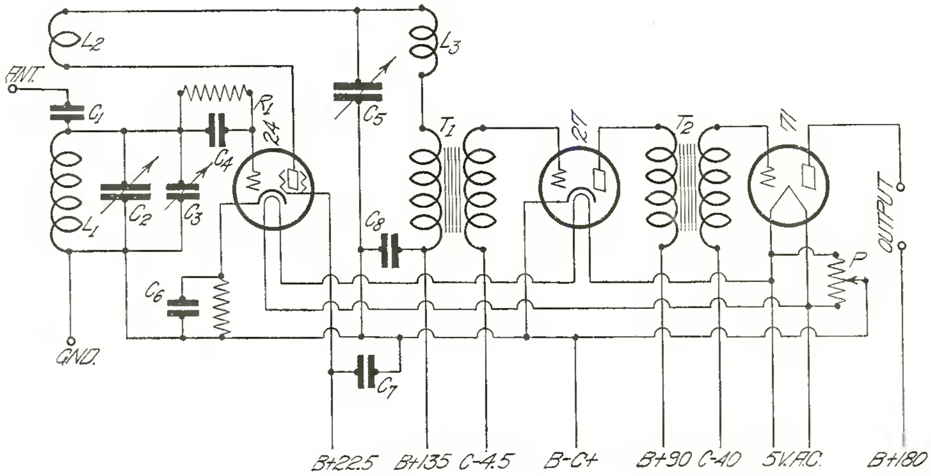
The final windings are those for the filaments, including the rectifier. Over the secondary, two layers of varnished cambric should be wound. It will be found that some difficulty may be encountered in fastening the heavy wire firmly at the ends, but, with care, and sufficient tape, it can be done satisfactorily. As with the primary winding, use spaghetti and run the start of the winding the width of the coil so that in winding over it, it will be firmly fixed in place. Be sure and allow sufficient spacing between rectifier and other tube filament windings since this voltage difference is the greatest in the transformer when in use. Better still, wind a narrow strip of varnished cambric half of its width on the filament winding, and half on the unwound portion. Start the next filament winding next to this filament on the narrow strip of cambric which will give adequate insulation.

It would probably be best to wrap several complete turns of tape about the coil after the filament windings are in place. To finish, paste two or three layers of gummed tape tightly around the coil. It is now ready for the impregnation in beeswax and rosin. After cooling, it may be laminated and tested. The beeswax and rosin should be hot, but not hot enough to scorch. This may be determined by first holding a piece of white paper in the mixture for an instant, and then a second piece for five minutes. If the second is darker than the first, the mixture is too hot and should be allowed to cool somewhat until no difference in color is discernible. Leave the coil in the bath for at least thirty minutes to expel all of the air possible, and to allow complete saturation. Then the coil should be hung up to drip and cool. After it is cool, the ends may be filled evenly by pouring the necessary amount of wax on them without warming the remainder of the coil.

To laminate, the coil is placed on its side, and the *E* laminations inserted from each side alternately. Do not put the *I* sections in at the same time because the core cannot be made as tight as without them. The last laminations should be pushed in by hand, never driven, since they will probably cut through the core tube in the corners and may shear off the first or second layer of the primary winding. Due to clearance of the tube used, no difficulty should be experienced in getting the required thickness of core if the tube is not warped or bent out of

(*Continued on page* 39)

3 TUBE S. W. RECEIVER



Bill of Parts

C_1—two 1″ squares 1/8″ apart.
C_2—five plate variable condenser.
C_3—midget condenser.
C_4—.0001 mica condenser.
C_5—nine plate variable condenser.
C_6—1 mfd. bypass condenser.
C_7—1/2 mfd. bypass condenser.
C_8—1/2 mfd. bypass condenser.
L_1—30 turns No. 28 d. c. c.
L_2—9 turns No. 28 d. c. c.
L_3—radio frequency choke.
R_1—1/2 megohm resistor.
R_2—potentiometer.
T_1—5 :1 audio transformer.
T_2—3 :1 audio transformer.

Tubes heated from 5 volt center-tapped transformer. 24 and 27 tubes in series, 71 across whole winding.

Practical Filter Design

(*Continued from page* 35)

We have just said that it is advisable to use T sections in the calculation of nearly all lines which terminate in a pure resistance load. Consequently, our filter section should be derived like the one in Figure 2a. Each of the series arms is made up of half of the total inductance L_o, so the value of each arm is $\frac{1}{2} \times 159$ or 79.5 millihenrys. For our purposes this might as well be 80 millihenrys. The shunt element is simply C_o or .01 mfd. The complete filter section and load appears in figure 2d.

High Pass Filter

Should it be necessary to design a filter which will efficiently pass high frequencies and yet bar low frequencies and direct current, we find the process very similar to that of designing a low pass filter. Certain differences, however, are at once apparent in Fig. 3. The series impedances are made up of capacitance in this case, whereas the shunt arms are inductance. This seems reasonable, because it is the low frequencies which we expect to suppress, and we know that low frequencies will encounter much difficulty in passing through the condensers in series, whereas they will readily shunt themselves out through the inductance.

If we know the desired cut-off frequency f_c and the terminal impedance Z_o, the values for C_o and L_o may be found directly, since

$$L_o = \frac{Z_o}{4\pi f_c} \text{ and } C_o = \frac{1}{4\pi F_c Z_o}$$

If it happens that we already have a filter with basic values L_o and C_o known, and we wish to know what will be the cut-off frequency and the most efficient terminal impedance, these are found to be

$$f_c = \frac{1}{4\pi\sqrt{L_o C_o}} \text{ and } Z_o = \sqrt{\frac{L_o}{C_o}}$$

The basic elements of a high pass filter designed to fit a 700 ohm terminating impedance Z_o, and having a cut-off frequency of f_c of 1125 cycles, for example, would be

$$L_o = \frac{700}{4 \times 3.1416 \times 1125} = \frac{700}{14{,}137}$$

$L_o = .050$ henrys or 50 mh.

$$C_o = \frac{1}{4 \times 3.1416 \times 1125 \times 700}$$

$C_o = .0000001$ farads or .1 mfd.

The complete T and π sections having the characteristics of this filter are shown in Figures 3d and 3e.

In the next issue of this magazine we expect to discuss some simple methods for the design of band pass and band elimination filters. There are also presented in Part 2 some types of filter structures which may be derived from the low and high pass filters just described, such that by their use any desired loss characteristic may be produced.

Building Small Power Transformers

(*Continued from page* 38)

shape. Now the *I* sections are forced in at each end to fill the spaces left for them. After these are inserted, the filler wedges are driven in one at a time on each side of the core until the coil is tight. Be careful that they are driven between the inside of the winding tube and the core, and not through the windings. The transformer core may be made even by using a hammer and a block, and the core pounded until the *E* and *I* sections make close edge contact. If clearance was left on the edges of the winding, there will be no danger encountered in doing this. After testing, the bolts may be used for mounting the transformer. Should some of the wax run out after operation for a period of time, no anxiety need be felt unless the transformer becomes much too hot to touch, or if the wax boils out in quantities and smokes. This wax may have a low melting point and flow at a temperature not at all high for the transformer itself. After the excess wax has run off, no further difficulty will arise.

Remember that one little oversight will mean undoing many hours of work, so be very careful in building up a transformer. This is especially true of taps and joints and splices. Always solder them well and use varnished cambric. Be sure that no sharp points are left after soldering, or any protruding wire which might be forced through the insulation. Remember to make all splices and taps and leads come from opposite faces, either end, so long as they do not come on the sides which will be under the core. A little added care in winding will give you a neat transformer, as good as any you could buy, and in addition to being cheaper, it will have been instructive and will be to your specifications. Always wind the turns next to each other, being careful not to ride over turns already wound, for the succeeding layer may be tight enough to cut the enamel and a short circuited group of turns would occur, making the transformer useless. The primary need not be the first winding, but it was found most convenient to wind the windings in the order given. Position makes no difference at all in the operation of the transformer.

Practical Designs

Let us design two practical transformers to illustrate the method in detail. Using the larger laminations shown in Figure 2, we find a square stack would be $1\frac{1}{2}$ inches on a side, or the area of the cross section would be $1.5 \times 1.5 = 2.25$ square inches. Using a stacking factor of 85%, the effective area is $2.25 \times .85 = 1.914$ square inches. For an additional factor to insure lenient design, we shall use 1.9 as the nearest convenient figure. Our power supply is 60 cycles, which is the common frequency. For the type of silicon steel used in the laminations, a flux density of 40 kilolines per square inch would give a transformer which would run very cool, 50 kilolines would not run objectionably hot, and 60 kilolines might be satisfactory if the ventilation afforded the transformer were exceptionally good. We shall, therefore, use 50 kilolines, since a lower flux density would mean more turns-per-volt, and we might have difficulty in getting the winding in the window space available in the laminations chosen. Our straight-edge then should connect the point corresponding to 1.9 square inches core area and 50 kilolines per square inch flux density. This would intersect the turns-per-volt scale at a value of 3.8. We have allowed tolerance on the kilolines density and may safely enough reduce this value to $3\frac{1}{2}$ turns-per-volt without objectionable heating. We now have all of the information we require for calculating all of the windings, and none of the subsequent problems are any more difficult.

Our primary voltage is 110 volts, that of the line supply, which, when multiplied by the number of turns necessary for each induced volt, gives $110 \times 3.5 = 385$ turns total. The wire size should be 23 or 24 gage, B. & S., to carry the primary current. The high-voltage secondary will be 400 volts on a side for full wave rectification, or a total of 800 volts developed, tapped at the center. For a half wave rectifier, the total voltage would be that specified. This gives the number of secondary turns as $800 \times 3.5 = 2800$, tapped at 1400 turns. The wire size may be either 30 or 31 B. & S. gage to carry the small secondary current. Larger wire would make the winding too large, and smaller wire than 31 gage would be too difficult to wind. (Remember that the shield was placed between the primary and secondary windings.) The rectifier filament for a 280 type tube is 5 volts, center tapped for the high voltage lead. The turns necessary will be $5 \times 3.5 = 17.5$ turns. Since filament voltages are not critical in that a lower voltage than rated voltage may

(*Continued on page* 41)

Progress in Recording Sound

(*Continued from page* 33)

in which we live. This selective process is made possible in part by the separation of the source of the noise from the source of the sound to which we are listening.

In the case of postephony, the microphone is not so discriminating and picks up the noise as well as the desirable sound, and furthermore, when a record is reproduced the sound and the noise must emanate from the same source—namely, the loud speaker. In this way you will see that the instrumental process of postephony is at some disadvantages compared with the natural process of direct hearing.

Our study of the problem of eliminating noises has drawn into a new field of acoustic engineering, which has to do with the treatment of rooms and public places for the purpose of suppressing noises on the one hand, and, on the other hand, making them properly receptive and responsive to the sounds that are desired.

A few examples may serve to illustrate the scope of this field. You have perhaps read of the study we have been making on subway noises for the Noise Abatement Commission in this city; and, as a corollary to that, one for a milk company here in an effort to suppress the noises connected with the delivery of milk so familiarly objectionable in the early hours of the morning. Churches, too, are seeking ways of making the spoken word more audible to congregations whose hearing appears peculiarly deficient as related to words of grace.

The results of similar studies made for the architects of the new Philadelphia Opera House have led to some fundamental features of design and treatment that will insure pleasing acoustics. How many public buildings have been constructed in the past with unsatisfactory acoustic qualities which might have been avoided with the application of our present day knowledge?

We rank as one of our most interesting projects the recent acoustical treatment of Madison Square Garden, which made it possible for the great Paderewski to give a piano recital there last month. His music was heard perfectly in every part of that vast auditorium, which was acclaimed by musical critics as an outstanding achievement.

In connection with modern records of music recorded, amplified and reproduced by modern electrical means we would invite your attention particularly to the definition as related to the various instruments. This definition is made possible by recording the full range of frequencies. When the upper and lower notes are missing, the instruments tend to sound alike and to flow together in the reproduction, but when all of the frequencies are present each instrument stands out in its true character and makes its proper contribution to the ensemble.

You will appreciate the importance of this improvement in naturalness and this ability to faithfully reproduce the speaker's personality when the science of postephony undertakes to make its contribution to dramatic art. Four years ago we ventured to prophesy that talking pictures would be applied to the fields of advertising, politics, education and religious teaching. Progress in these fields has been steady but somewhat slowed down by the business conditions of the past two years.

As was to be expected, the value of the talking picture for instructional purposes has been most quickly seized upon and most widely used in the field of commerce and industry. Many of the great corporations are using talking pictures today for the training and instruction of their personnel and for conveying the personal messages of their executives to outlying offices and branches of their organizations throughout the world. The epic story of many industries is being recorded and portrayed. Through these we may attain to an understanding of how these great industries came into being and why they exist and to understand these things is to interpret the forces that underlie our modern life and civilization.

Already talking pictures have been made to advertise commodities of everyday life. The cough that is never present in a carload can be recorded in talking pictures. The man who owns one can tell of his satisfaction with his motor car. Railroads, airlines, trade associations, insurance companies, newspapers and public service companies have used this medium to advertise their services and to create public understanding and goodwill.

Manufacturers, department stores, banks, hotels, theaters and other industrial and business organizations are using talking pictures to train their employees—churches to train their ministers and schools to train their teachers; athletic coaches to teach games; Bobby Jones to teach golf; Bill Tilden to teach tennis.

In closing we may say that we regard talking pictures as, in reality, a means of communication, whereby the art and inspiration of great actors, teachers, preachers, and statesmen may be carried from the sphere in which they move, to the ever widening sphere of world interest from the metropolis to the hamlet, from the great university to the country schoolhouse, from the cathedral to the parish church, from this generation to future generations who may find in the better understanding of our lives, our achievements, and our dreams, of our personalities and characters the inspiration and example that will lead them to a still higher civilization in the days to come.

Photronic Cell Experiments

(*Continued from page* 30)

the round, black cover. Access to the terminals is obtained simply by removing the fiber disc which forms the base of the relay.

The Photronic Cell should be placed where it will receive a maximum amount of light, preferably near a window normally exposed to the sun or at least to the open sky. The relatively large output obtained by placing it thus, assures the reliable operation of the relays, which may be grouped in any convenient location near the Cell, or at some distance, if preferred.

After the proper connections have been made, and as soon as the room in question is sufficiently dim to warrant the use of artificial light, the Weston Photronic Relay may be set for automatic operation. With the line voltage (not over 120 volts) on, carefully adjust the screw in the face of the sensitive relay until the small arm just makes contact and the lamp lights. A soft, but distinct, click from the Power Relay is positive indication that good contact has been made, and should this occur without the lighting of the lamp, it is evident that the fault lies somewhere between the output connections of the Power Relay and the lamp itself rather than between the Power Relay and the Photronic Cell.

Of course, the lamp may be cut out of the circuit at any time and worked independently of the relay system by means of the throw-over switch indicated on the diagram, and the automatic feature may be used only when required.

Jewell 563 Modulated Oscillator

(*Continued from page* 36)

this for a few of your customers who have receivers a year old or more. In most cases you can readily prove to them that you have done them a real service. Incidentally you can also make a large number of tube sales this way, for you can prove right in the presence of your customers that a new tube or tubes will give an increased reading on the output indicator, indicating that the original tubes were defective or weak.

(*Continued on page* 56)

Building Small Power Transformers

(*Continued from page* 39)

be used, the next lower even number of turns will be used. However, it must be remembered that the high current carried by all filament windings will cause a noticeable drop, so, rather than to use 16 turns, we shall wind 18 turns, tapped at 9. This wire need be about 18 gage.

Finally we have the filaments or heater windings of the tubes proper. One 2½ volt winding may be used to handle 10 tubes if the filament wiring in the set is of 14 gage hook-up wire. Or the power tubes may be heated from a second filament winding, identical with the first if the filament voltage rating is the same. The turns required will be $2.5 \times 3.5 = 8.75$ turns, half that of the 5 volt winding. We should choose 8 turns as the nearest even number, and tap at 4 turns for the midpoint connection. For any number of tubes over three or four, wire of 14 gage will be satisfactory. If only two tubes are used, 16 or even 18 gage will carry the load without undue heating.

Any other voltages may be obtained by multiplying the required voltage by the turns-per-volt and choosing a size of wire which will carry the required current. It should also be noted that a transformer of the above specifications operated satisfactorily with a lamination stack of only 1¼ inches thickness instead of 1½ inches. This was occasioned by the winding tube available at the time. In other words, allowing sufficient safety factor in the original designing permits minor changes necessary because of materials available.

Though no difficulty should be encountered in designing a filament transformer or any other transformer after understanding the above detailed information, the following design is illustrative of the general procedure with low voltage transformers. The second type of lamination will be sufficiently large for most requirements. A square lamination stack would be 1¼ inches on a side, or have an area of $1.25 \times 1.25 = 1.57$ square inches. The stacking factor of 85% gives an effective area of $1.57 \times .85 = 1.43$ square inches. We shall use 1.4 square inches on the chart, and 50 kilolines flux density per square inch of area. The straight-edge gives an intersection of 5.2 turns-per-volt, and we shall assume that 5 turns per volt is accurate enough for all practical purposes.

A 110 volt primary of 23 or 24 gage wire would have $110 \times 5 = 550$ turns. A 5 volt filament would have $5 \times 5 = 25$ turns, which would be used as 24 turns, tapped at 12 for the center. A 2½ volt winding would have $2.5 \times 5 = 12.5$ turns, for which we would substitute 12 turns, tapped at 6 for the center. Remember that under load, the voltages will be less than those rated for the tubes, but in most cases satisfactory operation and longer filament life may be expected if a 2½ volt heater is operated at 2.2 or 2.3 volts. Likewise, a 280 rectifier will operate satisfactorily on 4.3 to 4.5 volts.

It is now quite obvious that, if the stack area is increased, the turns-per-volt required are decreased. Therefore, a thicker lamination stack must be used if the required windings are too bulky for the window size. Clearing Radio Laboratory, 5424 West 64th Street, Chicago, has available the two types of laminations illustrated, winding tubes, varnished cambric, glassine paper, wedges, etc. (but not wire), for transformer construction. Details and prices may be obtained directly from them. They also wind small special power transformers to specifications in small lots for experimental and other purposes.

Standard Transformer Service

WITH the development by the Standard Transformer Corporation of their exact-duplicate Stock-replacement transformer division, those upon whom the obligations of service fall, have for the first time in the history of the industry, a source from which may be secured these vital parts for practically any make or model of standard receiving set now in operation.

Today, as this issue of Radio Call Book Magazine goes to press we have seen a listing of the Standard Transformer Corporation numbering fifty-three exact-duplicate power transformers for twenty-one makes and models of receiving sets; eight audios and chokes for twenty-four models of one well-known set alone; a comprehensive number of audio transformers for intermediate and push-pull stages; output transformers for single tube and push-pull stages; filter chokes and three types of universal power transformers adaptable to the sets made by practically every radio manufacturer in the United States, all stocked in adequate quantities to assure immediate shipment.

In the installation of these units no re-drilling, re-wiring or haphazard and unsightly work is required of the service man. The electrical characteristics as well as the physical of the original unit are identical and balanced with every other element in the set to assure restoration of the original performance of the set in every detail.

In telling us of this most recent development of his company's activities, Mr. Jerome J. Kahn said: "Since informing those groups of the industry most interested in this servicing matter, of our work in this direction, we have been more than justified in our conviction that this was a service long needed by dealers and service men, judging from the response we have received."

Voltage Analyses Charts

Kolster, K-80, 82

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.		185	.4*	48	2.5	80
27	Osc.		80	0 *	52	6.0	
24	1st Det.		185	5.5*	58	.6	80
35	I. F.		195	.2*	44	1.0	90
24	A. V. C.		15	.5*	—60	0	44
27	2nd Det.		150	15.*	75	.6	
47	P. P.		225	12*		30	245
47	P. P.		225	12*		30	245
80	Rect.					48–48	

RCA Radiola Superette R-4

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.66	260	3	3	3.0	65
27	Osc.	2.66	60	0	3	5.0	
24	1st Det.	2.66	260	5.5	6	.75	60
35	I. F.	2.66	260	3	3	3.0	65
27	2nd Det.	2.66	250	10	25	1.0	
47	Output	2.66	280	10		35	290
80	Rect.						

Gulbransen 13

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.		238		2.1		66
24	1st Det.		233		15		67
35	I. F.		237		2.1		66
24	2nd Det.		145		15		67
27	Osc.		82				
47	Output		220	3*			240
80	Rect.		250				

Silver-Marshall R

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	1st Det.	2.5	244		15		92
51	2nd I. F.	2.5	238		2.6		92
51	3rd I. F.	2.5	238		2.6		92
27	2nd Det.	2.5	154		20		
27	2nd Det.	2.5	154		20		
47	Parallel	2.5	198	16.5			
47	Output	2.5	198	16.5			
27	Osc.	2.5	92		4.0		
27	A. V. C.	2.5			—40		
80	Rect.	5.0	244				

Howard O

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.20	176		3.5	5.5	92
27	Osc.	2.10	92		3.5	2.5	
51	1st Det.	2.20	170		8.0	2.5	85
51	I. F.	2.20	170		3.5	5.0	85
27	2nd Det.	2.20	157		16.0	6.6	
47	Output	2.35	250	20		24.5	260
80	Rect.	4.60				42–42	

Silver-Marshall F

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
24	1st Det.		246		8.0		92
27	Osc.		92		8.0		
51	I. F.		246		3.2		92
51	I. F.		246		3.2		92
27	2nd Det.		200		23.0		
47	Output		232	16.5			258
80	Rect.		360				

Voltage Analyses Charts

Howard AVO

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.30	170		3		87
27	Osc.	2.31	80		9		
35	1st Det.	2.33	167		7		83
35	I. F.	2.37	172		3		87
27	2nd Det.	2.36	162	16.5			
47	Output	2.50	235	16.5			255
80	Rect.	4.80					
27	A. V. C.	2.50			100		

Silver-Marshall A

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.		252		3.2		95
24	1st Det.		252		17.0		95
27	Osc.		95		17.0		
51	I. F.		252		3.2		95
51	I. F.		252		3.2		95
27	2nd Det.		195		21.0		
47	Output		244	16			254
80	Rect.		315				

Bosch 20

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.2	225	3	18	3.5	90
27	Osc.	2.2	60	0	0	5.0	
51	1st Det.	2.2	225	7	8	2.0	80
51	I. F.	2.2	240	3	4	4.0	80
27	2nd Det.	2.2	130	15	0	1.0	
47	P. P.	2.2	240	16		30	240
47	P. P.	2.2	240	16		30	240
80	Rect.	5.0				38–38	

Freed-Eisemann FE-98

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.5	240		3	6.0	90
24	1st Det.	2.5	240		10	.2	90
27	Osc.	2.5	90			2.7	
51	I. F.	2.5	240		3	6.0	90
24	2nd Det.	2.5	125*		10	.1	40
47	Parallel	2.5	235	16		31	240
47	Output	2.5	235	16		31	240
80	Rect.	5.0					

Silvertone 1462

Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
35	R. F.	2.4	160		1.5	5.0	58
35	1st Det.	2.4	160		10	1.0	58
27	Osc.	2.4	55				
35	I. F.	2.4	160		1.5	5.0	58
24	2nd Det.	2.5	80*		6.0	.2	40
47	Output	2.6	242	18		26	250
27	A. V. C.	2.5	48				
80	Rect.	5.0	370				

Howard H

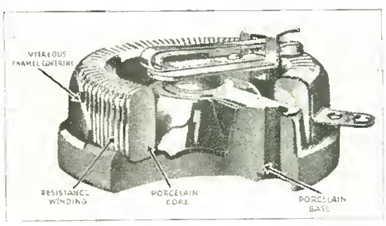
Tube	Position	Fil. Volts	Plate Volts	Grid Volts	Cath. Volts	Plate Ma.	S. G. Volts
51	R. F.	2.40	170		3.5	5.0	80
51	1st Det.	2.30	167		7.0	2.0	82
27	Osc.	2.30	87		5.5	3.0	83
51	I. F.	2.35	165		3.5	5.0	
27	2nd Det.	2.35	137		15.5	.6	
47	P. P.	2.35	237	16		30.0	260
47	P. P.	2.35	237	16		30.0	260
80	Rect.	4.60				65–65	

NEW PRODUCTS FOR THE TRADE

Ohmite Bulletin Number 12

D. T. Siegel, general manager, Ohmite Mfg. Co., 636 N. Albany Ave., Chicago, announces the publication of the Ohmite rheostat bulletin No. 12, an eight page booklet which illustrates and describes the models J and L Ohmite all-porcelain rheostats.

The bulletin makes use of section and detail drawings to illustrate very clearly the features of these rheostats, which include an all-porcelain construction, vitreous enamel covering, and metal impregnated carbon-graphite contact.



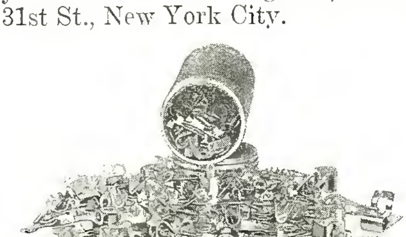
The illustration shows the details of the Ohmite rheostat construction. The resistance wire is wound around the solid sturdy porcelain core in such a way that it is completely insulated and protected by the vitreous enamel covering. With this type of construction it is virtually impossible for the wire ever to become loose or to slide on the core. The enamel, besides insulating the wire and locking it firmly in place, quickly conducts away the heat generated in the winding, and insures against overheating.

These rheostats are listed in two sizes, the model J, 50 watt unit, and model L, 150 watt unit, in a complete range of resistance values from 1 ohm to 35,000 ohms. A list of the stock values is given in the bulletin together with information about cages, tandem mounted rheostats, rheostats with special windings, and rheostats equipped with switches.

Bulletin No. 12 should be in the hands of every electrical engineer and manufacturer who is interested in the latest developments in his field. Copies will gladly be sent upon request.

Zierick Assortment

An assortment of 500 terminals and lugs, including battery clips and screen grid caps, is now being put out by the F. R. Zierick Mfg. Co., 68 East 131st St., New York City.



This assortment will be found valuable for the engineering departments of all radio, television and electrical concerns. Price, $1.00.

A New Radio Parts Company

Several months ago, a new parts company was formed by executives well known to the radio industry. No announcement was permitted until the factory was equipped and in production. The newcomer is Solar Mfg. Corp., 599 Broadway, New York City. Otto Paschkes, former president of Polymet Mfg. Corp., and Paul Hetenyi, until recently executive vice-president and chief engineer of Polymet, have been the prime-movers in Solar. They have associated with them a picked personnel from the parts industry.

Solar is specializing in the manufacture of all types of wet and dry electrolytic condensers and molded mica condensers. Other products will be added to the line as engineering developments are completed.

New B Battery Eliminator

In addition to manufacturing winterfronts and other quality products for automobiles, the Pines Winterfront Co. recently announced a new auto accessory, the Pines battery eliminator for auto, bus, motorboat and airplane radios.

Pines B battery eliminator is simple and rugged in its construction and there is nothing to get out of order, oil or grease. It consists of a motor in connection with a special rotary transformer. It takes the current from the regular A battery, steps it up, rectifies and filters it, delivering to the set a constant d-c current.

The installation of the new Pines B battery eliminator is simple. It requires a space of 5⅜x8 inches, only only 6¼ inches deep. This is approximately one-third the space required for the ordinary B battery which this eliminator now replaces. Its total weight is fifteen pounds, including a special heavy metal container, which protects it from all possible damage.

New Triad Tubes

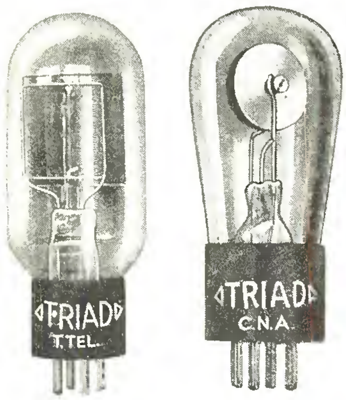
Triad Mfg. Co., Inc., Pawtucket, R. I., announces two new television tubes, illustrations of which are shown.

A tube known as the Crater neon arc type has been developed to supply the necessary light service for projecting television programs on suitable screens. The word "Crater" is used to describe the way the arc or ionization of the neon gas is produced. The tube consists essentially of two electrodes mechanically mounted within a few thousandths of an inch from each other. One electrode is known as the target and has a hole approximately .025 inches through it and it is through that hole that the intense

NEW PRODUCTS ITEMS

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

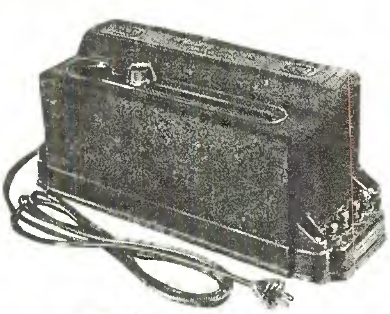
beam of light is projected on to the lens type scanning disc. Approximate striking voltage 180. Maximum current 40 milliamperes. Approximate Crater light source .030″.

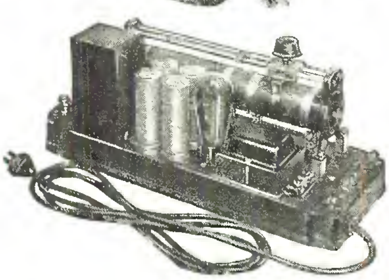


The T-Tel television tube is designed for use with the scanner giving maximum brilliancy with lowest current consumption; 1½″ plate, approximate striking voltage 190, maximum current 25 milliamperes.

G-M Laboratories DC Power Supply

A new d-c power supply to furnish high d-c voltages from the standard 110 volt 60 cycle lighting circuit is announced by the G-M Laboratories, Inc., 1735 Belmont Ave., Chicago. Equipped with a potentiometer control, this new unit makes it possible to obtain voltages ranging from 0-270 volts in minute steps.





In laboratories carrying on research and doing electrical and scientific work, this new d-c power supply will be found extremely convenient as a substitute for dry batteries. It can be used to replace as many as six heavy duty B batteries, with the assurance that its output will remain constant with age. Housed in a finely finished cast aluminum case and constructed of the highest quality parts available, it can be relied upon to give long and dependable service.

Two extra binding posts (No. 3 and No. 4) can be so connected as to supply any desired voltage within the range of the instrument. A special clamp provided can be set so as to limit the voltage available from binding post No. 2. Binding Post No. 1 is negative or zero terminal.

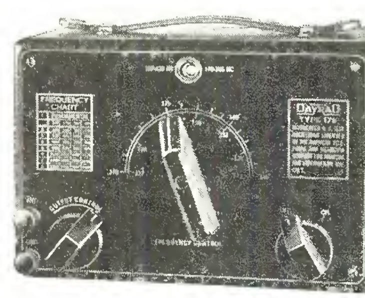
Due to proper design of the transformer windings and the arrangement of chokes and condensers, the d-c output voltage regulation over a wide range of load current is very satisfactory.

Further information on this new unit can be obtained from the manufacturers by writing for bulletin No. 147.

Day-Rad Type 175 Test Oscillator

Radio Products Co., Dayton, Ohio, announces their type 175 test oscillator for all intermediate frequency alignments between 170 kc to 185 kc, 127 kc to 133 kc, 254 kc to 266 kc.

Powerful harmonics are developed using this instrument for accurate alignment of stages in the broadcast spectrum from 550 to 1500 kc.

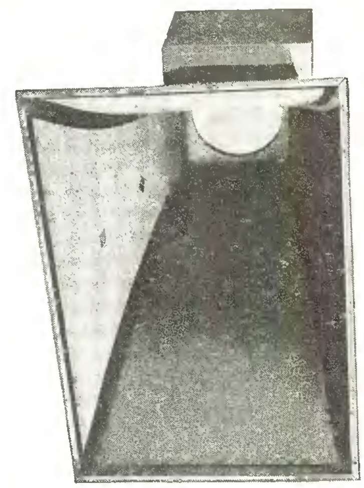


This is a self-modulated radio frequency oscillator, which generates signals in the intermediate frequency bands. Harmonics of these signals are utilized when the oscillator is used to align r-f stages in the broadcast band. This oscillator is provided with a variable output control for governing the amount of radio frequency energy to be supplied to the receiver. Shielded dummy antenna and input adapter are supplied with the instrument.

The case is of cast aluminum and arranged to receive batteries and tube, making the instrument totally shielded. Requires 5156 Burgess B battery, 2 No. 2 flashlight cells and one type 30 tube. For further particulars write direct to the manufacturer.

Wright-DeCoster Loudspeakers

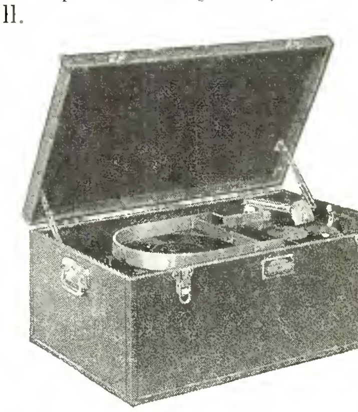
Wright-DeCoster, Inc., St. Paul, Minn., announce their No. 9 horn shown in the illustration above. This horn is designed for theaters and indoor installations where the sound is to be directed at the audience and kept away from the walls and ceilings as much as possible. The Wright-DeCoster midget reproducer is designed for manufacturers wanting a small speaker, which is efficient on both the high and low notes.



Model 247 is suitable for 100 to 120 volt a-c and can be supplied for 25, 50 or 60 cycles. Model 245 midget d-c has a 2500 ohm field, cone 6 inches, outside dimensions 8¼ inches, depth 4 inches.

Portable Automatic Phonograph Unit

A portable automatic phonograph unit for use with sound distributing systems has just been announced by the Operadio Mfg. Co., St. Charles, Ill.

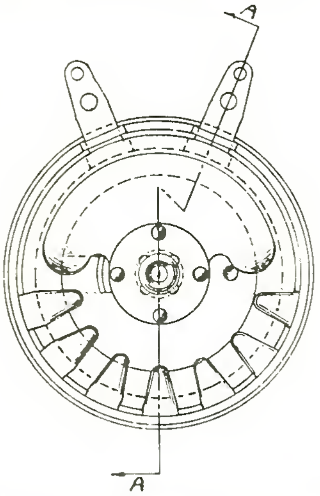


A thoroughly proved automatic record changer, playing 10 records on both sides continuously without attention, is incorporated in an attractive crystal line finished metal carrying case. All hardware is heavily nickel-plated.

This unit is available in several models adapted to various types of service. A bulletin has just been issued completely describing these models.

Tone Control Without Resistance Strip

The Filtermatic Mfg. Co., Hunting Park Ave. and Marshall St., Philadelphia, Pa., announces an entirely new feature in tone control called the Octave tapped condenser tone control. The resistance taper is not needed, as a new feature of tapped condenser with seven pronounced uniform adjustments of tone replace it.

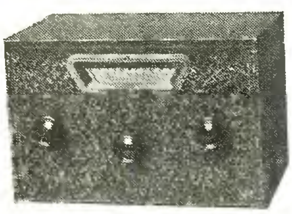


The unit has a working voltage of 500 volts d-c, is thoroughly impregnated with wax, and will stand the most severe humidity tests. It has a remarkably long life test, and is very rugged and compact, measuring only $\frac{5}{8}$x$1\frac{5}{8}$ inches.

The Octave tone control has been developed after months of experimenting by Filtermatic specialists, and is fully covered by patent applications.

Royal Short Wave Receiver

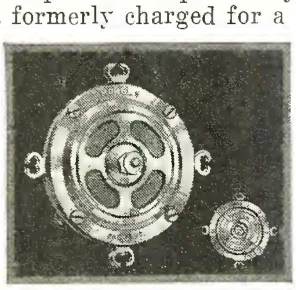
Harrison Radio Co., 142 Liberty St., New York City, announces their Royal model RP short wave receiver.



According to the manufacturers, this short wave superheterodyne receiver uses a screen grid power pentode, world-wide reception guaranteed. A micro-vernier full vision dial permits easy tuning, and a range from 14 to 200 meters is covered. List price $25.00.

New Shure Model 5N Microphone

Shure Brothers Company of Chicago announce a new two-button carbon microphone at a price they claim is that formerly charged for a single-



button unit. It is of the non-stretched diaphragm type, damped to eliminate chatter of noisy vibration, and giving clearness to the reproduced voice. Rating is 6 to 8 ma per button, with a maximum of 10 ma. The resistance is 200 ohms per button. Overall diameter $3\frac{1}{8}$ inches, with a frame diameter of $2\frac{1}{2}$ inches. Overall thickness is $1\frac{1}{4}$ inches. The finish is in nickel. Each Shure Microphone carries a full year's electric all guarantee against defects, if all instructions have been carefully followed. Two button microphones permit push-pull operation with increased stability against feedback.

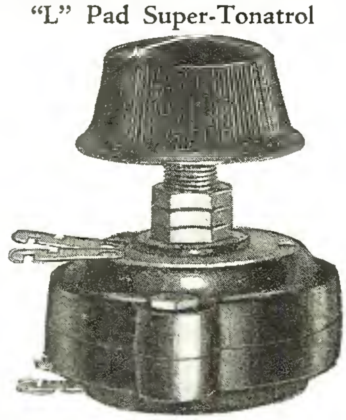
Simplex Model N Midget

The Simplex Radio Co., Sandusky, Ohio, announces their model N midget five tube super to cover the regular transcontinental broadcast band of 550 to 1500 kc, using two 24s, one 35, one 47 and one 80. 9 in. wide, 12 in. high, $6\frac{1}{2}$ in. deep. Weight 13 lbs. packed.

Electrad Products

Electrad, Inc., 175 Varick St., New York City, announces the following products as illustrated below:

"L" Pad Super-Tonatrol

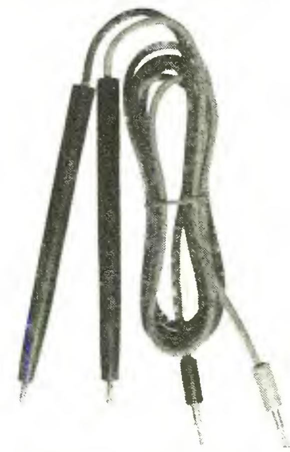


Constant impedance can be obtained by using a dual control consisting of a series and a shunt resistor. This arrangement is effected with the Super-Tonatrol illustrated above.

Duo-Point Test Prods

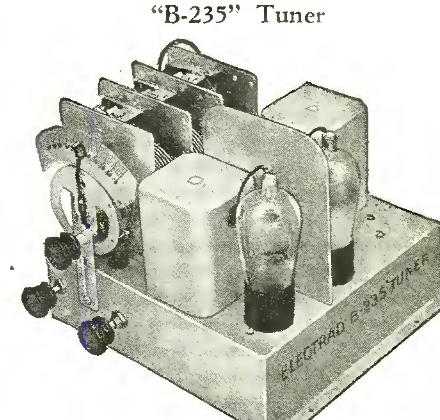
Rutherford Electrical Instruments Co., Superior, Ariz., have recently announced their Duo-Point test prods.

The body is machined from bakelite and is black. Polarity is indicated by color coded cords. Nothing less than 300 volt Underwriters Tested cord is used. The cord is soldered and cemented to the prod to prevent torsional strains on the wire. The inner point is of steel, the outer of nickeled brass. Springs are of piano wire carefully designed to prevent loss of tension through fatigue. A choice of special tips is offered.



The telescoping point offers the advantages of sharp pointed instruments without having the exposed point. The combination also has increased contact surface as both points are used on an exposed surface. In the case of a wire, the side of the inner point becomes the contacting member. Design of the prod results in a minimum of "hot" parts. This helps to reduce accidental shorting and promotes safety. Connecting tips are of a better quality than are found on most prods.

"B-235" Tuner



The new Electrad B-235 tuner is designed to work into the B-245 Loftin-White amplifier or for any other tuner use, requiring a compact unit with exceptional sensitivity and selectivity.

It uses 235 type tubes, has three tuned stages and draws its voltage supply direct from its companion unit, the B-245 amplifier. Dimensions: $7\frac{3}{4}$ by $9\frac{1}{8}$ by $8\frac{3}{4}$ inches. Net weight $7\frac{3}{4}$ lbs.

Tube Developments

(*Continued from page* 32)

drain up to the full emission of the filaments. Under normal operating conditions, the tube voltage drop is only about 15 volts. This desirable feature makes it possible to attain very high overall operating efficiency.

82 Characteristics

Filament Voltage	2.5 Volts
Filament Current	3.0 Amperes
Maximum A-C Voltage	500 Volts, RMS
Maximum Peak Inverse Voltage	1400 Volts
Maximum D-C Output Current, Continuous	125 Milliamperes
Maximum Peak Plate Current	400 Milliamperes
Tube Voltage Drop, Approximate	15 Volts

E772 Characteristics

Filament Voltage	5 Volts
Filament Current	10 Amperes
Maximum Peak Inverse Voltage	7500 Volts
Maximum Peak Plate Current	2.5 Amperes
Approximate Tube Voltage Drop	10 Volts

E766 Characteristics

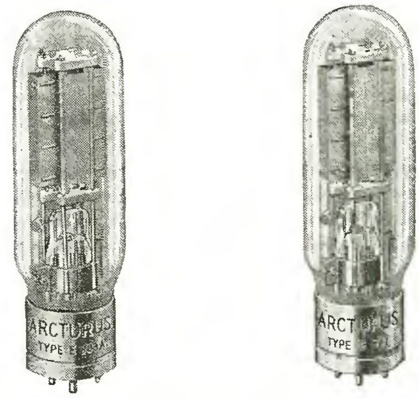
Filament Voltage	2.5 Volts
Filament Current	5.0 Amperes
Maximum Peak Inverse Voltage	7500 Volts
Maximum Peak Plate Current	0.6 Amperes
Approximate Tube Voltage Drop	12 Volts

E745 Characteristics

Filament Voltage	10 Volts
Filament Current	3.25 Amperes
*Plate Current	75 Milliamperes
*Plate Resistance	2100 Ohms
*Transconductance	2380 Micromhos
Amplification Factor	5
Plate to Grid Capacitance	15 mmf.
Input Capacitance	8 mmf.
Output Capacitance	7 mmf.

	Amplifier A. F. Power Class A	Modulator
Maximum Operating Plate Voltage (d. c.)	1250 Volts	1250 Volts
Maximum Plate Dissipation	75 Watts	75 Watts
*Plate Dissipation		75 Watts
*Plate Current (d. c.)	75 M. A.	75 M. A.
*Peak Grid Swing	145 Volts	145 Volts
*Load Impedance	8000 Ohms	....
*Undistorted Power Output	20 Watts	....
*Modulation Factor		0.6
*Oscillator Input Watts per Modulator Tube		120

*At 1000 volts plate potential and —150 volts grid bias.
NOTE.—The values of grid voltage given above refer to the mid-point of the filament.



E 703-A Characteristics

(*Continued on page* 49)

Tube Developments

(*Continued from page* 48)

Filament Voltage	10 Volts
Filament Current	3.25 Amperes
*Plate Current	72 Milliamperes
*Plate Resistance	5000 Ohms
*Transconductance	5000 Micromhos
Amplification Factor	25
Plate to Grid Capacitance	15 mmf.
Input Capacitance	8 mmf.
Output Capacitance	7 mmf.

	Oscillator and R. F. Power Amplifier	A. F. Power Amplifier
Max. Operating Plate Voltage (d.c.)		1250 Volts
Modulated d.c. Plate Voltage	1000 Volts	....
Non-Modulated d.c. Plate Voltage	1250 Volts	....
A.C. Plate Voltage (RMS)	1500 Volts	....
Plate Current (d.c.)	175 M. A.	*72 M. A.
Max. Plate Dissipation	100 Watts	75 Watts
Plate Dissipation	....	*72 Watts
Max. R. F. Grid Current	7.5 Amps.	....
Peak Grid Swing	....	25 Volts
Load Impedance	....	*9000 Ohms
Undistorted Power Output	....	*5 Watts

*At 1000 volts plate potential and —25 volts grid bias.
NOTE.—The values of grid voltage given above refer to the mid-point of the filament.

E711 Characteristics

Filament Voltage	10 Volts
Filament Current	3.25 Amperes
*Plate Current	72 Milliamperes
*Plate Resistance	3400 Ohms
*Transconductance	3530 Micromhos
Amplification Factor	12
Plate to Grid Capacitance	15 mmf.
Input Capacitance	8 mmf.
Output Capacitance	7 mmf.

	Oscillator and R. F. Power Amp.	A. F. Power Amplifier	Modulator
Maximum Operating Plate Voltage (d.c.)		1250 Volts	1250 Volts
Modulated D.C. Plate Voltage	1000 Volts		
Non-Modulated D.C. Plate Voltage	1250 Volts		
A.C. Plate Voltage (RMS)	1500 Volts		
Plate Current (d.c.)	175 M. A. (Max.)	*72 M. A.	**20 M. A.
Maximum Plate Dissipation	100 Watts	75 Watts	75 Watts
Plate Dissipation		*72 Watts	**20 Watts
Maximum R.F. Grid Current	7.5 Amp.		
Peak Grid Swing		*55 Volts	**70 Volts
Load Impedance		*6000 Ohms	
Undistorted Power Output		*10 Watts	
Modulation Factor			**.6
Oscillator Input Watts per Modulator Tube			**45

*At 1000 volts plate potential and —55 volts grid bias.
**At 1000 volts plate potential and —70 volts grid bias.
NOTE: The values of grid voltage given above refer to the mid-point of the filament.

Littlefuse Laboratories, 1772 Wilson Ave., Chicago, will send on request a folder entitled, "Littlefuse Goes to Hollywood" to those writing for it.

BRIEF ITEMS OF INTEREST TO MANY

Errata April Issue

Page 19, in the schematic diagram, the 8 mfd filter condenser connected between the filament lead of the 280 rectifier and the lead running to the plus B of the receiver should be changed and the connection now to the filament winding grounded.

Page 21, column 1, line 15, change 1.02 amperes to read 2.02 amperes.

Page 27, on the schematic, transpose 180 volt and 90 volt terminals on the connector block shown.

Page 37, all 1 mfd values given in the editorial columns should read .1 mfd and all .10 mfd values should read .01 mfd. Also .2 mfd should read .02 mfd.

Geo. R. Warren, Norristown, Pa.: In the text of the article on "Filter Design by Graphs," your examples are very far from being correct. There seems to be a series of misprints and the obvious error is in placing the decimal point in the capacity values. I have cut out the graph and stuck it on the wall over my work-bench, for it is a most convenient document. The *"Call Book"* is the only radio magazine that I read, and I must congratulate you on the excellent quality of the data you publish. Ans. As you correctly state, a typographical error occurred and the decimal point was misplaced. This correction will be found in the mention of "Errata" given under the Brief Items heading.

Telautograph Corp., W. A. Lauder, Engineering Dept., New York City: The article entitled "Filter Design by Graphs" is particularly useful and I believe it would be in order to publish the corrections we have mentioned. Ans. We wish to thank you for your helpful criticism and trust you will find the correction under the heading "Errata."

M. I. Hart, Plainville, Conn.: I have been reading *Radio Call Book Magazine* for several years and I have found it one of the most interesting published, even more so since it became a monthly. I am not a service man and there are many things I do not understand about radio, but I have always enjoyed reading your book from the standpoint of a *fan* and have learned a great deal by so doing. I noticed in answer to a question in the April issue regarding hooking up head phones in modern electric receivers. You state any method can be used and suggest phones be placed across the grid circuit rather than the plate circuit. I have an eleven tube receiver and would like to know some satisfactory way of connecting in a set of phones. I have tried so-called ear phone adapters but with little success. My idea is to make some kind of permanent connection whereby I can cut out speaker and cut in phones at will. I use phones more than speaker at present. Ans. The explanation given in the April issue should be sufficient for your needs. No harm will be done if the silencing switch for the speaker is connected in series with the voice coil to break the circuit.

Milton Wood, Mayville, N. Y. The midget speaker you sent me surely works fine and I am very glad to have noticed your ad.

(Continued on next page)

Brief Items Continued

A young man sat at a desk in a small room crowded with radio equipment, speaking a rapid staccato stream of seemingly meaningless words into the microphone. He was the operator of Station WUCG, the world's busiest airway radio station, in United Air Lines' hangar at Chicago Municipal Airport.

A tri-motored Boeing air liner with passengers and mail had just taken off for San Francisco and the operator sent the dispatch message.

While he listened, the message was repeated in sequence by operators at Iowa City, Des Moines, Omaha, Lincoln and North Platte, airports along the plane's route. The operator at Cheyenne, the last station in that division of the California bound plane, heard the message and sent an "O. K., it's clear," skipping back from station to station, to die in the Chicago headphones.

The relayed message and its answer on this 1,000-mile span took only one and one-half minutes. Thirty seconds after the reply the operator was busy talking to an air liner half way between Cleveland and Chicago. In another minute he heard the report of a plane just out of Dallas, Tex., Chicago bound with passengers and mail.

The dispatch message sent out by the operator ahead of the United air liner was "WUCG Chicago Morgan hello Iowa City 1 19 Knight Ferguson Zwickey 230 out 4:30 890 1 Cheyenne 2 Salt Lake 1 Reno 6 San Francisco 13 scheduled night. Reserved en route 2 Salt Lake Los Angeles. Chicago.

The message he conveyed was:

"This is United Air Lines station WUCG at Chicago, Operator Morgan; hello, Iowa City. Trip No. 1 of the 19th with Knight piloting, Ferguson co-pilot, and Zwickey, the stewardess, took off in plane No. 230 at 4:30 p.m. with 890 pounds of mail and one passenger for Cheyenne, two for Salt Lake City, one for Reno, six for San Francisco. Knight will radio on night schedule No. 13. Two seats are reserved at Salt Lake City through to Los Angeles. Chicago station signing off."

Every twenty-four hours WUCG maintains its reputation as the busiest airway radio station in the world by following twenty-four mail and passenger planes on the Chicago-New York, Chicago-Dallas and Chicago-Pacific Coast routes with weather reports every twenty minutes. Every hour the United operators speak to thirty-five ground stations in nineteen states.

J. C. Hurst, Dayton, Ohio: I would like to inquire if your laboratory will, for a reasonable fee, answer queries on radio construction. My radio knowledge is rather limited and I have trouble especially with mathematics, at times finding I would like very much to know of some place where I could get questions answered. If your staff does not handle this sort of work, I would, if you know of anyone, appreciate his address that I might communicate with him. Ans. Questions of a technical nature will be handled by the editor personally for a reasonable fee by addressing them to 5424 W. 64th St., Chicago.

E. L. Moorhouse, Pittsburgh, Pa.: Just another suggestion to help make the *"Call Book"* better as I see it. Why don't you show socket layout for the receivers and the location of trimmers? I think the service men would appreciate these items. Set manufacturers seem to pick out the nicest places to hide trimmers and all of us do not have their manuals to assist us in locating them. Ans. We are sorry that space does not permit us to comply with your request as to the location of trimmers on manufactured receivers. Although manufacturers design makes the layout a bit intricate at times, little difficulty

(Continued on next page)

Brief Items Continued

should be experienced in finding the location of the trimmers.

R. W. Hoffman, Chadds Ford, Pa.: I am writing to tell you that your new style printing on the curves of your magazine is not as good for the service man as it was. For instance, in your January issue you have a list of set schematics shown above in column form and it is very nice to find any set schematic. The later ones are in too much of a jumble and I hope you will act upon this constructive criticism. Your magazine is good and I certainly do enjoy it. Ans. We are sure that you will have no difficulty in finding your required schematics since they are given in two different locations in each issue, under the Service and Repair Section and on the Blue Print page.

Henry Lee, Carroll, Ia.: I should appreciate an answer to the following questions on performance curves which you print in your magazine. I notice when you first made measurements, the selectivity graphs were marked "field strength in microvolts." Later they were marked "field strength ratio." Please explain the difference in these graphs and how they may be compared. I notice also that the curves on the graph marked "field strength in microvolts" are short, while those marked "field strength ratio" go to the top of the graph. I should also like to know the difference between three-cycle and four-cycle graph paper. What would be the difference in selectivity curves plotted on these papers? I like your magazine but I think it would be great for us beginners if you could give a short description of the receivers with the wiring diagrams. Ans. The change from the scale of field strength in microvolts to field strength ratio is a very great convenience to engineers and men who use such curves, since by this method it is possible to directly compare curves at any frequencies as they begin at the same origin point. The shape of the curve is not any different from that of the former procedure. To change any of the old curves to the new type, it is only necessary to divide all of the ordinate values by the field strength at resonance. In other words, all selectivity curves are made by dividing the inputs necessary off resonance for standard output by the input necessary at resonance, the latter being known as the normal field intensity. It also makes possible a greater showing of the curve, since the height before was limited by the sensitivity itself. A change was made from 3 cycle to 4 cycle graph paper because at present, with the increased power of broadcasting stations and the increased problem of obtaining selectivity in radio receivers in congested broadcast areas, such as Chicago and New York, where field intensities run abnormally high, it was necessary to run ratios as high as 10,000 times normal input to predetermine, with a good deal of accuracy, just what a receiver would do in the above mentioned areas. We are always happy to explain any questions in detail, especially from readers who are becoming interested in this phase of receivers, because we know once you use curves as a criterion, you will always stand by them. Our curves, of course, are the only ones which are recognized as being unbiased and accepted by the Federal Radio Commission as legal evidence in cases of dispute.

Alfred W. Bulkley, Hannibal, Mo.: I have not noticed anything in your magazine about solicitation of contributions and I wonder what your definite policy is regarding them. Allow me to compliment you on the new issues of the magazine. I read a number of radio magazines and find valuable information in all of them, of course, but

(*Continued on page* 54)

Brief Items Continued

there has been some exclusive data in *Radio Call Book Magazine* which has been very helpful. Ans. Articles on constructional features are submitted gratis, while the special text matter on engineering subjects not prepared in our laboratory is paid for. Thank you for your kind words and continue to look for exclusive material in forthcoming issues.

A. J. Mowatt, Sussex, N. J.: I see you invite readers to speak up about the question of reverting to the old policy of articles for those who "build their own." It has been a question with me since the magazine has become almost entirely for the trade whether I should not discontinue taking it. Having tinkered and experimented with radio since the very beginning, it seems peculiar we cannot have a magazine which will keep us interested. The home experimenter consumes quite a good deal of parts. He is an indefatigable DX hound as a rule, and yet he is hardly considered in the picture today. Why not a couple of pages each month for the short wave enthusiast, the battery set maniac, the contructional articles for the fellow who is not exactly a novice? I'll wager you will please a great many, especially as almost all the magazines have forgotten we exist. Ans. We are sorry that you do not agree with our present policy, but upon surveying the last several issues we find that there has been published material for the type of man who experiments. We have run several short wave receivers which were designed by our readers. At present we are running a series of articles on experiments using the Photronic cell. Hardly an issue goes by but what we have articles on several new tube developments and photo-electric cells. We hope that with coming issues we may find more which will be of interest to this type of reader.

Mr. L. H. Georger, Buffalo, N. Y.: Being a constant reader of your magazine for some time, I was greatly interested in comments made by Mr. L. C. Umlauf published in your May issue. As you have asked for comments I hope the following data will not only be a direct help to him should he read it, but assistance to other experimenters who still term themselves "Radio Bugs."

In the first place, Mr. Umlauf must be living in some portion of these United States where a-c current is not available in quantities at low rates or he would never have made the statement he did with reference to the use of d-c receivers by the present day experimenter.

It is assumed, of course, that all any experimenter is looking for are the best results all told. If this is true, let me give an example of what was accomplished by the writer with a d-c receiver which gave a range of Catalina which I believe is fifty miles the other side of the Pacific coast. In spite of this record, this unit was torn down for a-c operation and, with some experimenting on the part of the writer over a period of a few months, a receiver was asembled for a-c operation which I would not exchange with any one for actual results with natural tone. Dynamic speakers never, in the opinion of the writer, will take the place of the 18" Western Electric speaker for fidelity of tone.

H. S. New, Maplewood, N. J.: Keep up the good work of your magazine, which is the only one I now subscribe to. I have been at it since before broadcasting and as long as I get response curves and the other data which you publish you may be sure that I will renew. Ans. We hope we may always be deserving of letters of the class illustrated by that of Mr. New.

(*Continued on next page*)

Globe About Cathode Ray Television

(*Continued from page* 37)

price of the good broadcast receiver, providing really good pictures for the usual home group. The images are quite detailed, even when handling two or three characters at a time. Titles and other printed matter are entirely legible. The entertainment possibilities, indeed, rest largely with the television studio, for the lens disc receiver has stepped well ahead of the material presented by the broadcasters.

While wishing to take a fair inventory of the lens disc possibilities of today, we must nevertheless look ahead to even greater technical possibilities with the cathode ray. To begin with, this electrical method of scanning has no moving parts. It is absolutely silent in operation. Again, it is easy to synchronize with the transmitter, irrespective of power supply and distance. The synchronization means no expenditure of power, as in the case of the mechanical scanner.

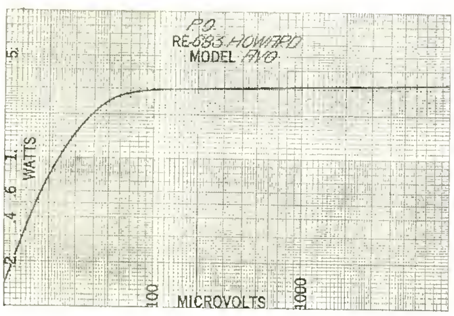
Another important feature in favor of the cathode ray is the ease with which the number of scanning lines may be changed. A simple twist of the knob controlling the local oscillator, varies the scanning system to handle present or future signals placed on the air.

Still another advantage is the color of the images. If desired, nearly pure black and white images may be obtained, as contrasted with the commonplace pink images of the neon light source.

The cathode ray tube is certain to grow in desirability as television broadcasting attains higher standards, while the mechanical method must eventually lose ground. When the scanning system attains several hundred lines, the cost of present mechanical scanners will become prohibitive. Also, there may be more than one television scanning system employed by broadcasters, in which event the cathode ray possesses the advantage of ready change in number of lines. Even today, the cathode ray scanner can be built at no greater cost than the better type lens disc scanner. As television advances, however, the cathode ray scanner must become increasingly more economical. The matter of associated equipment also points to the economy effected by the cathode ray scanner, since it is possible to modulate the cathode ray with the detector tube output, or with not over 8 volts, thus doing away with the usual amplifier. This makes for simplicity and low cost on the receiver end.

In conclusion, the cathode ray is certain to be the ultimate choice for television scanning. Meanwhile, however, let us not overlook the attractive possibilities of the lens disc scanner.

It is intimated that among the changes in receiver standard testing procedure now under consideration, output readings will be taken on the secondary side of the output



transformer, substituting for the voice coil. The above curve of the Howard AVO illustrates the difference when compared with the curve given on page 23.

Jewell 563 Modulated Oscillator

(*Continued from page* 36)

To connect the oscillator to the receiver, remove the regular antenna connection. However, leave the ground wire connected. Use the special shielded lead to connect oscillator to receiver. One end of this terminates in small plugs, the other end terminates in spade connections for connecting to the antenna and G post of receivers. If adjusting a t.r.f. receiver, connect the small plugs of the shielded lead to the two jacks of oscillator marked "Low Output." The bare wire lead goes to the jack marked G and the insulated one to the jack marked A. The spade connectors, of course, connect correspondingly to the antennas and ground posts of the receiver.

After connecting the oscillator, connect the output indicator according to the type of output stage used. Next, turn on receiver and watch output indicator to see if you have connected properly and that the needle does not go off scale.

Now set the frequency switch to the "Broadcast" position and the "On and Off" switch to "On." Adjust the filament knob at right to 6 on the dial scale. Rotate the "attenuator" control to "maximum" position at the right, and sweep the broadcast band by rotating the "tuning" control until the signal from the oscillator is heard in the speaker and a reading is obtained on the output indicator. The calibration chart gives the frequency of the output of the oscillator at various points on the "tuning" control for each band, and, since most radio sets are calibrated in kilocycles the signal should be found without difficulty.

In most receivers, small trimmer condensers are connected across the main tuning condensers. Beginning at the first stage, adjust each one of these until maximum reading is obtained on the output indicator. This adjustment is made with a small insulated hexagon wrench or screwdriver obtainable from any Radio mail order firm. Each stage is adjusted successively at a frequency of about 1300 kc. The oscillator and receiver is then tuned to about 600 kc. and the adjustment made again at this point. Again make the adjustment at 1000 kc. This should be sufficient. However, if the receiver is badly off it may be necessary to make the adjustment all over again.

In some receivers this adjustment may take the form of bending split rotor plates or adjusting the positions of the rotors with respect to the stators of the tunning condensers. This is particularly true of the older type Atwater Kent or Crosley receivers.

For neutralizing, where a much stronger signal is required, the posts marked "High Output" at the right are used in the same manner as the "Low Output" posts at the left. The signal from these posts is approximately 1/10 volt, and should be used for neutralizing only, since this output is not controlled by the attenuator. In order to neutralize, it is necessary to insulate one of the filament terminals of the tube in the stage to be neutralized. This may be done by means of a neutralizing adapter, slipping a piece of paper between socket contact and tube prong or inserting one tube prong in a short piece of straw obtainable from a soda fountain. The neutralizing condensers are adjusted similar to *trimming* condensers. However, remember that neutralizing condensers are adjusted for a minimum reading on the output indicator while trimming condensers are adjusted for maximum reading.

(*To be continued*)

Brief Items Continued

(*Continued from page* 55)

Ultra violet rays increase fluorescence of instrument dials and insure correct readings as aid to safety and accuracy of navigation, said J. H. Kurlander, engineer of the Westinghouse Lamp Company of Bloomfield, N. J., where this type of new lighting was developed.

According to Mr. Kurlander, the growing practice of flying in all kinds of weather makes it of prime importance that the pilot have maximum visibility of the ground and in every direction around his ship, so that the use of invisible ultra violet rays, or "black light" to illuminate instrument boards, entirely removes all stray artificial light which would shine in the pilot's eyes and at the same time makes the radium dial markings stand out in sharp image many times clearer than their own original brilliancy.

The principle of this new lighting is based on the fluorescent quality of radium paint and the characteristic of ultra-violet rays to make certain substances glow with greater brilliancy. While radium paint becomes difficult to read during periods where there is not total darkness, the invisible ultra violet ray permits perfect visibility. Ultra-violet rays for airplane dashboard lighting are produced by merely screening out the visible light of an ordinary lamp. Special glass lenses placed over the mouth of small reflectors allow only the ultra-violet to pass through.

The Westinghouse Lamp Company who developed this new lighting, demonstrated the practicability of this new light on the Stinson test ship of the Pioneer Instrument Company at the Newark Metropolitan Airport. Both companies will also demonstrate the new "black light" in their booths at the Detroit Air Show.

By developing "electric eyes" that respond to invisible infra red light, Westinghouse research engineers have demonstrated how safes, jewel cases and other valuables may be protected from theft. When beams of such light are interrupted they turn on lights, take the intruder's picture, sound an alarm, call the police and render the burglar helpless with a discharge of tear gas.

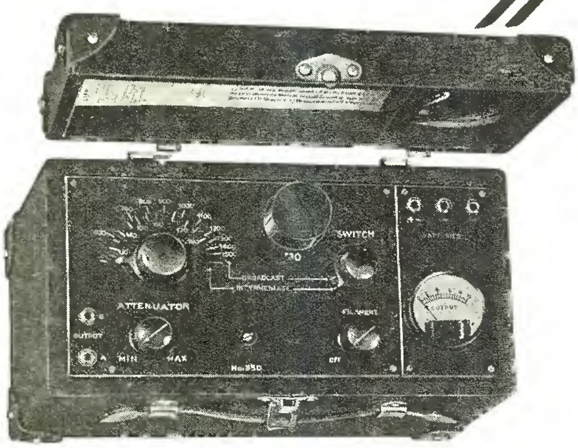
"The Aerovox 1932 Condenser and Resistor Manual and Catalog" a helpful manual containing detailed specification of the condensers and resistors manufactured by the Aerovox Wireless Corporation for Radio and Industrial Applications has just been announced by the Aerovox Wireless Corporation, 70 Washington Street, Brooklyn, New York. In addition to the usual detailed specifications, it contains much technical data, formulae and other information of value to engineers, purchasing agents, servicemen and experimenters. Copies can be obtained free of charge by writing to the Aerovox Wireless Corporation and mentioning this publication.

A group of radio service men in Chicago, members of the Institute of Radio Service Men, have launched a cooperative advertising campaign in the Chicago newspapers. Each participant in the campaign not only subscribes definitely to the policies of the Institute but signs a pledge to the organization that he will guarantee satisfaction to his customers.

Future campaigns dealing with the national events are planned, and the program started in Chicago will be carried to other cities where sections of the Institute have been established as rapidly as possible.

One can visualize the effect of a large radio service display advertisement appearing in a metropolitan newspaper, calling attention to the pledged reliability of the members whose names are attached and lacking reference to service charges.

Readrite



Licensed by A. T. & T. Co.

RADIO SERVICE TEST OSCILLATOR

Indispensable to the Serviceman

A REMARKABLE INSTRUMENT AT A POPULAR PRICE

No. 551

$18 Net to Dealer
$30 List

No. 550

$21 Net to Dealer
With Output Meter

YOU cannot service a present day superheterodyne without the use of an Oscillator, and this Readrite Test Oscillator will fulfill your every need.

A sturdy modulated instrument, carefully made. Completely shielded with separate battery compartment. Furnished with 22½ v. and 3 volt batteries and one '30 tube. Reads directly broadcast band (550-1500 k. c.) and intermediate band (120-185 k. c.). Other i. f.'s obtained by sharp harmonics. Operating instructions attached in case cover with shielded wire leads.

Very compact, light weight and easy to handle. Comes in strong leatherette case 6 x 11½ x 5½ inches. It is made not only of the best materials throughout and assembled for lasting durability, but its beautiful and trim appearance will be the pride of every serviceman to own and use.

One of the serviceman's most important instruments. Used to align r. f. gang condensers, locate defective r. f. transformers, adjust i. f. transformers, check oscillator stage, compare gain in tubes and determine the sensitivity of a receiver. Furnished with or without output meter built in the panel. A truly remarkable instrument at a remarkable price. Get yours today!

Write for Catalog of Servicing Instruments

READRITE METER WORKS

Established 1904

10 College Avenue BLUFFTON, OHIO

INDEX TO ADVERTISERS

YOU

Can Make Money as an Authorized Silver-Marshall Service Station—

SPECIAL DISCOUNTS on 142 Catalog items. Chassis, tuners, amplifiers, all-wave sets, short-wave receivers, converters, speakers, and replacement parts.

SPECIAL RECEIVERS—a line of S-M Bearcat receivers especially for Service Stations.

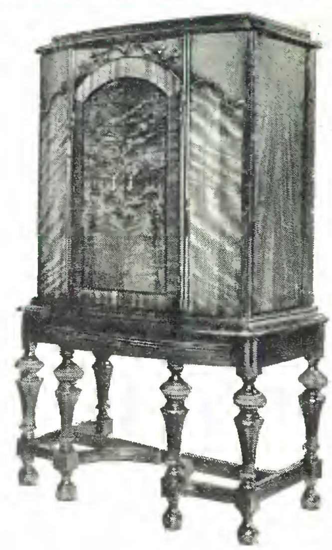
MERCHANDISING HELP—by the whole Silver-Marshall staff of experts.

INSIGNIA OF AUTHORIZATION—identification card, authorization certificate.

If you have any connection with radio, you ought to have all the details. Send the coupon NOW.

If You Are a Radio Dealer » »

and not making the money you should, you ought to know all about the Silver-Marshall line. They are sold DIRECT TO DEALERS. The jobber's profit is used in more profit for YOU and lower list prices. It is a COMPLETE line. Full-size superheterodyne consoles to sell from $49.95 to $139.50 complete with Eveready Raytheon 4-Pillar tubes. Silver-Marshall dealers have EXCLUSIVE territory. These are some of the reasons why you ought to know about it. Send the coupon for ALL the details.



Model C-24. 12 tubes . . . superheterodyne . . . 3-unit construction . . . pentodes in push-pull . . . double tone control . . . built-in tone chamber . . . meter tuning . . . automatic volume control . . . built-in aerial . . . 45-inch door console. The finest receiver made. Complete with Eveready Raytheons . . . $139.50 list.

SILVER-MARSHALL, Inc.
6413 W. 65th St.,
Chicago, U. S. A.

☐ Please send me Service Station details.

☐ Please send me Dealer details.

Name..

Address..

SILVER-MARSHALL, Inc.

6413 West 65th Street . . . . Chicago, Illinois

CANADA	EXPORT	WEST COAST
75 Sherbourne Street TORONTO	41 Water Street NEW YORK CITY	S-M Sales Co., 224 E. 16th Street, LOS ANGELES