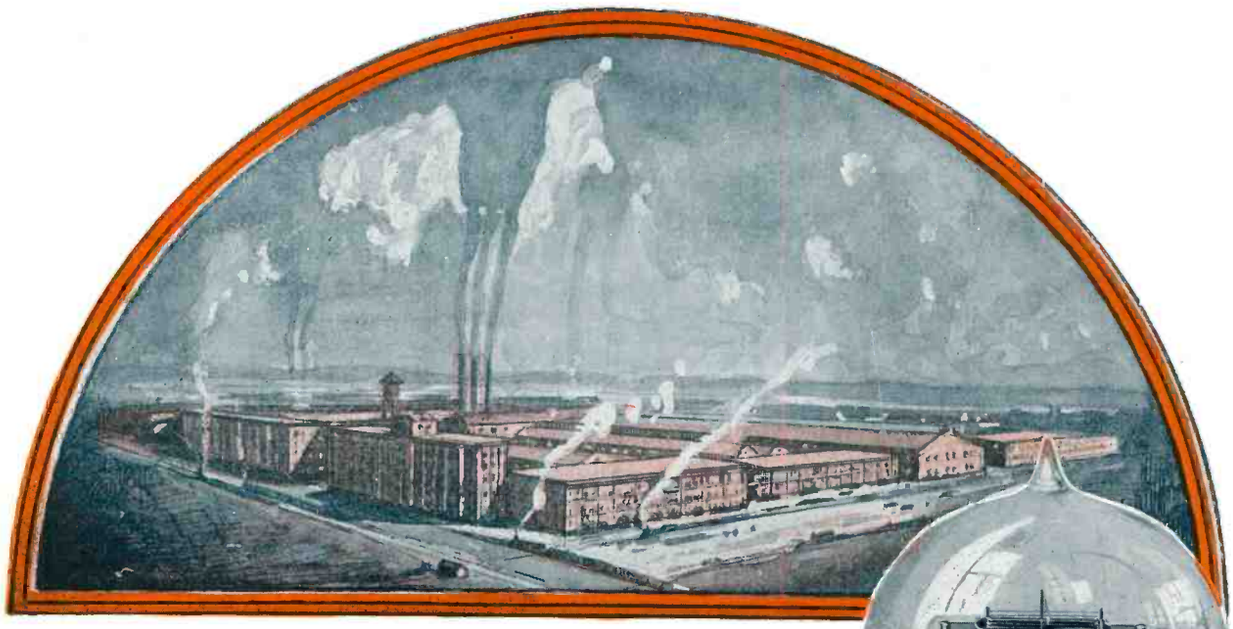
DECEMBER 1923 25 CENTS

The Wireless Age

"America's Foremost Radiophone Review"

Features in this Issue



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Home Offices

154 West Lake Street
Chicago, Illinois

182 Second Street
San Francisco, Calif.

30 Church Street
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The Wireless Age

America's Foremost Radiophone Review

Vol. XI — No. 3

December, 1923—Contents

Your Authors

AUSTIN C. LESCARBOURA (Footing the Broadcasting Bill) hardly requires an introduction. As editor of Scientific American for some years past, he has won a reputation for clear thinking and a directness of style in writing; he brings to his readers in this issue a refreshingly simple exposition of the broadcast situation as it looms before the people of the United States today.

DOCTOR ALFRED N. GOLDSMITH (Picking up Broadcast Music) is known throughout this country and abroad for his research in the realm of radio during the past ten years. As an eminent authority on the technical aspects of all radio matters, Dr. Goldsmith's story, in popular language, should hold a keen interest for novice and technician alike.

MISS HORTENSE LEE (Cooking Eggs via Radio) presents readers with a treat in her article on radio from the women's point of view. Miss Lee's reactions are sure to be checked by all readers among the fair sex with their own ideas and experiences. We leave it to the ladies to say whether or not she has struck a responsive chord.

PIERRE BOUCHERON (Opportunities in Radio Today) comes to his task with a personal background rich in interesting experiences. He is qualified to advise those who are thinking of making Radio their business or profession, because of his own rapid rise from an experimenter of modest operations to Manager of Advertising and Publicity in the world's largest radio company.

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James G. Harbord, Pres. — L. MacConnach, Secy. — George S. DeSousa, Treas. — H. L. Welker, Adv. Mgr. — H. H. Reber, Bus. Mgr.

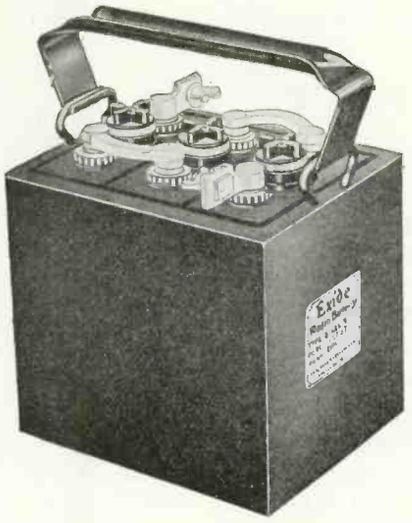
Major Jerome W. Howe, Editor — C. S. Anderson, Associate Editor

Printed in U. S. A.

During the last six months of 1922 there were printed 204,650 Copies.

THIS ISSUE — 60,000 COPIES

Will your battery stay for the concert?



THERE is nothing more exasperating than a battery that "signs off" just when you are enjoying a splendid radio concert.

A good A battery should supply uniform filament current during a long period of discharge. Frequent recharging and replacements take all the fun out of radio receiving.

When you hook up your set to an Exide A Battery you'll appreciate what ungrudging battery service means. You'll be impressed time and again with the value of its ample capacity-rating and the smooth, unvarying flow of current that it delivers to your tubes.

Features you will appreciate

From its heavy, well-made plates to its convenient terminal binding posts, every detail of the Exide's construction is designed to help you get better reception. Vent plugs that may be inserted or removed by a single twist of the wrist make it an easy matter to add water or test the battery. A deep sediment space in the bottom of each cell eliminates danger of internal short circuits or reduced life. Wood separators of the same fine quality that are found in the Exide automobile batteries insulate the plates from one another and also contribute to the battery's long life. A stout detachable handle across the top of the battery makes it extremely easy to carry.

Two- and four-volt A batteries

Two low-voltage A batteries

The Exide line has been extended to include two low-voltage A batteries, consisting of one and two cells. They are designed specifically for WD-11 and UV-199 vacuum tubes, and are right in line with recent developments in radio receiving.

The two-volt Exide A Battery will heat the filament of a quarter-ampere tube for approximately 96 hours. The four-volt Exide A Battery will heat the filament of a 60 milliampere tube for 200 hours.

Exide B Battery

Exide B Battery

Current from the new Exide B Battery is full-powered and noiseless. It is free from fluctuations that cause hissing and crackling sounds in your phones. When you tune in distant stations you know that your satisfaction will not be marred by imitation static that sounds as though a heavy electrical storm were in progress.

You don't have to put up with a battery that discharges quickly. Go to any radio dealer or Exide Service Station and ask for Exide A and B Batteries. If your dealer cannot supply you with free booklets describing the complete Exide line of radio batteries, write to us.

Exide
RADIO BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

Oldest and largest manufacturers in the world of storage batteries for every purpose

Service Stations Everywhere — Branches in Seventeen Cities

Editorial Chat

DECEMBER comes to announce, as a blustering self-important coachman might, that another Milestone is just ahead. We all have a troubling conscience about it, for we know that the First of the Year should punctuate a definite progress. So in December one makes a mental inventory and survey and lays plans for something still bigger and better, so that, when the New Year finally turns up, the Old Rascal will not find us unprepared and racking our brains for some New Resolutions, but will find us ready to shout: "Good morning, Old Fellow, glad to see you! Want to see what we're doing that's newer and finer than we did for your predecessor? Here you are!"

WIRELESS AGE has been making preparations to pass the Milestone with a fresh offering to Progress and making the snow fly. And we think that our readers will care to spend just a minute in our shop and get a line on what we are doing and planning.

Come in and meet Mr. John R. Meagher, who brings to our editorial department the valuable technical talent acquired by a long, practical experimentation with Radio. Mr. Meagher will preside over the INFORMATION DESK to which readers are encouraged to submit their questions. *Every one* will be carefully answered and the most generally interesting and instructive answers will be published.

And here's another thing! We plan to have for you every month a carefully prepared description of a WIRELESS AGE SET. This will be specially designed and actually made right here in our office. It will be fully described in our pages so that any amateur can confidently go ahead and build one for himself. And if you want to see how it works, just drop into our office at 326 Broadway, whenever convenient, and we'll show it to you.

Also we have added to our staff Mr. W. A. Hurd, who is going to work *with* our readers and not merely write *at* them. Look for him in the January number. He has some interesting projects under way.

Again, in the January issue, watch for Clarkson of Radio Data Sheet fame and an engineer of broad experience. We have secured from him the promise to contribute each month a double page "Test Table" in which he will tell you just how to examine and test all parts of your apparatus.

PEEPS INTO BROADCASTING STATIONS makes a very tentative start with this issue, but what we have in mind is to give you B. C. L.'s a place where you can get an intimate bit of gossip about your favorite stations. Every month a different selection of stations will be included. Of course, we shall continue to present the progress of Radio Broadcasting by means of feature articles by competent writers, and by story and picture keep you well informed of what interesting stunts are being pulled off in the Broadcasting World.

THE EDITOR

Major Jerome W. Howe, who leaves the regular army to come to The WIRELESS AGE, has for the past few years been in Washington on the staff of one of the chiefs of combat branches of the army, and engaged in publishing one of the service journals. Major Howe is a graduate of the Engineering Department of Worcester Polytechnic Institute.

The Sea-Going Operator's Page will give you an opportunity to chase around the Seven Seas with some interesting ship operators, and World Wide Wireless will continue to keep you abreast of Radio developments in foreign fields as well as nearer home.

We would like to tell you more about what we are planning ahead—some authoritative technical stuff, some bully stories, articles on Radio as a career, a page specially for our feminine readers, some serious discussions of the problems of Radio development, material for the amateurs who are working on transmitting sets and radio traffic—circuits and circuits, and more circuits—but we won't detain you longer. Turn the page and enjoy this Christmas number.

With our best Xmas Greetings

The WIRELESS AGE.

THE WIRELESS AGE

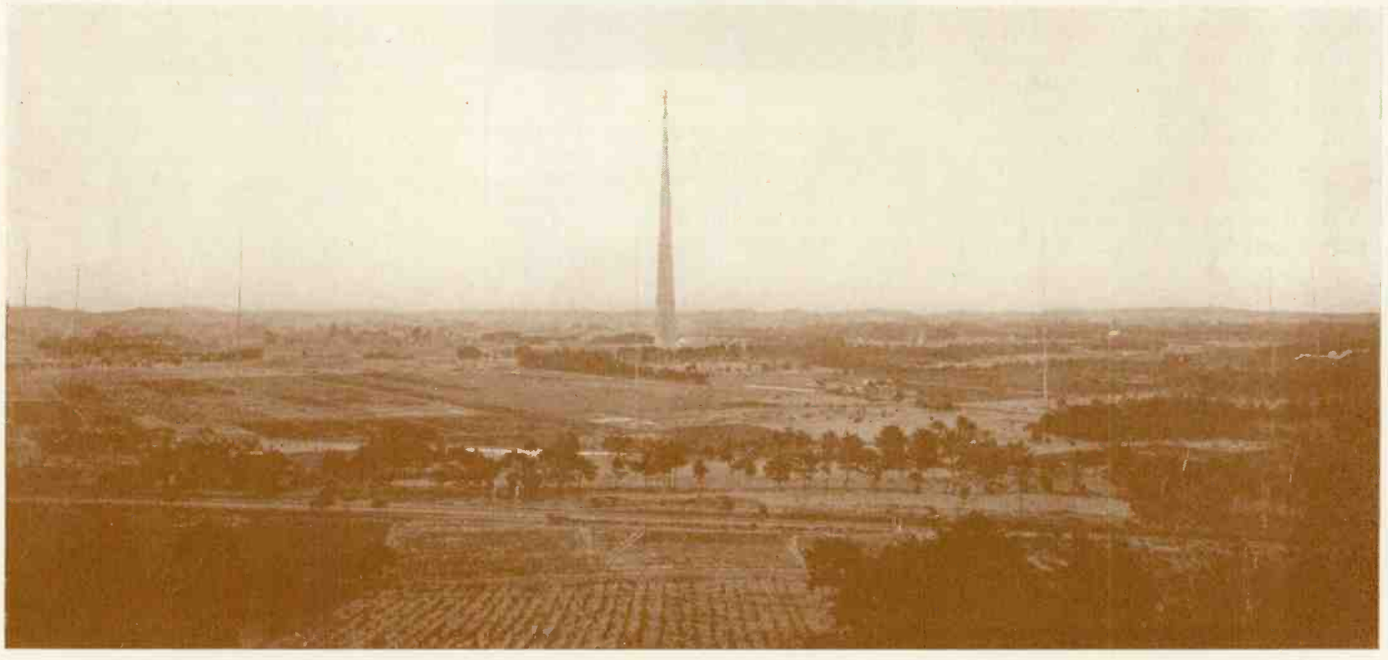
"America's Foremost Radiophone Review"

VOLUME XI DECEMBER, 1923 NUMBER 3

How Iwaki Told the World

By Col. Samuel Reber

Representing the Radio Corporation of America in Japan



Overlooking Haranomachi where the transmitting station of the Japanese Department of Communications is located

GENERAL SHERMAN said "War is hell," and he knew. Earthquakes and their resulting fires are worse, and I know as I have been through both. What happened in Tokyo and Yokohama on the first and second of last September is unthinkable and incomprehensible to one who did not go through those soul-trying days, for the imagination of a Dante and the pencil of a Doré can hardly portray the horrors of that Japanese inferno. Yokohama was entirely wiped out; Tokyo a mass of flames; two million homeless wanderers seeking a place of safety in the streets and parks; families separated; children lost by the thousand, all hungry and thirsty; more than a hundred thousand dead and missing; all bridges, railroads, telegraph and telephone circuits gone; all radio stations destroyed or without power as the hydro-electric transmission lines began to fail. The smoking ruins of that great city stood completely isolated in its misery with no communication to the outside world. Constant earth shocks accentuated the terrors of the tired populace which had justed passed through a night of horrors. Greater misery and woe were impossible.

Radio was first the herald of disaster and then the messenger of hope. It told the world of the horrors, brought the glad tidings of help with the speed of light, and echoed the sympathy of all mankind.

Having tried, the night before, to reach the embassy and having been cut off by the fire, I went there early Sunday morning where I found the American ambassador, Mr. Cyrus E. Woods, calmly surveying its smoking ruins from which he and his family had with great difficulty escaped with their lives, and planning to meet the grave problem of immediate relief for the sufferers. America may well be proud of her representative, as he embodies all the qualities that characterize the best type of our nation. His name will be ever linked with that of Perry in all future histories of Japan. His first thought was to get the news to Washington and ask for food for the hungry, as he clearly foresaw the conditions of the coming days. He asked me if I thought I could get a message through to the Secretary of State and I told him that I would, as I was confident that the radio station at Funabashi must be working, and, as it is less than 20 miles

from the city, I felt confident that the Navy Department would find some way to get the message there. He then dictated to me the following message:

Tokyo, September 2nd.

Secstate,
Washington.

All Americans (in Tokyo) believed safe stop all embassy buildings totally destroyed but no one in embassy injured stop food situation very acute stop send rations at once from Philippines.

Woods

(Note. Filed by S. R. at the Navy Department at 10 a. m., Sept. 2nd, sent by messenger to Funabashi and transmitted by radio to Iwaki which received it 3:30 p. m., Sept. 4th, and sent it to Honolulu. It was received at San Francisco which was listening in for anything from Japan at 10:58 p. m., Sept. 3rd. which corresponds to 4:20 p. m. Sept. 4th, Tokyo time.)

In company with Mr. John K. Caldwell, the Japanese Secretary of the Embassy, who, though he had lost his all in the fire and had been without sleep the entire night, had reported early that morning to the Ambassador, I went straight to the Navy Department, which was crowded by the refugees as the authorities had thrown open the building as an asylum to the homeless, and finally fortunately found Commander Y. Ko, of the Imperial Japanese Navy, Secretary to the Minister of Marine, to whom I explained my mission through Mr. Caldwell, as I unfortunately can speak but a very few Japanese words. Commander Ko took us to a spot in the grounds of the Department where under a large tree with a plank supported on two barrels underneath it, were several naval officers who were receiving the official messages from the several branches of the Japanese government for transmission by messenger to the Navy radio station at Funabashi. While Mr. Caldwell was copying my message in legible script, Commander Ko conversed with me in very good English, somewhat to my discomfiture, as I had possibly put the case more plainly than the chosen words of diplomacy might suggest. Twice again, that day, the ambassador entrusted me with the dispatch of other messages which were sent through the same channel.

K. Yonemura

The Radio Hero of the Japanese Disaster tells how he gave the world its first news from stricken Yokohama.

This thrilling story, the first to come direct from the lips of operator Yonemura, has been obtained exclusively for the readers of THE WIRELESS AGE.

This successful bridging of the awful chasm which earthquake and conflagration opened up between the Island Empire and the rest of the world, from which help must be summoned, will go down in history as one of the most important feats of radio and one of the milestones of wireless communication.

But even here the wonderful mechanism which human ingenuity has contrived would have been tragically useless but for the heroic human devotion of operators.

This is the story of how radio operators stuck to their job in the midst of devastation and terror.

Tokyo, September 2nd.

Secstate,
Washington.

Communications have just been opened with Yokohama stop the situation there is very serious and it is thought some Americans have lost their lives stop the casualties in Tokyo are estimated at ten thousand stop I believe all Americans here are safe stop the food situation will soon be acute send supply from Philippines at once as requested in my message of this morning stop the fireproof vault of the embassy was not fireproof and all embassy records were destroyed.

Woods

(Note. Filed at Navy Department at 9:30 p. m. Sept. 2nd by S. R., sent by messenger to Funabashi, transmitted to Iwaki by radio and received by Iwaki at 11:55 a. m. Sept. 5th, forwarded to San Francisco by radio and received there at 6:59 p. m. Sept. 4th which corresponds to 12:21 p. m., Tokyo time.)

Tokyo, September 2nd.

Commanding General,
Philippine Division, Manila.

The food situation here is acute stop please send supply by fast boats stop it is estimated that ten thousand lives have already been lost in Tokyo and the situation in Yokohama is probably worse.

Woods,
Ambassador

(Note. Filed by S. R. at 10:40 p. m. at the Navy Department, sent by messenger to Funabashi, transmitted by radio to Iwaki, Sept. 6th, 7:34 p. m. relayed by the U. S. Naval radio at Pearl Harbor to Cavite.

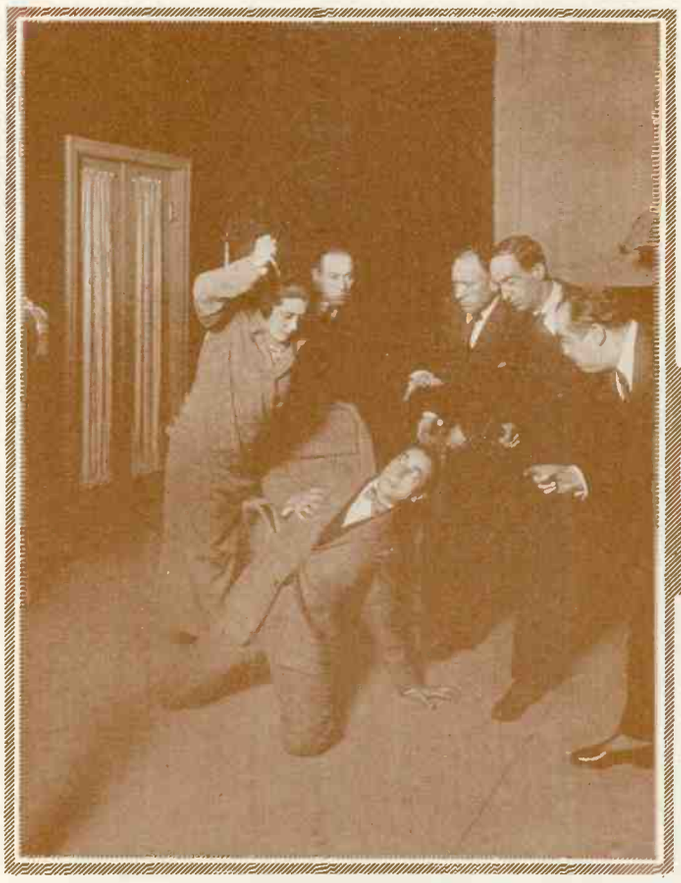
* * * * *

The following will be helpful in understanding the story of the Superintendent of the Iwaki radio station, Mr. K. Yonemura, who is the oldest radio operator in length of service in Japan. The Iwaki radio station is the high power station of the Department of Communications and forms the western end of the transpacific circuit of The Radio Corporation of America, the receiving and control station being at Tomioka, some one hundred and fifty-two miles north of Tokyo and the transmitting station at Haranomachi some twenty miles further north. This station is the Japanese outlet for the larger part of the Pacific transoceanic traffic exchanged between the U. S. and Japan, working with the high power stations of the Radio Corporation of America at Honolulu and San Francisco. Funabashi, the high power station of the Imperial Japanese Navy, is located at the head of Tokyo Bay, some twenty miles from the city, while Choshi, Shiomiasaki, and Shimotsui are coastal stations of the Department of Communications (the Teishinsho) for ship to shore service. Choshi is on the coast nearly due east of Tokyo near Cape Inubo, Shiomiasaki near Cape Ushio in Wakayama Prefecture

(*Continued on page* 48)

The receiving and control station at Tomioka

Costumes and Action in the Studio



The famous Grand Guignol troupe from Paris, now playing in New York, broadcasting a thriller in the French language from WOR. Their specialty: vivid drama

Clothes perhaps don't make the man, but when Jud Landon parades some fishing gear and old clothes he can tell a fish-story from WGY more convincingly

A "Farmer's Night" staged in the studio of WGY. Where several artists are rendering their combined effort before the microphone, the realistic effect produced by appropriate costuming and gesture reacts upon the artists themselves. Entering into the spirit of their act in this thorough fashion, they produce a more appealing entertainment. The listener is almost able to see the costumes and acting through his receiver

Popular People and Events by Radio

Edith Bennett, concert star, sings in Navy Day program at Electrical Exposition to radio accompaniment from WHN

Dorothy and Lillian Gish—saying good-by from WJZ to their host of friends before sailing to Italy to start a new picture

Football game delivered via Radio. The control tower at Franklin Field in Philadelphia, from which the radio announcer describes the gridiron battle, play by play

This "People" is not very big, but little fellers like him are "Popular" the world over. He doesn't have to "watch the birdie" any more. Radio sings and talks and whistles to divert his gaze and keep him quiet

MUSICAL Comedy Reduced to Wave-Lengths. A short time ago radio fans were treated to a choice bit from the popular "IRENE," when the KING SISTERS, Mary and Jane, broadcasted from WJZ

Opportunities In Radio Today

There's a Good Position Waiting for the Right Man. Six Different Ways of Breaking Into the Game

By Pierre Boucheron

"I WANT to get into radio. How can I do it?" This is the burning question which has been asked of me and probably of every other pioneer radio man during the past year. School boys in short pants, young men just out of college, clerks and all manner of business men, salesmen, middle-aged men who are past forty; old-young men who are past seventy and who are still in the running in spite of what Dr. Osler said ten years ago; girls and women—all have asked the question of the hour: "How am I to get into this radio business?"

Judging from these healthy questions, one would think that radio is the open sesame to all ills; that it is the happy solution of everyone's career problem; that it is all joy and no sorrow; that there is plenty of money to be made in it. All one has to do apparently is to get into it and the sooner the better and frequently with little thought as to qualifications.

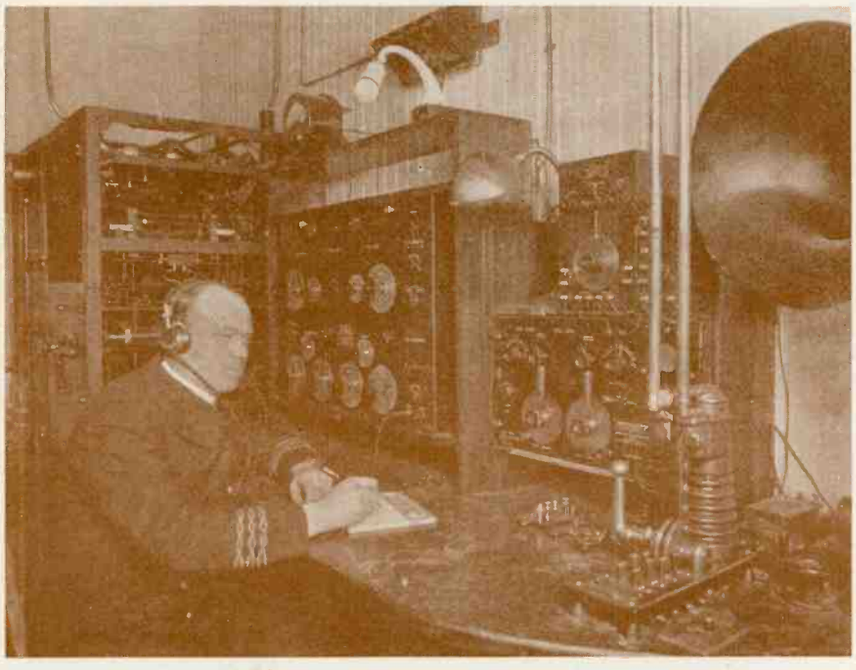
There are so many jobs to be filled in as many different branches of this big industry that it would perhaps be a good thing if I enumerated each one at this time and take up the factors connected with each afterwards.

As I see it, there are six main branches. These are:

1. Commercial Radio Operating
2. Engineering
3. Manufacturing
4. Broadcasting
5. Merchandising
6. Publishing.

Perhaps the most romantic and common start of many who are today leaders in this art is that known as commercial radio telegraph operating. As a matter of fact, these leaders, especially in the commercial and executive branches, started out as amateur radio operators and then branched out as commercial radio operators. There are two broad divisions in commercial radio operating. The first is the marine operator. This individual usually get his start as an amateur by learning the Continental code and communicating with his nearby amateur friends, first painfully slow in his speed of reception and finally becoming an expert relay man, handling non-commercial messages clear across the country. I am referring particularly to that great body of men associated with the *American Radio Relay League*. Later, the fascination of radio telegraphy, plus the desire to travel and see new worlds, becomes uppermost in the young man's mind and we see him taking the examination for a commercial operating license at the local inspector's office. A few weeks later he is upon the high seas on a tramp, tank steamer or a large sailing vessel.

For a few years he roams the seven seas, graduating from the tramp steamer class to the larger passenger vessels where he meets all manner of individuals among the passengers and where he visits strange ports and becomes familiar with the various races and nationalities of the world. This is perhaps the greatest and most fascinating



The Marine Radio Operator—E. N. Pickerill, chief operator of the S.S. "Leviathan"

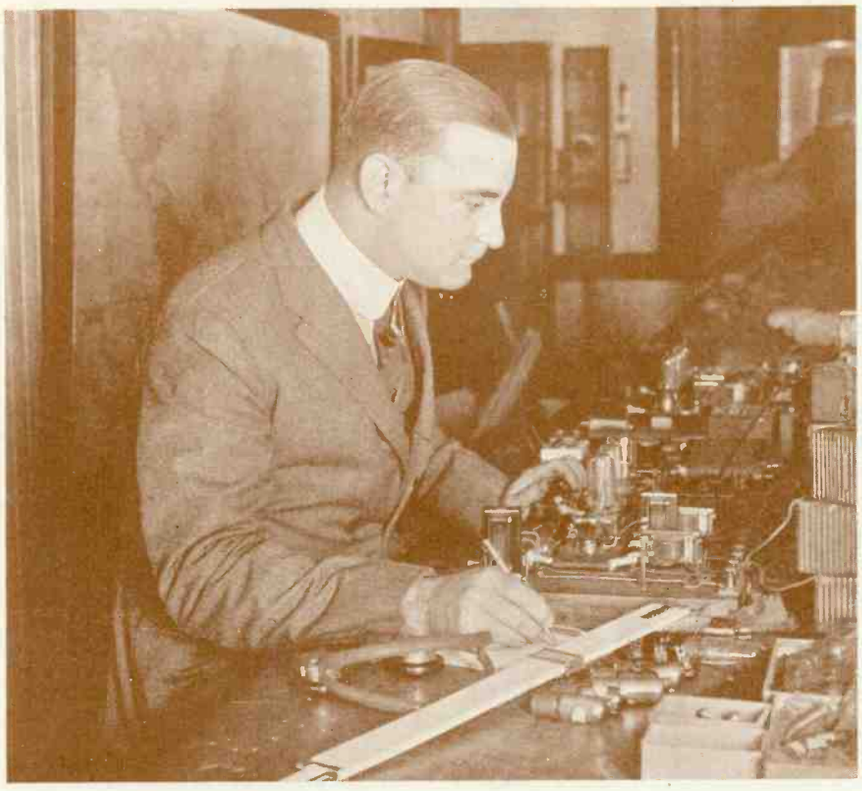
IT'S A GREAT GAME IF YOU FOLLOW THROUGH

Ten years ago a group of a few thousand men pushed on faithfully in their chosen work of radio. Some were ship operators, some were land operators, some were engineers, some construction men. Today, with few exceptions, these men have forged ahead steadily and are now holding key positions in the industry. Hard work, stick-to-itiveness, faith in the future of radio did it. In short these men followed through. Today the opportunities of radio are a thousandfold greater than they were ten years ago. The rapidly expanding art of broadcasting is responsible for this. There are a half dozen odd ways of breaking into The Game depending upon your individual taste and capability.

Mr. Boucheron is well qualified to write about this subject and to present the opportunities open today. He started as a "ham" amateur in 1907 and never lost faith in the great future of radio in spite of the early discouragement and unprofitable ventures of the pioneer days. Today he holds an important position within the rank and file of the Radio Corporation of America. This article is the first of a series describing the opportunities of radio. THE WIRELESS AGE plans to cover this important subject each month by a special article from the respective pens of several prominent men in the industry, men who will tell frankly and in uncolored language how any reader of THE WIRELESS AGE may enter one of the several branches mentioned in this paper.

It will interest some of our readers to know that this article was delivered by radio over WJZ on October 23, 1923. Over 200 letters were received from listeners asking for a copy of this talk. The interest displayed in this subject prompts the Editors to reprint it here in full for the benefit of readers of THE WIRELESS AGE.

THE EDITORS.



The Radio Scientist: Alfred N. Goldsmith, B.S., Ph.D, Fellow I.R.E., Director of Research Laboratory of the Radio Corporation of America

part of his career, for if I may use my own case as an illustration, I can say without the slightest hesitation, that some of the most ideal moments of my life were spent while a marine radio operator. Never shall I forget the thrill of anticipation, the feeling of accomplishment, the great hour of success when I stepped aboard my first vessel as a Marconi man.

The S.S. C——was a miserable tramp steamer of the fifth rate. She was laden to the Queen's mark with structural steel and a general cargo and was bound for the south side of Cuba. When she got out to sea she developed a bad list. The crew was the most nondescript crowd I ever saw even later after several years of experience. There were two Swedes, three beach combers, a college graduate who had long since lost all respectability because of drink, an ex-prize fighter who had seen better days, a clerk who had rebelled against a life behind a bookkeeper's desk in a dingy warehouse and a stowaway Cuban who was endeavoring to get back to his beloved country, the land of tomorrow—Lotus eaters all of them—fascinated by the spell of the Tropics. The captain was one of the hardest individuals I have ever met—"hard boiled" is the word. He feared neither God nor devil. The food was almost impossible, but to me this tramp steamer was a Leviathan. She was a seven-day wonder. I looked up at her aerials with an appraising eye and her radio shack seemed like a mecca for my dreams. The first trip on this steamer I lived in a daze. The sea was a revelation, tropical Cuba a Paradise. I shall never forget that first trip. It was wonderful.

I spent four years of this dream life and sailed on ships of various destinations and nationalities. Incidentally, I spent many hours in reading and in self-improvement, a point, by the way, which is often overlooked by the young ship operator. I saw new and strange parts and visited many foreign lands. It was not always ideal, however. There were storms; terrible, never to be forgotten storms; storms where even the captain had given up all hope of ever reaching land again. There were fires when the cargo had to be thrown overboard, jettisoned, it is called by sailors. There were shipwrecks and many other lesser catastrophes; nevertheless it was all very fascinating and enchanting.

It is simple enough to become a ship operator today. One goes to a school for training and after having secured a license, one waits for a ship assignment. This is possibly the easiest and most beneficial way of breaking into radio.

The other sub-division of commercial radio operating is that connected with land stations. In a few years the ship operator tires of the sea and wishes to settle down ashore. If he has become an expert radio operator, he is able to secure an assignment as a land station radio operator, working at one of the numerous coastal stations, the function of which is to communicate with ships at sea. Still another division of commercial radio operating is that of operator at a high-power trans-Atlantic radio station, such as those operated by the Radio Corporation of America. Employment of this sort does not necessarily mean that the operator must exile himself to some isolated section of the coast. Most land station telegraph operating is performed from a traffic center in a large city which controls the wireless station near the coast. Land station operating of this kind is practically the same as telegraph operating. It is a step up the ladder, however, because of increased responsibilities and greater opportunities. Later, the operator may become a minor traffic official or perform other executive work connected with this branch of radio.

ENGINEERING

When one has a natural bent towards engineering and provided also that one has the technical preparation such as electrical engineering it is comparatively simple to become a radio engineer. Post graduate courses may be had at various universities. There are several in this country who have of recent years recognized radio as a science and who have made it part of

(*Continued on page 53*)

Radio Manufacturing: The Factory

Cooking Eggs – via Radio

Miss Anna Lewis Pierce Runs a Newspaper Kitchen

By Hortense Lee

Miss Anna Lewis Pierce

"PLEASE send egg recipes as mentioned in Wednesday's broadcast by lady cooking expert."

This was one of a heap of letters Miss Anna Lewis Pierce showed me, when I asked if women were good radio listeners. There were letters asking for egg recipes—answers to one lecture alone—from women all over New York State and New Jersey—from Ohio, Massachusetts, West Virginia, even Canada. It is these letters that make the radio audience real.

Anna Lewis Pierce, Director of the Tribune Institute, runs the only newspaper kitchen. Now, through radio, its tests of foods and kitchen appliances reach all the country, instead of just the New York area. Her kitchen, though not a very big one, is a delight. Kitchen cabinet, electric range, everything for bright, clean efficiency. There, an expert in home economics, a domestic science expert, a dietitian, chemist and electrical engineer all work together to test foods, recipes and household appliances. All are people of wide experience. Miss Pierce herself was for ten years in the Federal Bureau of Chemistry, where the food law is administered. Her talks are not only interesting, but authoritative; her recipes not only cooked, but eaten.

Many a man comes home these days to find tempting new dishes on the table, but his radio batteries much weakened. And many a man listens eagerly to the food talks, sometimes dictating a little note next morning, to please send his wife some of those recipes. One man wrote:

"New York Tribune:

"Dear Sir—Last evening while listening at the radio, I heard the address broadcasted by WJZ, of Annie Lewis Pierce. Subject, "Eggs for Breakfast, Lunch and Dinner." To me this talk was very instructive, and I was awfully sorry my wife was absent, as she has the memory for the family.

"At the conclusion of your talk I understood you to say anyone wishing the directions of preparing 'Eggs the Nineteen Ways,' to address as above. I would like very much to have the directions. Thanking you in advance, I am very truly,

"....."

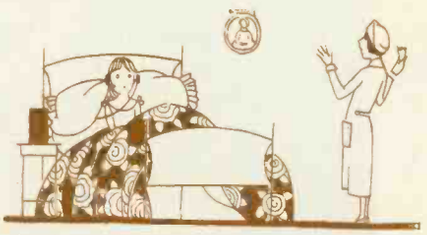
"If any charge please advise."

But most of the letters are from women. A young bride who says she just started housekeeping, writes:

"I am fortunate enough to get plenty of strictly fresh eggs, and would like to try a few of the dishes you mention."

Another writes:

"I tried the scrambled eggs your way and they were elegant."



And so they read on:

"I was ill at that time and listened in while in bed."

"I enjoy your talks over the radio to the utmost. I know a great deal more about food than I did before I heard you."

"I like eggs very much, and I would like to know how to cook eggs in different ways."

"I really enjoy your discourses and make a point to chase up to my son's room, where he has his radio installed. It is a crystal set he made himself, and in my anxiety to get paper and pencil for one of your candy talks before Easter, I shook off the crystal, so lost out, I am sorry to say."

(*Continued on page* 25)

A corner in the busy kitchen where radio recipes are tried out

Woodrow Wilson Breaks Silence of Years

Thousands of Letters From All Parts of the Country Proclaim Enthusiastic Response to His Startling Declaration of Position on the Issue Carried With Him to Long Obscurity

Ellen Wilson McAdoo, on the left, Mary Faith McAdoo on the right, in Mr. McAdoo's suite in the Hotel Hamilton, Washington, D. C., listening-in to their grandfather's speech.

Unique in their position of "audience" they care little about the whys and wherefores of League Covenants or Foreign Relations. To them it is grandfather talking

WOODROW WILSON'S address, "The Significance of Armistice Day," was broadcast by WCAP in Washington, D. C., and WEAF in New York on November 10th.

He presented his appeal for America's participation in world affairs without compromise from his original position. Reminding us that Armistice Day should be a time of exaltation because of the recollections prompted, he deplores the fact that we turned our backs upon our associates and refused to bear any responsible part in the administration of peace, or the firm and permanent establishment of the results of war—won at so terrible a cost of life and treasure—only to withdraw into a sullen and selfish isolation which is deeply ignoble because manifestly cowardly and dishonorable.

In conclusion he declared that the only way in which we can worthily give proof of our appreciation of the high significance of Armistice Day is by resolving to put self-interest away and once more formulate and act upon the highest ideals and purposes of international policy.

And his closing words were: "Thus, and only thus, can we return to the true traditions of America."

The complete success of broadcasting Wilson's speech may be better appreciated from the fact that thousands of letters were received by WEAF from listeners-in all over the country expressing their delight not only with the address itself but as well with the clearness of reception, one amateur in Colorado claiming perfect results on his loud speaker.

The extent to which prominent speakers can reach millions of people vastly scattered over an immense territory was demonstrated as being most practicable by radio.

A few years ago Woodrow Wilson's address at best could have been heard by a comparatively small audience.

Cooking Eggs—via Radio

(*Continued from page* 24)

A husband and wife listened in together in one home, when Miss Pierce spoke of eighteen-cent veal. "See," said friend husband, "you can get cheaper meat." His wife wrote indignantly to Miss Pierce to ask where. Telling where, and telling how to make that cheaper meat appetizing and delicious is a big part of Miss Pierce's job. She says that the man wants to eat the expensive cuts, but to pay for the cheaper ones. And American women have yet to learn to make the most of the inexpensive meats.

A man will go to a restaurant and pay a good price for a French "ragout." At home, he scorns the common American stew. The meat is the same. The difference is in simple matters of seasoning and preparation. More power to Miss Pierce and her pleasant radio voice, if she can turn our stews into tastier dishes.

"Foods for Health and Pleasure" is the general title of Miss Pierce's talks. Today, foods are our health remedies —not drugs. And much of the pleasure is in the preparing. Miss Pierce puts into the job of cooking all the interest and delight of an artist—and is trying to spread, through her talks, a sense of real enjoyment in cooking. Not only her experience, but her deep personal interest, gives her a sympathetic contact with the homes she is addressing. Many of the troubles of these homes are brought to her, and she finds much pleasure in helping to smooth them out.

Miss Pierce spends considerable time preparing her talks, and delivers them with much spirit to a very real audience, though only the little microphone appears before her. She has lectured on canned foods, on vegetables, on meats—each talk filled with practical, up-to-the-minute, ready-for-use ideas, with a bit of fun to make them good to listen to, and as much of personality as voice can carry through the air.

It is interesting to know how this woman lecturer feels about her radio audience. First, full of her subject, with a keen, sympathetic imagination, she feels the elation of talking to people everywhere; sees them listening interestedly—young, old—men, women —near, and miles away.

Then sometimes, half way through a talk, will come a sudden sense of utter flatness. How perfectly simple and foolish it seems, talking to a little instrument! Surely the people have tuned out or gone to bed, or switched to some other program. But the proof of this particular pudding is right in the dish on the table; many tables everywhere. And in the hundreds of letters that come in; some appreciative, some asking for more information, for recipes, for diet lists. These letters are the inspiration of the radio speaker. Keep them coming, if you want more lectures.

Footing the Broadcasting Bill

It's All Very Well to Turn the Dials and Pick Our Choice of Several Dozen Radio Programs, But How Long Is This Gratis-Free-for-Nothing Thing Going to Last?

By Austin C. Lescarboura
Managing Editor of The Scientific American

IF the automobile manufacturers supplied us with free gasoline, irrespective of what make of car we were using; if the phonograph manufacturers supplied us with free records for any make of phonograph; if the electric light and power companies supplied us with free current, because we had wired our homes; if the manufacturers of heating plants supplied us with free coal—if any of these things took place, then we would have a real parallel for radio broadcasting.

As it is, radio broadcasting is unique. There never was anything else like it; there is nothing like it today. And, most likely, there will be nothing quite like it in the future; for, truth to tell, the present state of affairs is economically unsound—and unfair.

The Old Story of the Early Bird

The story of how broadcasting came about is too well known and, as a matter of history, is too recent to require reiteration at this time. Suffice it to point out for the purpose of the following discussion that the early broadcasters were moved by one of three motives, and, in several instances, by all three. First, they broadcasted as a mere matter of radio telephone experimentation; in truth, that is how radio broadcasting came into being. Secondly, they broadcasted in order to put something in the air which the public would want and which could only be taken out by means of a radio receiving set, thus bringing about a popular demand for radio receiving equipment. Thirdly, they broadcasted because it afforded a new avenue of publicity at a time when other avenues were quite choked up. In the beginning there were very few broadcasters, to be sure, and these early birds certainly caught the figurative worms as a reward for their labors.

But these ideal conditions did not obtain for long. Presently, broadcasting became something more or less akin to an epidemic. Not only did receiving sets multiply by leaps and bounds, but more and more individuals and organizations suddenly discovered that they must broadcast some message or other to the public. From less than a dozen broadcasting stations, the number rose to 847, representing the high-water mark of the broadcasting fever, supplying good, bad and indifferent programs to well over two million receiving sets.

The pioneer broadcasters found themselves submerged by the avalanche of broadcasters. They no longer enjoyed that close and intimate contact with their listeners which marked the early days of the new art, because they now had to share their erstwhile exclusive audience with hundreds of other broadcasters. The early radio manufacturers who had found it profitable to broadcast as a means of stimulating radio sales, soon discovered, very much to their surprise, numerous newcomers pouring into the radio manufacturing field to take advantage of

A small tax on each vacuum tube

the business created through broadcasting. These newcomers, for the most part, have failed to contribute a single thing towards broadcasting or any other factor which has brought about and is maintaining the present radio industry. And then, as though to add insult to injury, they have proceeded to slash prices and to indulge in the most questionable business practices, while expecting the large radio manufacturers to continue broadcasting for the purpose of sustaining the radio industry. Queer psychology, this, and very much like biting the hand that feeds them. How long would these parasites last if the leading broadcasters were to quit in sheer disgust!

All for Publicity

As for the publicity possibilities of radio, these are as good as ever—better, if anything, because of the greater number of listeners. There is no better way of bringing a story to the attention of a large gathering of people than by radio broadcasting. Even the mere mention of the company doing the broadcasting has been considered ample reward, in numerous instances. It is thanks to this intangible something called publicity, therefore, that we are getting many of our excellent programs from organizations that are totally disinterested in the manufacture and sale of radio equipment.

Strangely enough, the little publicity that these unselfish broadcasters secure is often begrudged them. Every so often some bright individual solemnly rises to criticize the mention of the broadcaster's name, and to call attention to the alarming fact that said broadcaster is deriving real publicity from his broadcasting. Even newspaper men occasionally express their anxiety and displeasure in the matter of publishing the radio programs, with the customary mention of the call letters of the various broadcasters. Time was when these programs carried the name of the broadcaster as well as the call letters, but now the only mention made is that of the call letters and possibly the location of each station. Still, there are those who feel that the broadcasters are getting publicity—free advertising—from the mere publication of their call letters.

Now just for the fun of it, let us look into this question of free advertising. Instead of dealing with generalities, we will take a concrete case —the excellent WWJ station maintained by the *Detroit News*. The author was recently informed while visiting this station that it costs between $75,000 and $80,000 per year. This cost is due in large measure to the excellence of the WWJ programs. The WWJ orchestra alone, which is one of the very finest musical treats available through broadcasting, represents a considerable item in the total expenses. The first-class soloists who go to make the ensemble of this orchestra are paid handsomely for their frequent performances before the microphones. Then, too, the operating staff of this station is rather large.

Of course, WWJ has served as nothing else possibly could serve to spread the name and fame of the *Detroit News*. This progressive newspaper is performing a most commendable service for the Detroiters primarily, and for a wide circle of broadcast listeners. Indeed, the *Detroit News*, through its WWJ station, has become a real national institution, extending its activities far beyond its customary bounds. Whatever tangible value broadcasting may have for this enterprising newspaper must come through its efforts in the immediate vicinity of Detroit, however, while the longer reach of its radio arm must be considered as a most unselfish contribution to radio.

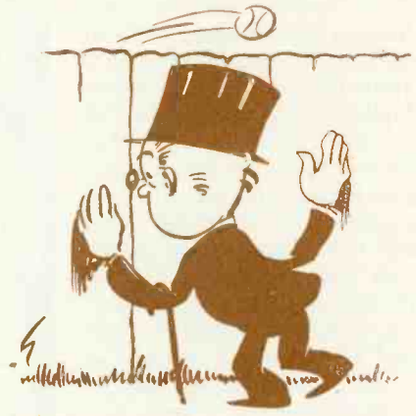
But what are the tangible results? What has been bought with the expenditure of $75,000 to $80,000? Merely publicity and the good will of the listeners. The results are so vague that they cannot be measured with any yard-stick. No direct commercial benefits are derived. The same sum of money could be employed to buy advertising space in newspapers and magazines throughout the country, if desired. Why, therefore, begrudge such publicity as WWJ may receive?

THE HIGH COST OF BROADCASTING

And so it goes with other broadcasters. Aside from the original investment for the broadcasting equipment which may range from $50,000 to $100,000 for a high-power station, the weekly cost of a first-class program, including the operating expenses, is in the neighborhood of $2,000. Obviously, the small broadcasting stations, with infrequent and short programs, have lower expenses, some of them operating for as little as $250 per week. Please note that these operating costs are based on obtaining free talent, for the most part. As yet but few broadcast entertainers are being paid for their services, but the evil day will soon be upon us when many of them will insist on remuneration.

With the high costs on the one hand and the not altogether satisfactory rewards on the other, it is to be expected that many broadcasters are losing heart. Not a few have quit. From a total of 847 licenses granted by the Department of Commerce for broadcasting, the active number of broadcasters at this writing is 565, or a decrease of over 32 per cent. While on its very face such a drop might be considered a serious blow to the art, as a matter of cold fact it is a blessing in disguise. Most of the discontinued stations were of limited power and mediocre programs, and with their elimination it becomes possible for listeners, in their respective territories, to pick up the high-grade programs of the better stations. In fact, there are still far too many broadcasters in the air. Here is a case where quantity is a decided disadvantage. It makes for unnecessary interference. Better to have fifty first-class broadcasting stations, properly distributed so as to blanket the entire country, than over five hundred as at present. Hence there need be no weeping and gnashing of teeth over the present mortalities in radio broadcasting, just so long as the worth-while broadcasters stick to their lasts.

And here we are face to face with the ultimate problem. We must see to it that the real broadcasters remain with us. Just because they are supplying us with excellent programs day in and day out is no proof that all goes well with them. As a matter of cold fact, they are having a rough time of it. Talent is becoming increasingly rare—on the free basis, of course. time after time the announcers ask us to send in letters of appreciation and comment, in order that the talent may have something by way of applause. Yet how many of us take the trouble of writing just a few lines of appreciation? It is the only way, at present, in which we can repay the radio entertainers.



Listening-in like peeping through the knot-hole at a baseball game

Let us not be lulled into the belief that broadcasting is firmly established on the present basis. Let us not be led to believe that it is due us. Having paid nothing for this service, we are not entitled to demand such service. There are not a few among us who have felt for some time back that listening-in under the present arrangement was not unlike peeping through a knot-hole of the baseball field. There is a growing feeling among broadcast

(*Continued on page* 51)

Picking Up Broadcast Music

The Difficulties Encountered in Picking Up and Reproducing What Happens in Concert Hall or Broadcast Studio

By Alfred N. Goldsmith, B.S., Ph.D.
Fellow I. R. E.

THE human ear is a truly marvelous instrument. Few people recognize all the amazing feats which the ear and brain in combination can perform, and therefore how difficult is the task of the broadcast device which aims to hear and pick up for the listening radio audience exactly what is happening in a concert hall or studio.

To begin with, the ear hears a tremendous range of differently pitched sounds from the lowest notes to the highest. The deep boom of an organ pipe lies at one end of the gamut of notes which the listener prefers to have reproduced. At the other end of the long range lie the overtones of the violin and piccolo in all their interesting and tart shrillness, and the high pitched overtones which alone make the spoken consonants "s" and "f" sound natural. Actually the necessary frequencies range all the way from the ponderous tone of about 30 vibrations in a second to the piercing sound of 10,000 or more vibrations per second. If the lower frequencies are not correctly picked up the piano sounds "tinny," the baritone voice becomes a tenor, and the speaking voice, while understandable, sounds thin and unnatural. On the other hand, if the high frequencies are left out or partly lost, the violin sounds like a flute, orchestras give a jumbled and incomplete impression, and the voice, particularly of the feminine speaker, sounds muffled and indistinct.

The ear is also capable of hearing and appreciating a wide range of loudness in a sound. One can hear and understand a faint whisper and also an almost deafening shout. In broadcasting, so extreme a range of loudness is hardly required, yet it is necessary that the expression of a piece of music be preserved by subduing appropriately the softer parts, and accentuating fully the more forceful portions. It is not easy to find a suitable telephone transmitter and vacuum tube amplifier that will preserve the relative loudness of tones accurately. It becomes necessary to use vacuum tubes in somewhat extravagant fashion, most of the time working them far below the output they will give in other service in order to avoid distortion when loud notes are produced.

The artists must be correctly disposed before the microphone. The singer, carrying the melody, right before it; the violinist with the obbligato a trifle to one side, the piano farther away

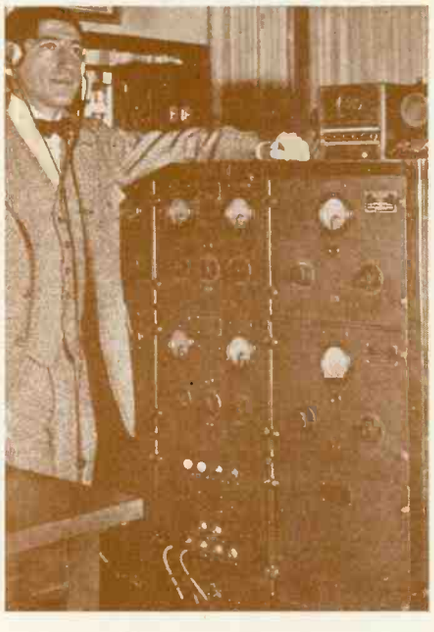
Another characteristic of the human ear, or it may be, of the brain, is the ability to concentrate on a strain of melody or a particular part of a musical composition. This is particularly noticeable in connection with orchestral compositions. It is well known that the ear and mind can pick up and follow the melody played by the violins of an orchestra although the remainder of the orchestra is also contributing its full quota to the total of sound. To some extent this can be imitated in broadcasting by properly placing the transmitter so that the instrument carrying the melody is nearest to the transmitter and thus is accentuated in the resulting broadcast music. This, however, is always done at the risk of exaggerating this instrument unduly, or of suppressing other important instruments, and thus doing what is known as "throwing the orchestra out of balance." In fact, a good musical critic is a necessary element in every broadcasting station that has any pretensions to sending out really artistic productions.

Having mentioned the problems in picking up music for broadcasting, it may be desirable to give some of the various solutions for them which have been found. "The telephone transmitter which is used must be a very different device from the ordinary transmitter used on the usual telephone system." While the ordinary transmitter suffices for speech under comparatively uncritical conditions, it would not do at all for broadcasting. In the first place, it would be far too noisy. That is, "the average transmitter produces a certain amount of hiss and crackle which would be intolerable in high-grade broadcasting." When carbon grain transmitters are used, they have to employ a special grade of carbon and to use very small currents so that they will produce a minimum of such objectionable noise. Otherwise the desired velvety silence when the artists are not singing will be missing, and the audience will be distracted and annoyed by the hiss of the transmitter.

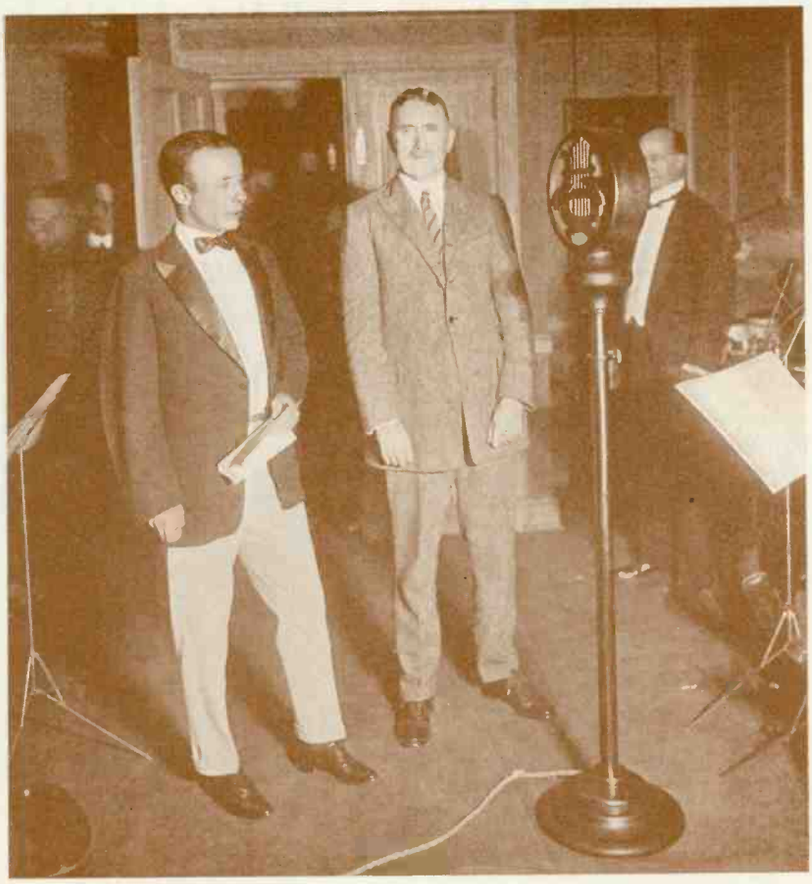
A second objection to ordinary telephone transmitters is that they exaggerate certain frequencies of the voice or music very markedly because the vibrating diaphragm or sheet of the telephone transmitter responds most vigorously, or "resonates," to certain frequencies or pitches. This is not acceptable in sending out music. Particularly dangerous would be the effect of such partiality for certain notes if the transmitters were used for sending out an orchestral selection. Some instruments would be partly suppressed

and others exaggerated, thus spoiling the effect. So that it becomes necessary to use a telephone transmitter which has a diaphragm which responds as evenly as possibly to notes of all pitches. One way of doing this is to use a thin and powerfully stretched diaphragm of steel or some other strong material which will respond equally to all usual tones. Another way is to use the so-called "glow microphone," where the vibrating element is a small column of glowing gas through which a small electric current is passing. Yet other methods are available, but most of them not particularly simple.

The telephone transmitter used for pick-up in the studio has to be suitably mounted and wired up to the rest of the equipment. One of the photographs accompanying this article is the pick-up transmitter at station "WRC" of the Radio Corporation of America, located at Washington, D. C., and familiarly known to listeners as "The Voice of the Capital." Standing before it is Assistant Secretary of the U. S. Navy, Colonel Theodore Roosevelt and Major General John L. Hines, Deputy Chief of Staff of the U. S. Army. The transmitters—for there are two inside the casing—are enclosed in a casing which carries a design that is highly symbolic of broadcasting. It shows the harp—the emblem of music from earliest times, and the spark—which has always remained our classical symbol for radio. Although the spark is really not used in radio telephone stations, yet the harp-and-spark design is an appropriate symbol for "music carried by radio." This particular design is due to Mr. Edward Field Sanford, Jr., one of America's leading sculptors and also, incidentally a most ardent broadcast listener.



Controlling the quality of tone



Colonel Theodore Roosevelt, Assistant Secretary of the Navy, and Major-General John L. Hines, Deputy Chief of Staff of the Army, before the microphone of WRC, "The Voice of the Capital"

The amount of power which it is possible to get from these high-grade telephone transmitters is nearly always very small, and it becomes necessary to amplify it by means of a powerful amplifier. This amplifier must also be free from noise-producing tendencies, and must amplify notes of all pitches equally. Both these requirements are very difficult to meet. Either resistance-coupled amplifiers have to be used, or else the greatest care has to be taken in the design of the special transformers used in a transformer-coupled amplifier for this work. Ordinary amplifiers would not serve at all, as is sometimes evident when listening to the "music" emanating from a badly designed broadcasting station. A good idea of the elaborate nature of a suitably designed amplifier is obtained from the photograph accompanying this article which shows the control room amplifier of Broadcast Central, Stations WJY and WJZ of the Radio Corporation of America at Aeolian Hall, New York City. This amplifier is really two amplifiers, one at the top of the case, and the other at the bottom. Special relays permit either amplifier to be used at will so that there is always a spare amplifier available in case a tube burns out or some other defect develops in one of the amplifiers. The control room engineering attendant at these amplifiers is perforce chained to his post during the entire performance listening to every note that goes out through special "monitoring sets" and maintaining loudness and quality of the music by the suitable controls which are provided. He also has a number of special colored signaling lamps before him on the control room amplifier so that he knows just what is going on in the studio and whether the transmitter which he controls is actually "on the air"—that is, transmitting—or not.

Clearly carelessness and simplicity have no place in either the design or the supervision of the pick-up transmitter and control room amplifier of a satisfactory broadcasting station. The broadcast listener would do well when he is especially pleased by the clarity and excellence of an evening's performance to remember something of what has been done by "brain and brawn" in reproducing in his home the intricate and yet delightful melodies and sounds which make up the broadcast program.

Radio Making Sport Interest Nation Wide

We Can Participate in the Event When it Transpires. No Need to Wait for Cold News

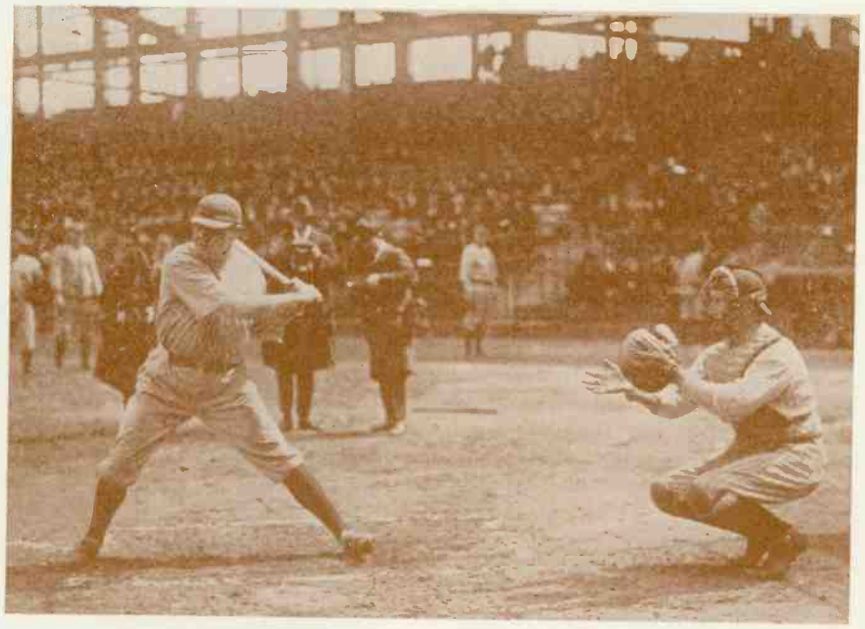
By Raymond Francis Yates

THOSE who know the technical, economical and commercial limitations of radio have always objected to the manner in which unseasoned radio editors are inclined to speculate. Some of our more daring and imaginative newspaper scribes have had it doing everything from curing cancer to felling airplanes. It is a jack-of-all-trades, capable of turning the world topsy-turvy.

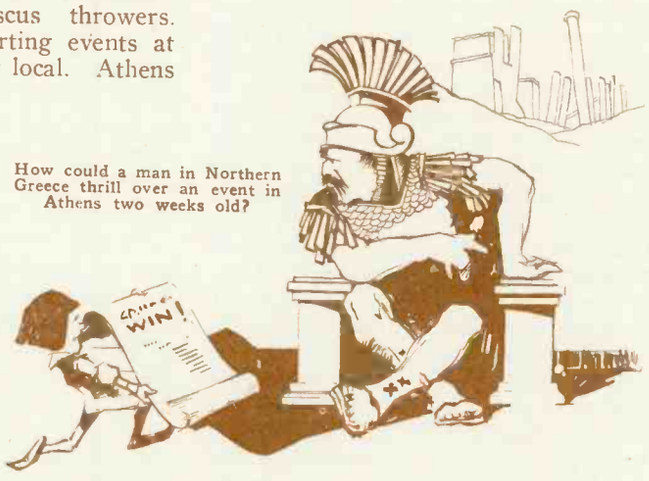
Radio is a tremendous thing and it is easy for one to under-estimate its importance and the far-reaching effect that it will have upon the lives of men. The writer mentions these things just to warn the reader that he is not off on one of these highly speculative tangents telling how radio is going to do this and that with the avowed purpose of shocking someone's imagination. He is not going to tell what radio can do but what it is doing.

If there is one thing upon which radio has made an unmistakable impression it is sport. Indeed a careful observer will agree that radio has proved itself a needed stimulant, for a new wave of enthusiasm is passing over the entire country. This is not a phenomenon, but the natural, inevitable outcome of the broadcasting of sport events.

Before the writer goes further with his argument, he would first like to prove to the reader, beyond the question of a doubt, that national interest in any sport is simply a matter of communication. Offhand this may sound like a wild statement, unfounded in fact, but let us go back to the time of ancient Greece with her unmatched marathoners and discus throwers. Practically all the sporting events at that time were entirely local. Athens had its meets as well as other cities. But there was no rousing national enthusiasm or keen interest in any one particular match. How could there be when news traveled so slowly? What enthusiasm could a man in northern Greece have for an event in Athens when it took two weeks for the outcome to reach his ears? Each particular community, where news could travel by word of mouth with a fair speed, could, of course, raise itself to a normal pitch of interest. But, in any case, there was not that great national fever that can be worked up today. Take our world's series, for instance, the broadcasting of which is still fresh in our minds. The baseball fans of Buffalo, Chicago or Philadelphia were just as keen about the outcome as a man in the Bronx whose apartment window overlooked the Stadium. The reason is simple enough to understand. The men in Buffalo, Chicago and Philadelphia have kept themselves informed regarding the vying teams throughout the entire year. They know the batting average. the errors and the general record of each player. They read it in the newspaper every night or they get it over the radio.



The World's Series attendance multiplied with the advent of Radio



How could a man in Northern Greece thrill over an event in Athens two weeks old?

When Benjamin Franklin was Postmaster General of the United States, it took over two weeks for a communication to reach Buffalo. Compare two weeks with two minutes and you can easily account for the enthusiasm of the Buffalo fan. It keeps his imagination fresh and alive because he knows that the event has just happened. It isn't stale; it isn't a thing of yesterday or last week, it is fresh and stimulating. Would the enthusiasm of any fan survive to thrill him if he had to wait two or three weeks to hear of the outcome of a sporting event? It is the rapid spreading of news that has given to America that great and healthy love of sport, that has placed her in the front rank as a sport-loving nation.

We do not have to go back very far in history to discover the period during which our sporting fever began to grow and thrive. Before the telegraph came there were no Bob Fitzsimmonses, Babe Ruths or Bill Tildens. If there was a big event in Buffalo, the man in Frisco had no interest in it for the thing was history by the time he got word of it. Each event was isolated to the community in which it took place.

When clicking telegraph instruments began to feed hungry newspaper columns with red hot news, there was born in the national heart an undying love for the thrill that comes through the contest of human skill and power, whether it be fighting, sculling or automobile racing. Before Morse's telegraph system came into wide use sports were practically dead in this country.

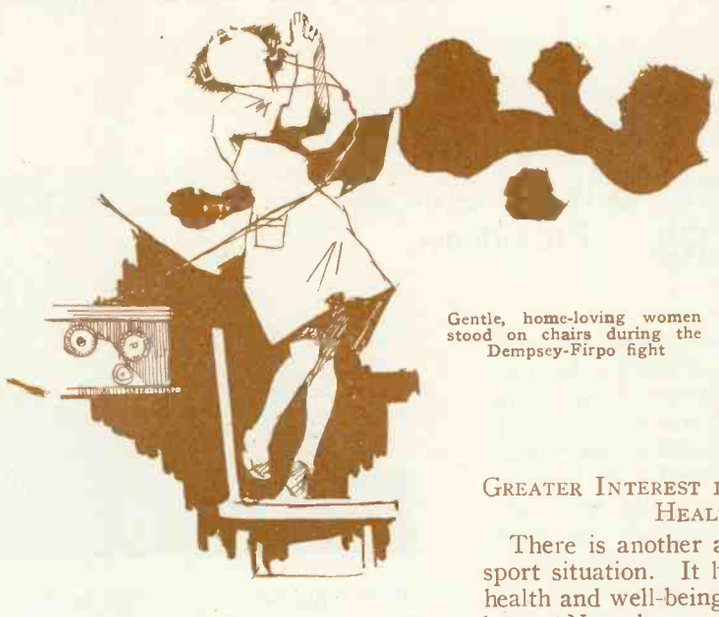
Ask any real old man to name a few of the champions of his early youth. Indeed, sport was dead until 1850. John L. Sullivan owes his fame to the noisy little telegraph instruments that brought the news of his prowess to city and hamlet of the United States.

Before the Atlantic cables were installed, what did we care about the fast English racing horses or the outcome of boxing matches? If we can have the details the same day the event happens the thing takes on an altogether different aspect, especially if preceding news items have kept us "keyed up." If we had to wait for the *Leviathan* to bring the news what a drop the barometer of sports would take!

SPORTS NOW BROUGHT TO YOUR EASY CHAIR

Is it not natural therefore that radio should bring about a great revival of love for sport? Here is an instrumentality that so effectively annihilates space and time that it permits us to move our easy chairs to the noisy grand stand of the football and baseball fields, the race tracks or the spectators' boats of the regatta. No event, whether taking place in the clouds or the English Channel is out of reach of the radio. The extent of the usefulness of radio would be appreciated by wondering what would happen if we had to stretch wires to these points and connect every home to the main line by their use.

If the growth and support of sporting has been brought about through communication, we have every right in the world to expect that radio will bring with it a revival that will end one knows not where. It has already created a stir. People who never before took an interest in sports have found them to be exhilarating. They did not go over to the baseball field to get this enthusiasm, it was brought into their homes through the loud speaker or telephones. They tasted a little bit of it, liked it, and had more. Radio was the first thing that actually ever brought them into contact with clean sport. Many of them never knew what they had been missing until the voice in the loud speaker brought to them a mind picture of a great contest; brought to them the living voices and actions of the players as well as the fans. Thousands awoke to find that they had discovered a new form of recreation. Gentle, home-loving women who thought they never could be interested in a prize fight found themselves standing on chairs during the excitement of the Dempsey-Firpo battle. Business men who never liked baseball listened to the report of one over the radio and next day found them for the first time lured to the grand stand. The conversion was wholesale, for radio is now installed in probably three million homes, and any converting that it does is usually done with a vengeance and it is necessary to deal with appalling numbers. If only five per cent. of the listeners were made better sport lovers the calculation brings us to a figure of two hundred thousand. The writer knows of a dozen and one people who had aroused in them a desire to see either a prize fight, baseball or football game. Before radio they were phlegmatic and uninterested.



Gentle, home-loving women stood on chairs during the Dempsey-Firpo fight

A few years ago there was plenty of room left in the grand stand at the world's series, although the Polo Grounds Stadium was not as large as it is today by some few thousand seating capacity.

RADIO HAS INCREASED GATE RECEIPTS

Last year the world's series was broadcasted by radio. This year, both the Polo Grounds Stadium and the Yankee Stadium, which by the way is the largest in the world with a seating capacity of 62,000 souls, were filled to overflowing at every game, piling the gate receipts up to a point well over a million dollars and only six games were played! Never before had so much money been taken in at a world's series. Never before was there such a nation-wide interest in the games. Is it not reasonable to conclude that radio has been responsible for this new support?

The American Baseball Writers' Association objected to the broadcasting of the world's series on the grounds that it would interfere with the sale of the evening newspapers that carried a story of the games. Fortunately the wise and able Judge Landis overruled their objection. Did it interfere with the sale of papers? It did not. It helped the sale by tens of thousands, for the fans who had heard White and McNamee describe the action, play by play, in the most vivid fashion, turned off their loud speakers and hied them out to buy a paper to see how accurately the broadcasters had described the games and also to get details of the games not possible to report over the radio. Practically everyone who listened and who felt the excitement had this desire to buy a newspaper and to read again the actions that took place. Every newspaper circulation man in New York City will disclaim that radio had anything but a good influence upon the distribution of newspapers carrying sporting pages. Here again we find radio building up in a constructive way.

What holds true of baseball holds true of fighting. Half again as many seats could have been sold for the Dempsey - Firpo fight, and what holds true of this also holds true of football.

GREATER INTEREST IN SPORTS MEANS HEALTH

There is another angle to this radio sport situation. It has to do with the health and well-being of the country at large. Now that everyone with a radio receiver is exposed to the thrill that sport brings, is it not reasonable to believe that we will have more actual participants in sport? For instance, a man listens to the account of an exciting tennis match. He may decide at the time that tennis is just the game he would like and next week we will probably find him on the neighboring tennis court trying his best to learn all the tricks of the game. If he is young, he may succumb to the lure of baseball, to running, boating or a dozen other sports. This is happening every day and will continue to happen. Women, too, will be led to the tennis court, golf links or swimming pool.

This wholesale conversion to outdoor sports is bound to have a beneficial effect on our national health and consequently on morality statistics. It is just another instance of the way in which radio is bringing with it undreamed of benefits. The radio horn is a potential spreader of good.

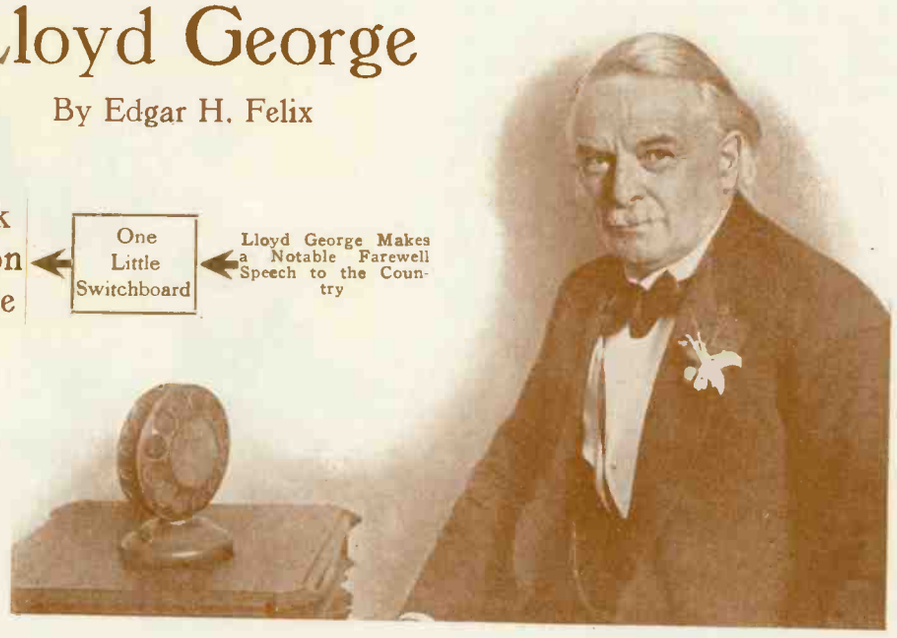
Every sporting event of any consequence that is broadcasted is now carried to an amphitheatre large enough to pale the great Coliseum of the Romans into insignificance. Its seating capacity is limited only to the United States, and out of the millions who are seated in it we can expect to win many thousands over to be not only lovers of sport, but participants as well.

The glow of vacuum tubes in thousands upon thousands of homes, accord former Premier of Great Britain a farewell reception of proportions never before enjoyed by a guest of the nation

Radio's Torchlight Parade to Lloyd George

By Edgar H. Felix

A MILLION LISTENERS ← New York Washington Providence ← One Little Switchboard ← Lloyd George Makes a Notable Farewell Speech to the Country



THE uproarious welcome to Lloyd George as he stepped on the platform of the Metropolitan Opera House in New York was an expression of cordial feeling which only an American audience can accord a world hero!

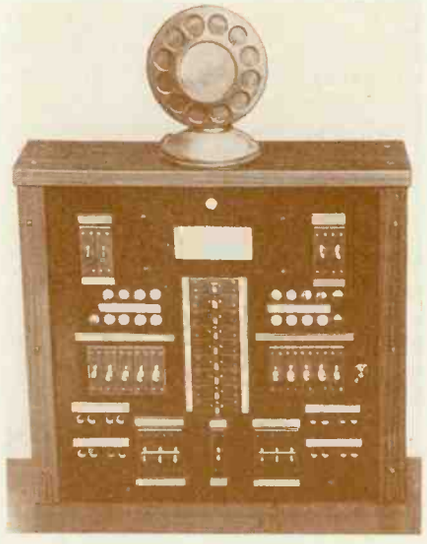
But a magic eye could have perceived a greater reception—the glow of a million expectant vacuum tubes—which exceeded in significance the cheers of ten thousand lusty throats. The little beacons of the ether awaited America's guest in hundreds of thousands of homes and augmented the army of listeners to Lloyd George's momentous speech of November 2nd by hundreds of thousands. If these glowing ether sentinels could have passed in review before the ex-Premier's eye he would have seen a torch light parade which has never been equaled in the annals of time.

Here was a reception to the mighty leader who directed the destinies of the world's greatest empire through the world's greatest war which, though unseen, was none the less a great step in promoting international intimacy. Radio broadcasting made possible an acquaintance with one of the greatest characters of the age which months of speaking could not have accomplished. The use of lines in connection with several broadcasting stations made this event of even still greater scope and significance.

Three scattered stations, WEAF in New York, WCAP in Washington, D. C., and WJAR in Providence, R. I., enabled the owner of even the simplest of radio sets to pick up Lloyd George's speech almost anywhere along the Eastern third of the United States.

The microphones on the speaker's platform served as the connecting link with an extensive lay-out of special telephone equipment. The tiny microphone currents which it controlled were amplified through a special speech input panel at the Opera House which supplied telephone lines leading to WEAF's plant department.

We will not consider technical details more than to point out its special functions. Before it may be used in connection with radio broadcasting a telephone line must be especially treated to adapt it for the purpose. The output of these lines is subjected to immense amplification by the radio transmitter before it is broadcast into the ether. Any extraneous noise or distortion even though completely inaudible to one listening on an ordinary telephone line becomes objectionable when broadcast in its amplified form. To accomplish a degree of quality required for broadcasting, a surprisingly large array of adjustable inductances, capacities, resistances, filters and what not, must be manipulated by skilled engineers. Preparations involving extended tests contribute in no small degree to the quality of what is ultimately sent into the ether.



This is the announcer's switchboard at WEAF, through which programs coming over land line from various other stations may be put on the air in any or all of the Bell System Broadcast Stations. Conversely, programs in any of the associated Bell Stations may be routed to any of the other stations in the system.

Who can say that this is not the forerunner of a super-switchboard of the future, that will distribute programs to broadcasting stations all over the country!

The nerve center of WEAF and its associated stations is the special switchboard installed in the announcer's booth. This board serves as an exchange for both incoming and outgoing programs and provides for separate or simultaneous announcements through various stations connected with it. Cam switches on this board control all circuits, both incoming and outgoing.

Special telephone circuits lead from the switchboard at 195 Broadway to the terminus of the long distance telephone lines at 24 Walker Street. All

long distance telephone circuits centered about New York terminate in the Walker Street Building and the transmitting apparatus of Station WEAF is also installed there, including lines connecting with broadcasting Station WCAP of the Chesapeake and Potomac Telephone Company in Washington, D. C., and to the Outlet Company's Station WJAR in Providence, R. I.

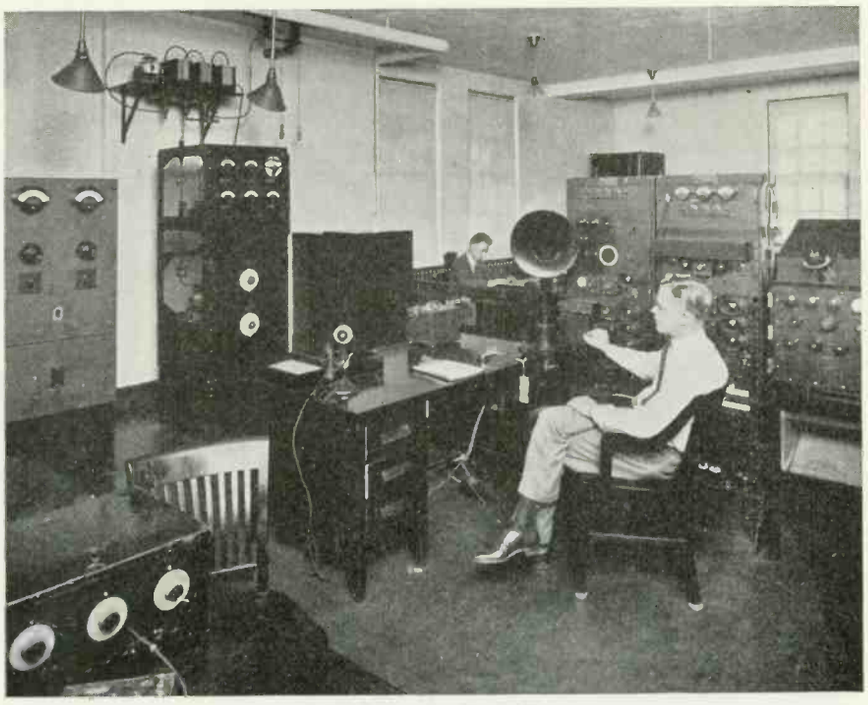
For special events, other stations have been linked by special circuits, including WGY, General Electric Company at Schenectady; WNAC, Sheppard Stores, Boston, Mass.; WMAF, Colonel E. H. R. Green's Station at South Dartmouth, Mass.; KDKA and KYW, the Westinghouse Electric and Manufacturing Company's station at Pittsburgh, Pa., and Chicago, Ill., respectively.

Connected with the nerve center of the station are incoming circuits some of which are temporary and others permanent. For instance, the installation at the Metropolitan Opera House was a temporary one, but other locations are used on a regular schedule as occasional features of WEAF's program. Most noted of these are the Capitol Theatre installations, the Skinner Organ Company and the Bedford Branch Y. M. C. A. Each of the features thus made available to the radio audience is appreciated as expressed in thousands of letters each month and it is only by the combination of wire lines in connection with radio broadcasting that the greatest features are made possible to the radio audience.

Temporary input circuits through WEAF's plant department have been employed from many points, including Washington, D. C., Chicago, Ill., Alexandria, Va., Cambridge, Mass., New Haven, Conn., Baltimore, Md., St. Louis Mo., and Kansas City, Mo.

The use of telephone lines in connection with radio broadcasting has been, from the technical standpoint, highly successful. Expert judges of speech and musical quality have declared that events picked up from distant points and supplied several stations, do not suffer from objectionable distortion. Almost any listener on the Atlantic Seaboard can determine this for himself by comparing the quality of the reception of the Capitol Theatre program which is sent simultaneously each Sunday evening through WCAP and WJAR as well as WEAF.

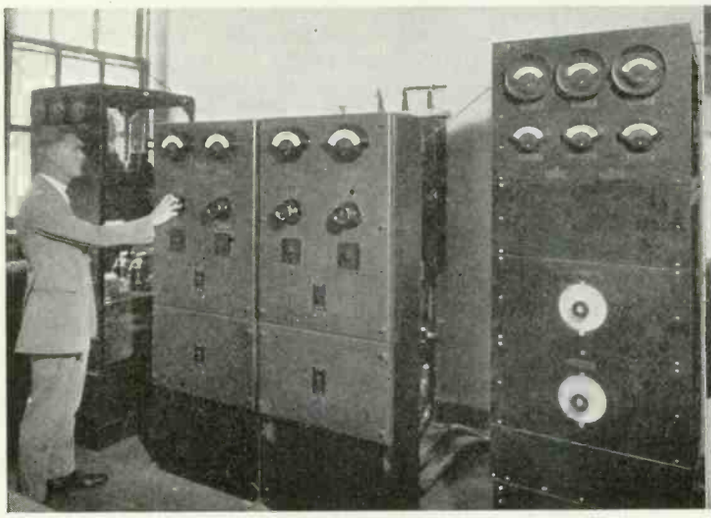
The public demand for important speakers and events can never be met entirely by studio events. Nor can a standard of program necessary to satisfy the demands of radio listeners centering about stations not located in very large cities be met by the broadcasting of local talent. The exchange of radio programs through WEAF's special exchange, as used on the occasion of Lloyd George's speech, is, therefore, likely to become of constantly increasing importance.



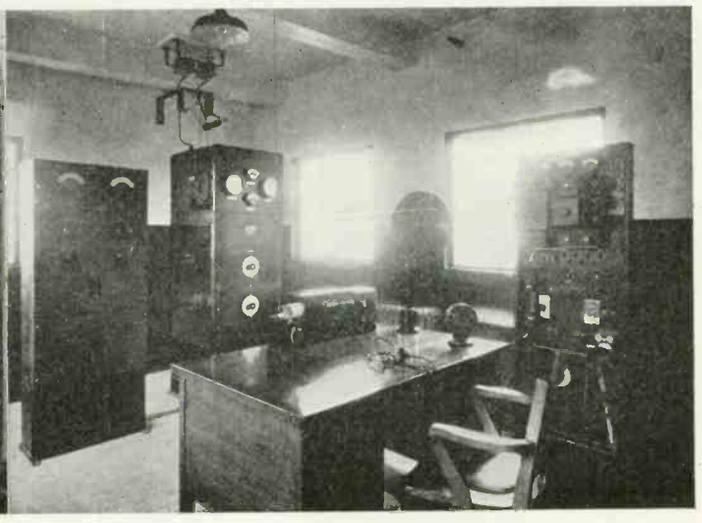
WASHINGTON, D. C.
Control room of WCAP, the Chesapeake & Potomac Telephone Company

French Interested in American Apparatus

RADIO fans in the Lille District of France are manifesting interest in American-made equipment, Consul Squire reported recently, pointing out that as permits for receiving sets may now be obtained from the government, there is no reason why the use of radio should not increase steadily. Broadcasting from Paris, London, Cardiff and Glasgow can be heard in Lille regularly, he adds, the Paris concerts coming in on 1,000 to 1,500 meters and the British stations on 200 meters.



NEW YORK CITY
Transmitting apparatus of WEAF, the American Telegraph and Telephone Company



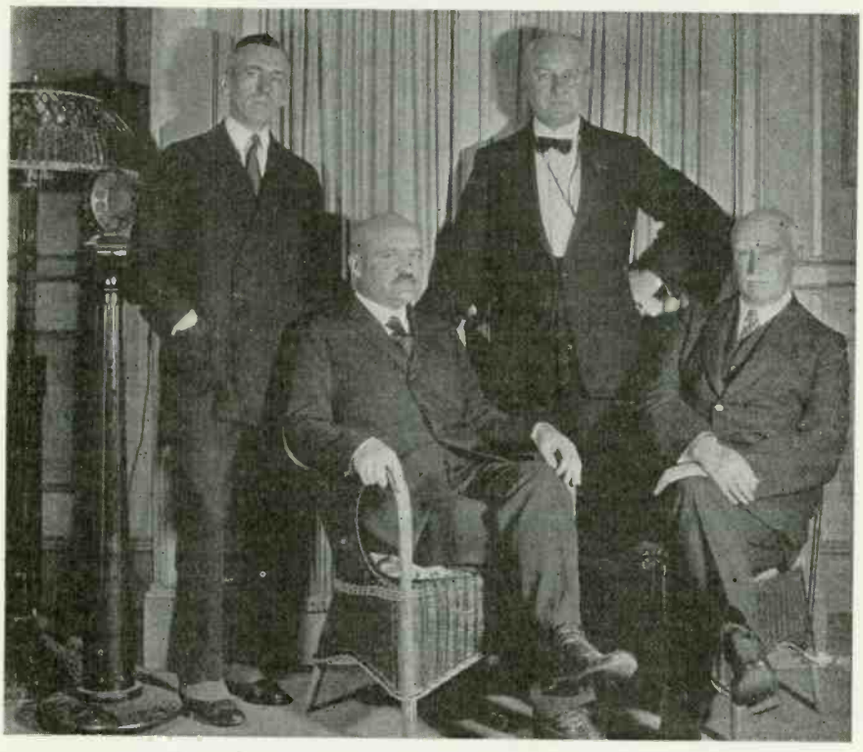
PROVIDENCE, R. I.
Transmitting and control room of WJAR, the Outlet Company

RADIO provides means for affording national participation in events of national interest

Filling the Air With Tribute

Roosevelt Memorial Day

By Stuart Hyde Hawkins



Speakers whose tributes to Roosevelt were broadcast from WJZ October 27. Standing: W. J. Hays, former secretary to President Roosevelt; General J. G. Harbord, President of the Radio Corporation of America. Seated: Ex-Senator Calder of New York; Judge McAdoo, Magistrate of the City of New York

And all the winds that blow
Must bear his praises sung
By an adoring people so that they
On farthest hills and over widest seas
Must hear of him and stop to pause
and listen. —Parclenus.

WHEN the ancient Romans heard these words, it is not probable that they conjured a vision of radio broadcasting as we know it today; the words were merely intended to express the depth of a love which exceeded the descriptive power of human adjectives. Yet today, taken literally, those same words describe with utmost perfection the degree of love of a nation for a man which also exceeds the scope of linguistic vocabulary. For the first time in history the ether of half the world has been actually filled with the name and praises of a nation's favorite; never before has the sentiment of a people for a departed leader received the fulness of expression which was accorded that for one of the greatest Americans of all time on October 27th; other leaders of this and other countries may, and in all probability have been as loved, admired, and revered by their people as has Theodore Roosevelt, but science has never until now supplied the means of expressing that sentiment so fittingly. Roosevelt Memorial Day found broadcasting stations throughout the country sending tribute after tribute into the air, until at one time the ether from the coast of France to the middle of the Pacific, from northern Canada to southern Mexico, was filled with eulogies and commemorative ceremonies.

One of the most interesting and inspiring ceremonies I have ever witnessed was the presentation of the Roosevelt Memorial program to the hundreds of thousands of radio listeners from station WJZ in New York City. It was my particular good fortune to be present at that station on the evening of October 27th; good fortune because the inner workings of a radio broadcasting studio are always interesting, and particular because to this station, one of the greatest in the country, was allotted the longest and most extensive program of the many which composed the transcontinental radio tribute. A musical program by the band of the U.S.S. Colorado, the latest and greatest dreadnaught of that navy in which Roosevelt took such pride and interest, and addresses by four of his closest friends, were combined to form one of the most expressive anniversary ceremonials which man could give.

When I entered, the band was already seated in the large studio, arranged in fan-shaped formation radiating from a mahogany cylinder which stood high on a severely plain shaft near one end of the room. In an adjoining room a man was seated before a table on which reposed in solitary state a black disc-like object, into which he spoke, in that clear calm voice radio listeners know so well. "In honor of the late Theodore Roosevelt, whose birthday anniversary is being commemorated throughout the country—" and so to a short, clear, simple and dignified explanation of the nation-wide radio tribute in which WJZ was about to participate, ran the voice. A movement of the wrist, the almost inaudible click of a switch, accompanied by a nod to the leader of the band, and the opening strains of "Anchors Aweigh," one of Roosevelt's favorite marches, filled the studio. And over me swept the realization that the studio was the most negligible part of the vast space those notes were filling; unseen, apparently unappreciated, that band was playing to the greatest audience in the world; the march which Roosevelt so liked was being heard in thousands of homes by hundreds of thousands of the people whom he had so enjoyed serving.

In a soft-toned, dimly-lighted reception room, isolated from the studio by sound-proof walls, sat four men, listening with varying emotions to the reproduction of that march which issued from a cabinet receiving set in one corner. Every one of them had at some time heard that march in the company of Theodore Roosevelt, for each had been a close personal friend

of the former President. Walter J. Hays, former Senator Calder of New York, Judge McAdoo, and General J. G. Harbord were there to describe to the listening populace the life of "T. R." as they had known him. As the band neared the end of the march Mr. Hays rose quietly and walked to the table where the announcer sat. The moment the last note of "Anchors Aweigh" had died the announcement that "Walter J. Hays, former Secretary to President Roosevelt, will be the first speaker," and a few scant seconds later Mr. Hays was telling the listeners-in of his own contact with his former chief. In the low, serious, conversational tone, the talk seemed infinitely more personal, more sincere, than do the oratorical eulogies so often delivered by speakers in large meetings. The simplicity and unaffectedness of the talk, impossible of attainment through any medium other than radio, solemnized the occasion to an inexpressible degree.

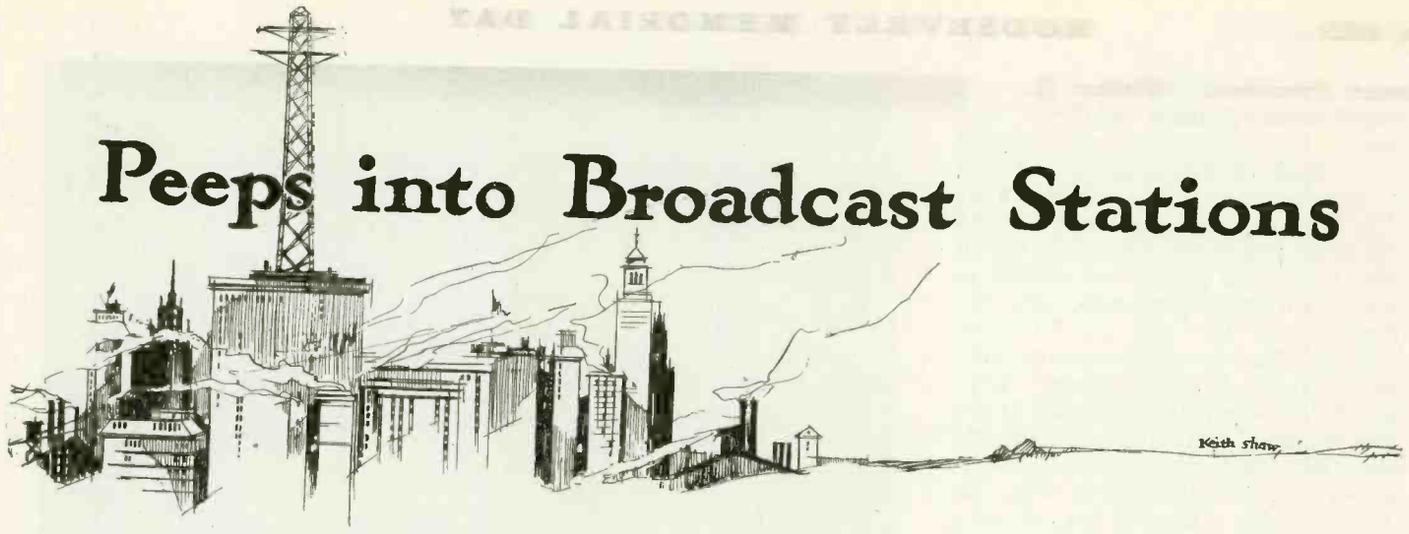
Quietly, calmly, with no stir or confusion, the program was carried out with one number by the naval band between each of the four addresses. Mr. Hays, Judge McAdoo, Senator Calder, and General Harbord—each speaker took his place before the microphone, each one described, in the dignified convincing manner which radio makes possible, his memories of Theodore Roosevelt, telling in the strictest sense of the word just what Roosevelt had done, what he had stood for, and what manner of man he was. From Mr. Hays the radio audience heard the story of "T. R." as the First Executive of the Land, for it was in that capacity that Mr. Hays came into daily and intimate contact with him; from Judge McAdoo came the description of Roosevelt as the insuppressible New York politician, overcoming the obstacles placed in his way by the "interests"; Senator Calder, one of his closest friends, told of Roosevelt as the rebuilder of the navy; and General J. G. Harbord, himself a former army commander of long experience, told of Roosevelt as a soldier, the Roosevelt the popular imagination pictures most often.

Birthplace of Theodore Roosevelt in New York City, dedicated as a National Shrine, Oct. 27. Crowds outside the house could hear the dedicatory exercises through loud-speakers

The beauty of the tributes lay in their sincerity; the intricacies of vacuum tubes and amplifiers enabled those men to portray Roosevelt as faithfully as they would have done in reminiscing together in a corner of a club. The utter lack of dramatization, the ordinary conversationalism of the speeches, was more impressive, more splendid, than hours of platform oratory. Straight from their hearts they spoke, conjuring up as much for their own benefit as for that of the invisible audience the memories of their common friend, talking as men talk when effect and applause are forgotten. No audience was there to spur them to bursts of dramatism; apparently—so it seemed there in the studios—they were unheard. And in the security of the seeming seclusion they could forget themselves and remember Theodore Roosevelt as they could have done in no other way. Genuine wholehearted tribute it was; and that the vast number of Americans who were listening in could hear such a memorial is reason enough, to my mind, for the existence of radio broadcasting.

The last number by the band was "on the air" when the four men left; they had expressed a little of what T. R. meant to them and to the country; they had said it well, and in dignified simplicity commensurate with the spirit of the entire program. They said goodby to each other and to the studio personnel and left. To me, the entire affair seemed to personify the man whom it honored. By the great and yet fundamentally simple medium of radio, in an unpretentious and yet forceful way, the sincerest type of eulogy had been delivered to a great audience; and certainly Roosevelt was great, was unpretentious, was forceful, and was sincere.

Peeps into Broadcast Stations



A Bank Becomes a Broadcaster

Mr. Elmer G. Johnson, announcer of WJAX

THE Union Trust Company of Cleveland has inaugurated an interesting experiment, along the lines of adapting broadcasting to commercial use. It has established a station of its own from which to send out financial and commodity reports. Appreciating the value of adding entertainment to its programs, it is gaining for itself a well-deserved popularity.

October 23, it broadcast the address of Lloyd George, former Premier of Great Britain, delivered upon the occasion of the laying of the cornerstone of the new Main Building of the Cleveland Public Library. Powerful receiving sets, with loud speakers, were set up in the school auditoriums and classes were suspended while the students gathered to hear the words of the famous statesman.

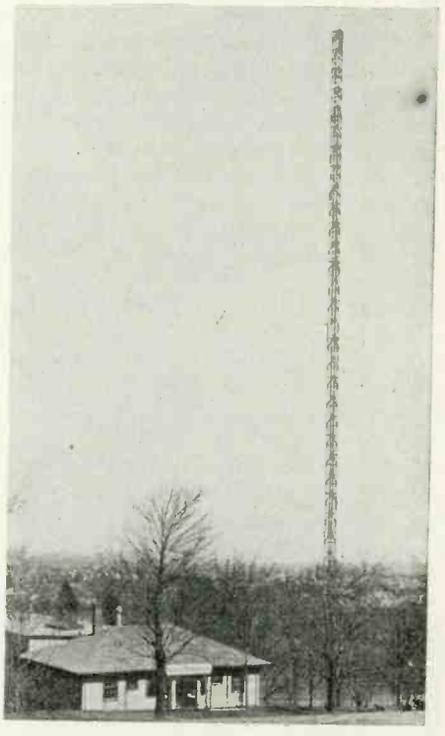
Countless thousands beside the school children heard Lloyd George from WJAX as was attested by the many telephone calls and telegrams from many different states and from Canada.

Union Trust Company's project of a radio financial news service to the farmers and business people is unique and promising.

Studio of WJAX, the Union Trust Company, Cleveland, Ohio

Amrad WGI

FROM its lofty tower close by the route of Paul Revere's historic ride, the Amrad station was among the very early pioneers in broadcasting speech and music across the land.



The tower that nearly wrecked the Montreal Express. 320-foot tower of WGI

"Sowing seeds in the air" seemed in those early days of radio but the odd dreams of a fanciful visionary. How well these "seeds" took root is evidenced by the remarkable growth of the radio industry.

It was in the summer of 1915 that Amrad WGI, was first erected at Medford Hillside, Mass., due to the persistence and foresight of Harold J. Power, one of the great leaders in the radio art. These were the days before present-day broadcasting licenses were issued by the government. WGI was then designated as 1XE, an experimental station call assigned to the American Radio and Research Cor-

poration. It was during 1916 and 1917 that the newspapers of New England frequently printed stories about radio music and speech being heard in isolated communities and by ships at sea—stories which seemed almost incredible to the reading public.

In connection with the erection of the tower over eight years ago, there is an interesting story:

On a Saturday noon, the workmen erecting the tower, the first and highest of its kind, had almost finished their job. However, the supporting guide wires were not in place. This almost criminal negligence on the part of the workmen nearly resulted in a serious fatality. A gentle breeze sprang up, rocking from side to side the 320 foot perpendicular structure which was entirely unsupported. An extra draft, and over the tower toppled, falling across the trolley wires of an adjacent thoroughfare, and also across the fairway of the Boston & Maine Railroad. The Montreal Express was approaching at 60 miles an hour, but fortunately the engineer saw the tower falling, and was able to bring the train to a standstill by applying the emergency without crashing into the débris.

At once work was started to reerect the tower, but this was delayed due to a protest from the trolley company, railroad, and nearby residents, who feared the tower as a mysterious menace to public safety. The proposition even went before the State Commissioners, who fortunately were broad-gauged enough to appreciate the far-reaching possibilities of radio broadcasting and to recognize that the engineering construction of the tower was basically sound. Their judgment has been adequately justified by the intervening years.

Herbert Dwight Miller, the announcer of WGI, has a keen sense of humor

Of course, the early broadcasting efforts were periodic, first bi-monthly and then weekly, and then twice a week. Over two years ago, May 20, 1921, regular daily and nightly broadcasting was scheduled, and has continued without intermission ever since. The first Director of Broadcasting was H. M. Taylor. The first studio was a comparatively primitive affair in marked contrast to the richly furnished and conveniently arranged studios of today. Three times has the studio been entirely remodeled to keep pace with the increasing improvements of the broadcasting art, in order to keep this oldest broadcasting station on a par with the best of the recent stations.

While using comparatively low power, 100 watts, the station has been heard from coast to coast in Canada, and the West Indies. Noted persons of this country and Europe have been attracted to the station.

"H. D. M.," the genial announcer of WGI, has the title of "Professor" or something like that, out of Tufts College. Herbert Dwight Miller, Instructor of English, is the popular Medford announcer.

"Artists often ask us what they are to sing in," said Mr. Miller. "We tell them to just go ahead and sing, the microphone will pick up the voice, but some of them demand to see it, so we have to take off the lamp-shade and then they are all right. They explain that they wish to see the thing so that they can concentrate on something. You know it is a new sensation singing or playing to an invisible audience. There is no applause—nothing.

"Announcing has its difficulties. I remember one night I was announcing a recitation of 'The Raven' by Pie. Imagine the laugh that went up for several thousand miles when I made that slip.

"One night we had a woman singer who insisted there should be something or other to help send out her voice. She didn't have much confidence in the little microphone. Finally, to please her, I said we would have to get out our resonator. I did not have the slightest idea what a resonator was, but we found a drawing board about

OTTO E. KRUEGER

Many people have heard Otto Krueger introduced to the radio audience as the conductor of the Detroit News Orchestra, but few have ever seen him, so here he is. A sparkling personality, brilliant musician and a good natured "plump" man. The orchestra he leads was organized in May, 1922, to play for WWJ auditors

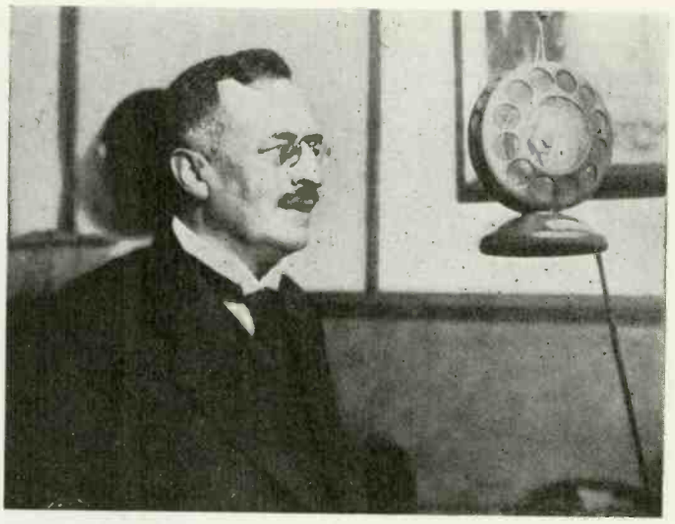
JEAN GOLDKETTE'S ORCHESTRA

This is one of the recent additions to WWJ's list of music every Wednesday and Friday noon and every Thursday at 10 p. m. Their music is broadcast from the Graystone Ballroom, Detroit's leading dance hall

the size of a bread board, placed it on the floor, told her that was the resonator, and to go ahead. This did the trick, and everybody was happy.

"A while back WGI used to send out setting-up exercises every morning about 7:30. The fellow who ran the series used to get lots of letters from enthusiasts who said they did the exercises, but one day a listener wrote in stating that 'While you read off those exercises I lie in bed and listen to them, refusing to get up.' Our instructor wrote back, 'That's nothing, I send them lying in bed myself.' (Perhaps they were both lying.)"

Herbert Dwight Miller was born in Saranac Lake, N. Y., 27 years ago. He is a graduate of Dean Academy and Tufts College. At the outbreak of the war he organized the Tufts Ambulance Unit, which upon arrival in France was immediately inducted into the French Motor Transport Service. Within four days after arriving at Bordeaux the unit was sent to the front, and saw service in the Aisne Sector between Soissons and Rheims. Since the war, Mr. Miller has been an instructor of English at Tufts College. He is a prominent member of the Pheta Delta Phi Fraternity and is married and has a little baby girl.



When Doctor Sven Hedin, world-famous Swedish explorer and writer, speaking in the studio of KHJ, (The Times, Los Angeles, Calif.), recently thrilled Radiolanders with an account of his hazardous exploration of the Thibetan Desert, he was equally thrilled with this, his first experience in a broadcast studio

A Broadcasting Station Without a Studio

By S. R. WINTERS

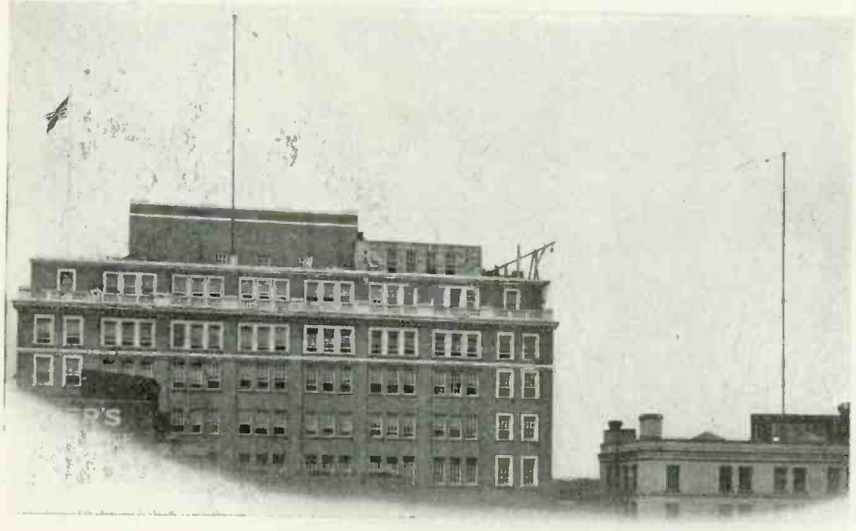
A RADIO broadcasting station without a studio and with its programs originating in New York City, is the unique position occupied by the broadcasting station of the Chesapeake and Potomac Telephone Company, Washington, D. C., whose call letters are WCAP. The music, both vocal and instrumental, and other forms of entertainment dispersed by WEAF, the broadcasting station of the American Telephone and Telegraph Company of New York City, are simultaneously disseminated from the ninth floor of a building located at 725 Thirteenth Street, Northwest, in the national capital.

Direct transmission from the studio of the broadcasting station of the American Telephone and Telegraph Company, 195 Broadway, to Washington, a distance of 238 miles, is accomplished by means of the long-distance wire service of this company. Three telephone wires are in reserve for this purpose—a regular wire, an emergency wire, and an order wire. The emergency electric circuit is pressed into service in case the regular wire becomes inoperative, and the order wire is a means for conducting conversation between Washington and New York City concerning the broadcasting service. For instance, if the musical programs are lacking in clarity the New York station is so informed by an operator in Washington, D. C.

Other than the absence of a studio or the necessity for arranging its own programs, WCAP is an honest-to-goodness radio-telephone broadcasting station—in fact, it is perhaps the most powerful non-government station between Philadelphia and Atlanta. At the latter city, the electric equipment of the "Atlanta Journal" is a duplicate of that installed by the Chesapeake and Potomac Telephone Company in Washington. Both of these installations are of 500-watt power, representing the most powerful broadcasting equipment manufactured by the Western Electric Company. Thus, the equipment at the national capital qualifies as a class B, 500-watt transmitting station. It operates on a wave length of 469 meters. WEAF of New York City, and the counterpart of WCAP, however, broadcasts on a wave length of 492 meters.

The room reserved for the installation of electrical equipment of the broadcasting station of the Chesapeake and Potomac Telephone Company covers an area of 1,460 square feet, which is literally jammed with apparatus necessary for radiating music and other kinds of entertainment on electro-magnetic waves within a radius of hundreds of miles of the national capital. The radio room is on the top floor of a magnificent building, which was erected in 1918 at a cost exceeding $1,000,000, and is the headquarters for the officials and administrative employees of the Chesapeake and Potomac Telephone Company.

The antenna of WCAP is formed by extending four strands of wire from an 80-foot mast atop the administrative building to a mast on top of another building, 250 feet distant. Thus the four-wire antenna, taking the shape of the letter T, is 250 feet long. The administrative building is 125 feet high, and by adding another 80 feet, the mast on this structure towers a distance of 205 feet from the ground.



WCAP, Washington, D. C. The broadcast station of the Chesapeake and Potomac Telephone Company is shown here. An interior view is exhibited on page 33

BROADCASTING STATION DIRECTORY

(Revised to November 20th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop.....Monterey, Calif.	261
KLS	Warner Brothers.....Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNJ	Roswell Public Service Co.....Roswell, N. M.	250
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	288
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros.....San Francisco, Calif.	423
KQI	University of California.....Berkeley, Calif.	360
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreld.....San Jose, Calif.	278
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	360
KSD	Post-Dispatch.....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co...San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop.....Honolulu, T. H.	360
KYW	Westinghouse Elec. & Mfg. Co.....Chicago, Ill.	536
KZM	Preston, D. Allen.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDLY	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre .....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology....Portland, Ore.	360
KDYS	The Tribune, Inc.....Great Falls, Mont.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co....Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company.....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co.....Reno, Nev.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZT	Seattle Radio Association.....Seattle, Wash.	360
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	360
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	Electric Shop.....Moscow, Idaho	360
KFAP	Standard Publishing Co.....Butte, Mont.	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAY	W. J. Virgin .....Medford, Ore.	283
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill.....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCB	W. K. Azbill.....San Diego, Calif.	278
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCL	Los Angeles Union Stock Yds...Los Angeles, Calif.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....LeMars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDB	Mercantile Trust Co.....San Francisco, Calif.	509
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agri. College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. E. Cutting.....Bozeman, Mont.	248
KFDP	Hawkeye Radio & Supply Co....Des Moines, Ia.	278
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	360
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEP	Radio Equipment Co.....Denver, Colo.	240
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Douglas, Wyo.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs..St. Louis, Mo.	360
KFFA	Dr. R. O. Shelton.....San Diego, Calif.	242
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Ore.	229
KFFP	First Baptist Church.....Moberly, Mo.	275
KFFQ	Markschoffel Motor Co.....Colorado Springs, Colo.	360
KFFR	Jim Kirk.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co....Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Mo., 138th Inf..St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGP	Cheney Radio Co.....Cheney, Kans.	229
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Co..Berrien Spgs., Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	The Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHJ	Fallon Co. .....Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Phillip Laskowitz.....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co. Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co..Juneau, Alaska	226
KFIV	V. H. Broyles.....Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ, of Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories.....Seattle, Wash.	236
KFIZ	Daily Commonwealth .....Fond du Lac, Wisc.	273
KFJA	Central Power Co.....Brand Island, Nebr.	244
KFJB	Marshall Electric Co., Inc....Marshalltown, Iowa	248
KFJC	Post Intelligencer .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co....Oklahoma City, Okla.	252
KFJH	The Sugar Bowl.....Selma, Calif.	273
KFJI	Liberty Theatre.....Astoria, Ore.	252
KFJJ	Carrollton Radio Shop.....Carrollton, Mo.	236
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJR	Ashley C. Dixon & Co.....Stevensville, Mont.	258
KFJU	Central Power Co.....Kearney, Nebr.	234
KFJV	T. H. Warren .....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories..... Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Electric Co.....Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co..Colorado Springs, Colo.	231
KFLA	Abner R Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Monominee, Mich.	248
KFLD	Paul E. Greenlaw .....Franklinton, La.	234
KFLE	National Educational Service.....Denver, Colo.	268
KFLH	Erickson Radio Co., Inc....Salt Lake City, Utah	261
KFLP	Everett M. Foster .....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop .....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. M.	254
KFLU	Rio Grande Radio Supply House.San Benito, Tex.	236
KFLV	Rev. A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co....Missoula, Mont.	234
WBL	T. & H. Radio Co.....Anthony, Kansas	261
WBS	May & Co.....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBU	City of Chicago.....Chicago, Ill.	286
WBZ	Westinghouse Elec. & Mfg. Co..Springfield, Mass.	337
WCE	Findley Electric Co.....Minneapolis, Minn.	360
WCK	Stix-Baer-Fuller .....St. Louis, Mo.	360
WCM	University of Texas.....Austin, Texas	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDM	Church of the Covenant.....Washington, D. C.	360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co.....St. Louis, Mo.	360
WFV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	360
WGY	General Electric Co.....Schnectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHD	West Virginia University..Morgantown, W. Va.	360
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre....New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cino Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co.....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co..New York, N. Y.	360
WJY	Radio Corp. of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America—Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKC	Joseph M. Zamoiski Co.....Baltimore, Md.	360
WKY	Oklahoma Radio Shop....Oklahoma City, Okla.	360
WLB	University of Minnesota.....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co. .....Indianapolis, Ind.	360
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMH	Precision Equipment Co.....Cincinnati, Ohio	248
WMU	Doubleday-Hill Elec. Co.....Pittsburgh, Pa.	261
WNJ	Shotten Radio Mfg. Co.....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic...Davenport, Iowa	484
WOI	Iowa State College .....Ames, Iowa	360
WOK	Arkansas Light & Power Co....Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co. .....Kansas City, Mo.	360
WOR	L. Bamberger Co. .....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record .....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm.....New Lebanon, Ohio	234
WPI	Electric Supply Co.....Clearfield, Pa.	360
WQX	Walter A. Kushl .....Washington, D. C.	469
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co.....Hamilton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co.....Utica, N. Y.	273
WSY	Alabama Power Co. .....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co.....Toledo, Ohio	360
WTG	Kansas State Agr. College....Manhattan, Kans.	360
WTP	George M. McBride .....Bay City, Mich.	360
WWB	Daily News Printing Co.....Dearborn, Mich.	273
WWI	Ford Motor Co. .....Detroit, Mich.	517
WWJ	The Detroit News .....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WWZ	John Wanamaker .....New York, N. Y.	360
WAAB	Waldemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	266
WAAH	Commonwealth Electric Co.....St. Paul, Minn.	360
WAAK	Gimbel Bros. .....Milwaukee, Wisc.	280
WAAM	L. R. Nelson Co. .....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	264
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co. .....Decatur, Ga.	360
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co. .....Emporia, Kans.	266
WABA	Lake Forest College .....Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence.....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.....Anderson, Ind.	229
WABD	Parker High School .....Dayton, Ohio	286
WABE	Y. M. C. A. .....Washington, D. C.	283
WABF	Mt. Vernon Register-News Co..Mt. Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co....Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College.....Storrs, Conn.	283
WABM	F. E. Doherty .....Saginaw, Mich.	254
WABN	Waldo C. Grover .....La Crosse, Misc.	254
WABO	Lake Avenue Baptist Church...Rochester, N. Y.	252
WAJV	Indian Pine Line Corp.....Princeton, Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co. .....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation .....Paterson, N. J.	244
WBAO	James Millikin University .....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Ft. Worth, Tex.	476
WBAV	Erner & Hopkins Co. .....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	248
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co. .....New York, N. Y.	492
WBRA	Newark Radio Laboratory.....Newark, Ohio	240
WBBC	Sterling Radio Equipment Co.....Sterling, Ill.	229
WBRD	Barbey Battery Service .....Reading, Pa.	224
WCAD	St. Lawrence University .....Canton, N. Y.	280
WCAE	Kaufman & Baer Co.....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall .....New Orleans, La.	268
WCAH	Entrekin Electric Co. .....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel .....Northfield, Minn.	360
WCAL	St. Olaf College .....Villanova, Pa.	360
WCAM	Villanova College .....Baltimore, Md.	360
WCAO	Sanders & Stayman Co. .....Washington, D. C.	469
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co.....San Antonio, Tex.	360

WCAS	Dunwoody Industrial Institute, Minneapolis, Minn.	246
WCAT	South Dakota School of Mines..Rapid City, S. D.	240
WCAU	Durham & Co. .....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont .....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Music House, Milwaukee, Wisc.	261
WCAZ	Carthage College .....Carthage, Ill.	246
WCBA	Charles W. Haimbach .....Allentown, Pa.	280
WCBB	K. & K. Radio Supply Co....Greenville, Ohio	240
WCBD	Zion Radio Broadcasting Station.....Zion, Ill.	345
WDAD	Central Kansas Radio Supply..Lindsborg, Kans.	360
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star .....Kansas City, Mo.	411
WDAG	Martin J. Laurence .....Amarillo, Tex.	263
WDAH	Trinity Methodist Church .....El Paso, Texas	268
WDAI	Hughes Radio Corporation.....Syracuse, N. Y.	246
WDAK	Hartford Courant .....Hartford, Conn.	261
WDAL	Florida Times Union .....Jacksonville, Fla.	360
WDAM	Weston Electric Co. .....New York, N. Y.	360
WDAQ	Automotive Electric Co. .....Dallas, Tex.	360
WDAP	The Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers .....Philadelphia, Pa.	395
WDAS	Samuel W. Waite .....Worcester, Mass.	360
WDAU	Slocum & Kilburn .....New Bedford, Mass.	360
WDAX	First National Bank .....Centerville, Iowa	268
WDAY	Fargo Radio Service Co.....Fargo, N. D.	244
WDBC	Kirk Johnson & Co., Inc.....Lancaster, Pa.	258
WDBF	Robert G. Phillips .....Youngstown, Ohio	261
WEAA	Fallain & Lathrop.....Flint, Mich.	280
WEAB	Standard Radio Equipment Co...Fort Dodge, Ia.	360
WEAE	Virginia Polytechnic Institute...Blacksburg, Va.	360
WEAF	American Tel. & Tel.....New York, N. Y.	492
WEAG	Nichols Hineline Bassett Laboratory, Edgewood, R. I.	231
WEAH	Wichita Board of Trade.....Wichita, Kans.	244
WEAI	Cornell University.....Ithaca, N. Y.	286
WEAJ	University of South Dakota....Vermillion, S. D.	360
WEAM	North Plainfield, Borough of N. Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. .....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co., Inc.....Mobile, Ala.	360
WEAR	Baltimore Am. & News Pub. Co., Baltimore, Md.	360
WEAS	Hecht Company .....Washington, D. C.	360
WEAU	Davidson Brothers Co. .....Sioux City, Iowa	360
WEAY	Will Horwitz, Jr. .....Houston, Tex.	360
WEAZ	Donald Redmond .....Waterloo, Iowa	360
WFAA	A. H. Belo & Co. .....Dallas, Tex.	476
WFAB	Carl C. Woese .....Syracuse, N. Y.	234
WFAF	Henry C. Spratley .....Poughkeepsie, N. Y.	273
WFAG	Radio Engineering Laboratory, Waterford, N. Y.	360
WFAH	Electric Supply Co. .....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAM	Times Publishing Co. .....St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co...Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo.	360
WFAT	Daily Argus Leader.....Sioux Falls, S. D.	360
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WGAC	Orpheum Radio Stores Co.....Brooklyn, N. Y.	360
WGAD	Spanish Am. Sch. of Telegraphy, Ensonada, P. R.	360
WGAJ	W. H. Glass .....Shenandoah, Iowa	360
WGAL	Lancaster Elec. Supply & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd .....Pensacola, Fla.	360
WGAQ	W. G. Patterson .....Shreveport, La.	360
WGAR	Southern American .....Fort Smith, Ga.	360
WGAU	Marcus G. Limb .....Wooster, Ohio	226
WGAW	Ernest C. Albright .....Altoona, Pa.	261
WGAX	Radio Electric Co., Washington Courthouse, Ohio	360
WGAY	North Western Radio Co.....Madison, Wisc.	360
WGAZ	South Bend Tribune .....South Bend, Ind.	360
WHAA	State University of Iowa.....Iowa City, Iowa	283
WHAB	Clark W. Thompson .....Galveston, Tex.	360
WHAC	Cole Brothers Elec. Co.....Waterloo, Iowa	360
WHAD	Marquette University .....Milwaukee, Wisc.	360
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	J. T. Griffin .....Joplin, Mo.	360
WHAK	Roberts Hardware Co....Clarksburg, West. Va.	258
WHAL	Lansing Capital News .....Lansing, Mich.	248
WHAM	Eastman School of Music of Univ. of Rochester, Rochester, N. Y.	283
WHAP	Dewey L. Otta .....Decatur, Ill.	360
WHAQ	Semmes Motor Co. .....Washington, D. C.	242
WHAR	Paramount Radio and Elec. Co., Atlantic City, N. J.	231
WHAS	Courier Journal & Times.....Louisville, Ky.	400
WHAV	Wilmington Elec. & Supply Co., Wilmington, Del.	360
WHAX	Huntington Press .....Huntington, Ind.	360
WHAZ	Rensselaer Polytechnic Institute.....Troy, N. Y.	380
WIAB	Joslyn Automobile Co. .....Rochford, Ill.	360
WIAD	Ocean City Yacht Club.....Ocean City, N. J.	254
WIAF	Gustav A. De Cortin.....New Orleans, La.	234
WIAH	Continental Radio and Mfg. Co., Inc., Newton, Iowa	258
WIAI	Heers Stores Co. .....Springfield, Mo.	252
WIAK	Journal Stockman Co. .....Omaha, Nebr.	278
WIAP	J. A. Rudy & Sons.....Paducah, Ky.	360
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Burlington Hawkeye-Home Elec. Co., Burlington, Ia.	360
WIAT	Leon T. Noel .....Tarkio, Mo.	360
WIAU	American Sec. & Sav. Bank.....Le Mars, Ia.	360
WIAV	New York Radio Laboratories, Binghamton, N. Y.	360
WIAW	Saginaw Radio & Elec. Co.....Saginaw, Mich.	360
WJAD	Jackson's Radio Eng. Lab.....Waco, Tex.	360
WJAF	Press Pub. Co. .....Muncie, Ind.	360
WJAG	Huse Publishing Co. .....Norfolk, Nebr.	360
WJAJ	Y. M. C. A. .....Dayton, Ohio	360
WJAK	Rev. C. L. White.....Greentown, Ind.	254
WJAM	D. C. Perham .....Cedar Rapids, Iowa	268
WJAN	Peoria Star Co. .....Peoria, Ill.	280
WJAR	The Outlet Co. .....Providence, R. I.	360
WJAS	Capper Publications .....Topeka, Kans.	360
WJAT	Kelly-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co. .....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory .....Chicago, Ill.	448
WKAA	H. F. Paar .....Cedar Rapids, Iowa	268
WKAD	Charles Looff .....East Providence, R. I.	240
WKAF	W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.	360
WKAN	Alabama Radio Mfg. Co.....Montgomery, Ala.	360
WKAP	Dutee Wilcox Flint .....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College.....East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.....Springfield, Mo.	360
WKAV	Laconia Radio Club .....Laconia, N. H.	254
WKAW	United Battery Service Co., Montgomery, Ala.	226
WKAX	W. A. Macfarlane.....Bridgeport, Conn.	231
WKAY	Brenau College .....Gainesville, Ga.	280
WLAC	North Carolina State College...Raleigh, N. C.	360
WLAG	Cutting & Washington Radio Corp., Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Mach. Co.....Bellows Falls, Vt.	360
WLAL	Tulsa Radio Co. .....Tulsa, Okla.	360
WLAN	Putnam Hardware Co. .....Houlton, Me.	283
WLAP	W. V. Jordon .....Louisville, Ky.	360
WLAQ	A. E. Schilling .....Kalamazoo, Mich.	360
WLAS	Central Radio Supply Co.....Hutchinson, Kans.	244
WLAT	Radio and Specialty Co.....Burlington, Iowa	360
WLAV	Electric Shop, Inc. .....Pensacola, Fla.	254
WLAW	New York Police Dept.....New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station, Greencastle, Ind.	231
WMAB	Radio Supply Co.....Oklahoma City, Okla.	360
WMAC	J. Edward Page .....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co. .....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co. .....Kansas City, Mo.	275
WMAK	Norton Laboratories .....Lockport, N. Y.	360
WMAL	Trenton Hdw. Co. .....Trenton, N. J.	250
WMAN	First Baptist Church .....Columbus, Ohio	286
WMAP	Utility Battery Service, Inc.....Easton, Ohio	246
WMAQ	Chicago Daily News .....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAW	Wahpeton Elec. Co. .....Wahpeton, N. D.	360
WMAY	Kingshighway Presby. Church....St. Louis, Mo.	280
WMAZ	Mercer University .....Macon, Ga.	268
WNAB	Park City Daily News....Bowling Green, Ky.	360
WNAC	Shepard Stores .....Boston, Mass.	278
WNAD	Oklahoma Radio Eng. Co.....Norman, Okla.	360
WNAL	R. J. Rockwell .....Omaha, Nebr.	242
WNAM	Ideal Apparatus Co. .....Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co..Syracuse, N. Y.	286
WNAP	Wittenberg College .....Springfield, Ohio	360
WNAQ	Charleston Radio Elec. Co.....Charleston, S. C.	360
WNAR	Rhodes, C. C. .....Butler, Mo.	231
WNAS	Texas Radio Corporation and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Bros. Co. .....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Tel. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzmann.....Fortress Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.....Yankton, S. D.	244
WNAY	Ship Owners' Radio Service.....Baltimore, Md.	360
WOAA	Dr. Walter Hardy .....Ardmore, Okla.	360
WOAC	Maus Radio Co. .....Lima, Ohio	266
WOAD	Friday Battery & Elec. Co.....Sigourney, Iowa	360
WOAE	Midland College .....Fremont, Nebr.	360
WOAF	Tyler Commercial College .....Tyler, Tex.	360
WOAG	Apollo Theatre .....Belvidere, Ill.	224
WOAH	Palmetto Radio Corp. .....Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Texas	385
WOAJ	Ervin's Electrical Co. .....Parsons, Kans.	360
WOAK	Collins Hardware Co. .....Frankfort, Ky.	240
WOAL	Wm. Evans Woods .....Webster Groves, Mo.	286
WOAN	James D. Vaughan .....Lawrenceburg, Tenn.	360
WOAP	Kalamazoo College .....Kalamazoo, Mich.	360
WOAT	Boyd Martell Hamp .....Wilmington, Del.	360
WOAV	Pennsylvania National Guard.....Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Nebr.	526
WOAX	Franklyn J. Wolff .....Trenton, N. J.	240
WOAZ	Penick Hughes Co. .....Stanford, Tex.	360
WPAB	Pennsylvania State College....State College, Pa.	360
WPAC	Donaldson Radio Co. .....Okmulgee, Okla.	360
WPAD	Wieboldt & Co. .....Chicago, Ill.	360
WPAG	Central Radio Co., Inc.....Independence, Mo.	360
WPAH	Wisconsin Dept. of Markets.....Waupaca, Wisc.	360
WPAJ	Doolittle Radio Corporation..New Haven, Conn.	268
WPAK	No. Dakota Agricultural College...Fargo, N. D.	360
WPAL	Superior Radio & Telephone Co., Columbus, Ohio	286
WPAM	Awerbach & Guettel .....Topeka, Kans.	360
WPAP	Theodore D. Phillips .....Winchester, Ky.	360
WPAQ	General Sales & Eng. Co.....Frostburg, Md.	360
WPAR	R. A. Ward .....Beloit, Kans.	360
WPAS	J. & M. Electric Co.....Amsterdam, N. Y.	360
WPAT	St. Patrick's Cathedral .....El Paso, Tex.	360
WPAU	Concordia College .....Moorhead, Minn.	360
WPAY	Bangor Radio Laboratory .....Bangor, Me.	360
WPAZ	John R. Koch .....Charleston, West Va.	273
WQAA	Horace A. Beale, Jr.....Parkersburg, W. Va.	360
WQAB	Southwest Missouri State Teachers College, Springfield, Mo.	236
WQAC	E. B. Gish .....Amarillo, Tex.	360
WQAD	Whitehall Electric Co. .....Waterbury, Conn.	242
WQAE	Moore Radio News Station.....Springfield, Vt.	275
WQAF	Sandusky Register .....Sandusky, Ohio	240
WQAH	Brock Anderson Elec. Eng. Co., Lexington, Ky.	254
WQAK	Appel-Higley Electric Co.....Dubuque, Iowa	360
WQAL	Cole County Tel. & Tel. Co.....Mattoon, Ill.	258
WQAM	Electrical Equipment Co. .....Miami, Fla.	360
WQAN	Scranton Times .....Scranton, Pa.	360
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	West Texas Radio Co.....Abilene, Tex.	360
WQAS	Prince Walter Co. .....Lowell, Mass.	266
WQAT	Radio Equipment Corporation.....Richmond, Va.	360
WQAV	Huntington and Guerry, Inc....Greenville, S. C.	258
WQAW	Catholic University of America, Washington, D. C.	236
WQAX	Radio Equipment Co. .....Peoria, Ill.	360
WQAZ	Greensboro Daily News.....Greensboro, N. C.	360
WRAA	Rice Institute .....Houston, Tex.	360
WRAD	Taylor Radio Shop .....Marion, Kans.	248
WRAF	Radio Club, Inc. .....Laporte, Ind.	224
WRAH	Stanley N. Reed .....Providence, R. I.	231
WRAL	Northern States Power Co..St. Croix Falls, Wisc.	248
WRAN	Black-Hawk Electric Co.....Waterloo, Iowa	236
WRAO	Radio Service Co. .....St. Louis, Mo.	360
WRAP	Winter Park Elec. Construction Co., Winter Park, Fla.	360
WRAU	Amarillo Daily News .....Amarillo, Tex.	360
WRAV	Antioch College .....Yellow Springs, Ohio	360
WRAW	Horace D. Good .....Reading, Pa.	238
WRAX	Flexon's Garage .....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation .....Scranton, Pa.	280
WRAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WSAA	B. S. Sprague Elec. Co.....Marietta, Ohio	360
WSAB	Southeast Mo. State College, Cape Girardeau, Mo.	360
WSAC	Clemson Agri. College....Clemson College, S. C.	360
WSAD	J. A. Foster Co. .....Providence, R. I.	261
WSAH	A. G. Leonard, Jr. .....Chicago, Ill.	248
WSAI	U. S. Playing Card Co.....Cincinnati, Ohio	309
WSAJ	Grove City College .....Grove City, Pa.	360
WSAK	Daily News .....Middleport, Ohio	258
WSAL	Franklin Electrical Co.....Brookville, Ind.	246
WSAN	Allentown Radio Club .....Allentown, Pa.	229
WSAP	Seventh Day Adventist Church..New York, N. Y.	263
WSAR	Doughty & Welch Elec. Co....Fall River, Mass.	254
WSAT	Plainview Elec. Co. .....Plainview, Tex.	268
WSAW	Curtice & McElwee .....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WSAY	Irving Austin, Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop .....Pomeroy, Ohio	258
WTAB	Fall River Daily Herald.....Fall River, Mass.	248
WTAC	Penn Traffic Co. .....Johnstown, Pa.	360
WTAD	Robert E. Compton .....Carthage, Ill.	229
WTAG	Kern Music Co. .....Providence, R. I.	258
WTAH	Carmen Ferro .....Belvidere, Ill.	236
WTAJ	The Radio Shop .....Portland, Me.	236
WTAL	Toledo Radio and Electrical Co., Toledo, Ohio	252
WTAM	Willard Storage Battery Co....Cleveland, Ohio	390
WTAN	Orndorff Radio Shop .....Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	360
WTAQ	S. H. Van Gorden & Son.....Osseio, Wisc.	226
WTAR	Reliance Electric Co. .....Norfolk, Va.	226
WTAS	Charles E. Erbstein.....Elgin, Ill.	275
WTAT	Edison Elect. Ill. Co.....Boston, Mass.	244
WTAU	Ruegy Battery & Elec. Co....Tecumseh, Nebr.	360
WTAW	Agricultural and Mech. College, College Station, Tex.	254
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill.	226
WTAZ	Thomas J. McGuire .....Lambertville, N. J.	283
WWAB	Swern Hoenig & Co.....Trenton, N. J.	226
WWAC	Sanger Brothers .....Waco, Tex.	360
WWAD	Wright & Wright, Inc.....Philadephia, Pa.	360
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAH	General Supply Co. .....Lincoln, Nebr.	360
WWAX	Worman Brothers .....Laredo, Tex.	360

Canadian Broadcasting Stations

CKY	Manitoba Telephone System.....Winnipeg, Manitoba	
CFAC	Radio Corporation of Calgary, Ltd...Calgary, Alberta	
CFCA	Star Publishing and Printing Co., Toronto, Ontario	
CFCB	Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.	
CFCD	Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba	
CFCE	Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia	
CFCF	Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec	
CFCH	Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario	
CFCI	Motor Products Corporation.....Walkerville, Ontario	
CFCN	W. W. Grant Radio, Ltd.....Calgary, Alberta	
CFCX	The London Advertiser.....London, Ontario	
CFPC	International Radio Development Co., Fort Frances, Ontario	
CFTC	The Bell Telephone Co. of Canada....Toronto, Ontario	
CFUC	University of Montreal.....Montreal, Quebec	
CFVC	Roy Russell Brown.....Courtenay, British Columbia	
CFYC	Victor Wentworth Odium.....Vancouver, B. C.	
CFZC	Canadian Westinghouse Co., Ltd.....Montreal, Quebec	
CHAC	Radio Engineers, Ltd.....Halifax, Nova Scotia	
CHBC	The Albertan Publishing Co.....Calgary, Alberta	
CHCA	Radio Corporation of Vancouver, Ltd., Vancouver, B. C.	
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario	
CHCC	Canadian Westinghouse Co., Ltd., Edmonton, Alberta	
CHCF	Radio Corporation of Winnipeg, Ltd., Winnipeg, Manitoba	
CHCQ	The Western Radio Co., Ltd.....Calgary, Alberta	
CHCS	London Radio Shoppe .....London, Ontario	
CHCX	B. L. Silver .....Montreal, Quebec	
CHCZ	The Globe Printing Co. .....Toronto, Ontario	
CHFC	John Millen & Sons, Ltd.....Toronto, Ontario	
CHIC	Canadian Westinghouse Co., Ltd....Hamilton, Ontario	
CHOC	Canadian Westinghouse Co., Ltd.....Vancouver, B. C.	
CHVC	Metropolitan Motors, Ltd. .....Toronto, Ontario	
CHXC	J. R. Booth, Jr. .....Ottawa, Quebec	
CHYC	Northern Electric Co. .....Montreal, Quebec	
CJBC	Dupuis Freres .....Montreal, Quebec	
CJCA	The Edmonton Journal, Ltd.....Edmonton, Alberta	
CJCB	James Gordon Bennett .....Nelson, British Columbia	
CJCD	T. Eaton Co., Ltd. .....Toronto, Ontario	
CJCE	Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.	
CJCF	News Record, Ltd. .....Kitchener, Ontario	
CJCG	Manitoba Free Press Co., Ltd....Winnipeg, Manitoba	
CJCH	The United Farmers of Ontario.....Toronto, Ontario	
CJCI	McLean, Holt & Co., Ltd....St. John, New Brunswick	
CJCN	Simons Agnew & Co. .....Toronto, Ontario	
CJCS	Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia	
CJCY	Edmund Taylor .....Calgary, Alberta	
CJGC	London Free Press Printing Co., Ltd., London, Ontario	
CJNC	Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba	
CJSC	The Evening Telegram .....Toronto, Ontario	
CKAC	La Presse Publishing Co. .....Montreal, Quebec	
CKCB	T. Eaton Co., Ltd. .....Winnipeg, Manitoba	
CKCD	Vancouver Daily Province .....Vancouver, B. C.	
CKCE	Canadian Independent Telephone Co., Ltd., Toronto, Ontario	
CKCK	Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan	
CKCR	Jones Electric Radio Co.....St. John, New Brunswick	
CKCS	The Bell Telephone Co. of Canada...Montreal, Quebec	
CKCZ	Canadian Westinghouse Co., Ltd.....Toronto, Ontario	
CKKC	Radio Equipment and Supply Co....Toronto, Ontario	
CKOC	The Wentworth Radio Supply Co....Hamilton, Ontario	
CKQC	Radio Supply Co. of London.....London, Ontario	
CKZC	Salton Radio Engineering Co....Winnipeg, Manitoba	

Afloat and Ashore With the Operator

As Reported by W. S. Fitzpatrick

AN interesting place for one to visit—especially for a student of psychology—is a marine radio office the day before a busy sailing morning, when the operators are making their final reports and arranging for supplies needed for their voyages.

The office in America from where the greatest number of operators are dispatched to ships is, of course, located in New York. The visitor observes only an assembly of men, some quite young and a few well on in years, none giving outward signs to indicate that he is other than one of a crowd of ordinary fellows in whom no cause for special interest can be seen. But there's a fund of interest here!

On one side of the office is a smiling young chap calmly preparing to sail for France. He is Herbert McCeney, who was picked up at sea after swimming unaided about an hour following the sinking of the steamship *Lake Frampton* three years ago. The tall fellow who just passed him is R. L. Etheridge, who almost lost his life with the sinking of the *Munroe* in 1914, in which his partner perished. He is preparing for a trip to ports on the Gulf of Mexico.

Passing out the door on his way for a long trip to South American ports is Joe Welch, who twice proved himself a hero and as many times experienced anxious hours in an open boat in the middle of the Atlantic after German submarines had paid their visits.

Awaiting his turn at the desk so as to be cleared before his departure for Japan and China is G. B. Rabbitts, another who experienced the thrill of having his ship torpedoed and sunk in mid-ocean.

Among the crowd, too, is seen the dignified figure of E. N. Pickerill, a radio man of 18 years' service and now chief on the *Leviathan*. Two of his five assistants are preparing for the trip to England from which they expect to be back in less than three weeks.

Near him is Ben Beckerman, who has had 15 years of radio experience. Ben is on a run to Norfolk which brings him back to New York twice a week.

The sailor-looking man who, incidently, is an ex-soldier and who was wounded in battle, you would surely say is about to sail on at least a year's voyage. He is on a harbor tug boat! That timid-looking very young fellow with the refined manner you would imagine is on one of the over-night passenger boats. Through his own request he is about to sail on a five months' voyage to South Africa, on which he will visit not only Cape Town, Durban and Madagascar Island, but semi-civilized towns up African rivers, and this is not his first long trip.

C. S. Thevenet, senior operator of the new Savannah liner "City of Chattanooga." He has served in that line four years

Yes, a marine radio office is an ideal place for a trained psychologist. There is a gathering of men and boys from all ranks: run-away farm boys, who never before saw a ship, to college graduates who formerly spent their vacation periods on the water; from ex-army privates to lieutenants, captains and majors, and from former apprentice seamen to naval officers.

As the crowd at the office begins to grow smaller the realization comes that this same assembly will never again be together. The men are leaving for all parts of the globe; some to return soon and others not for many months. They may pass on ships at sea and may communicate between themselves at great distances; and friends may in time come together, in this or in distant ports, but the same crowd will never be. for each day's gathering at a radio office is different.

* * *

Some folks hold the opinion that radio operators are thin fellows capable of passing behind panel sets and making themselves comfortable in the small cabins found on some ships. They should see the famed operator Bandettini on the steamer *Clauseus*. Born and bred in Michigan he started crossing the Atlantic about three years ago when he weighed about 180. Since then he has grown to around 280, and is still going strong. His joining the Elks a few months ago certainly didn't take any weight off, but rather added to it, say his friends.

* * *

The Elks is popularly known as an order of prosperous gentlemen. It is fairly well represented among the sea-going radio men. F. N. Normandin, running on the *Swiftwind* between Providence and San Pedro, is one of the latest to join. Four members of that order recently left the sea: Clyde Diderick is now the proprietor of a restaurant in Prangeville, Ill.; Edward Freeman is one of the staff at the WJZ broadcasting station in New York City. A. E. Ermatinger is now located in the middle west and Bill Ferrick is in the Shipping Board's London office.

* * *

Mentioning Bill Ferrick's name brings to the fore one of the old time radio men about whom there are many inquiries, especially among the army of ex-operators. He has a pretty good berth as operator at the United States Shipping Board's receiving station in London, England. Ferrick's radio service has been a long and varied one, broken only by the couple of years spent as postmaster of a small town above New York City. Since then and up to his taking his present position he was chief operator on trans-Atlantic passenger ships. Many years ago Ferrick was at different times manager of coast stations, notably those at New York, Charleston and Jacksonville, all three of which have long since been discontinued.

* * *

A remarkable reception record was made by Jack O'Connell, mate and radio operator on E. W. Scripps' yacht *Ohio,* on the night of President Harding's death, when he obtained over a thousand words of press while the vessel was west of the Fiji Islands. By nine o'clock on the night of the President's death, O'Connell had his story complete and handed in to the owner of the yacht. Upon arrival at Suva, Fiji, the following day the local newspapers, which had only received bare facts, got real details from those aboard the yacht. Some of the items were received at a distance of 7,000 miles from the transmitting station.

Marconi Transmits on New Waves

ANOTHER step in the development of wireless telegraphic transmission has been realized, says Senatore Marconi, who has returned to London after a two months' experimental cruise in his yacht, according to a London dispatch. A system has been evolved whereby wireless messages are transmitted with a minimum of electrical power, and at very low cost.

"We have transmitted messages up to a distance of 2,250 miles, not only with a very much smaller amount of power and energy, but faster and more cheaply than with the ordinary system of long-distance wireless," said Senatore Marconi.

"When the new system is adopted it will mean that a power station for long-distance work can be erected at much less cost than at present. I have telegraphed on this system from Cape Verde Island, off the African coast, to London. To send messages clearly and more rapidly over those 2,500 miles took less power than a message from London to Paris by the ordinary methods."

Senatore Marconi explained that these advantages were gained by the utilization of waves that have not before been used.

France Increases Ship Radio Requirements

THE recent French radio requirements for vessels extending the range of transmission fifty miles, also affect all foreign ships touching at French ports since October 6. The French radio decree, signed last spring, but which only reached this country last month, provides that all vessels of 2,000 gross tons, all ships licensed to carry 50 persons, including the crew, and also all craft having as many as twelve passengers aboard, must be equipped to send and receive wireless messages by day up to 150 nautical miles.

Merchant ships between 500 and 2,000 gross tons, licensed to carry less than fifty persons, or with less than 15 passengers aboard, must be capable of receiving radio signals up to 2,800 meters and preserve a watch for emergency calls.

In establishing the minimum of 150 miles for first class ship radio transmission, fifty miles farther than the regulations of the International Convention of London in 1914, the American Law of 1910, and the British regulations of 1919 provide, France has taken a step forward in making for better protection of life at sea. The increase of fifty miles is not at all out of proportion, however, with the progress made in radio telegraph transmission during the past ten years.

The French decree of 1923 makes it mandatory upon the master, who receives a wireless distress call, to proceed to the ship's aid; this decree also increases the number of responsible ships by requiring all French merchantmen and fishermen over 500 tons to carry radio receiving equipment even though not equipped with transmitters. This involves a practical acquaintance with wireless signals by at least one of the crew, who must be certified by the government. It is a self-denying ordinance, but is in the interest of humanity in general; obviously the master getting an "SOS" call must start for the scene, although he could not himself issue such a call for aid. The masters, however, are benefited by receiving meteorological, time and position signals and in keeping in touch with world events, depending upon the skill of their wireless watcher or listener-in.

The new French regulations will make it practically necessary for other nations to adopt the same transmission limits and minimum tonnage. The International Convention will also be concerned in an effort to preserve uniformity of radio laws.

It is understood that the State Department Committee on Electrical Communications, which now meets frequently, will consider the phases of this law which affect United States ships.

Boston Radio Show

BOSTON'S third annual radio exposition will be held on December 3, in Horticultural Hall, where it is believed better facilities for displaying the latest in radio may be had. In addition to a large number of displays by manufacturers and dealers, there will be lectures, movies of radio subjects, prize contests and constructional exhibits. Local broadcasting stations will give special programs and visitors will be given an opportunity to see a special broadcasting studio.

High Power Station Near Cape Town

THE Wireless Telegraph Company of South Africa (Ltd.), has been recently organized to provide international telegraphic service for the Dominion. The principal high-power station is to be located at Klipheuvel Station, Cape Province, about 30 miles by rail from Cape Town. The site comprises about 1,000 morgen—2,110 acres—of farm land and is so located as to be about 10 miles distant from any mountains. It is estimated that the station will be in operation in about eighteen months. The power of the new station will be 750 kilowatts and it is probable that it will operate on a wavelength of about 16,000 meters.

Uncle Sam's radio station at Guam

Poland Circuit Opened

A NEW record for long-distance commercial radio communication was set with the opening of a circuit between Rocky Point, Long Island, and Warsaw, Poland. The space over which the signals must travel is more than one-sixth the distance around the earth.

This circuit, which is a part of the Radio Corporation of America system, was formally opened when officials of the Polish Government and the Radio Corporation exchanged greetings by radio. It marked the first time in history when the United States and Poland were brought into direct communication, without the messages being relayed over land wires through other countries.

The cost of the sending station at Warsaw and receiving station on Long Island was approximately $2,000,000, and the work of building them began in August, 1921.

The transmitting aerial at the Polish station is similar in design to those employed at Radio Central, the Radio Corporation station at Rocky Point, L. I. There are ten steel towers erected on a large tract of land on the outskirts of Warsaw, and these support aerial wires a mile in length. The receiving apparatus consists of a double receiving circuit used in connection with the recently developed wave antenna, which is nine miles long.

Forty engineers and operators are employed at the Warsaw terminal.

The establishment of the new circuit gives Poland political advantages not enjoyed by countries which must relay their messages by land wires under the control of neighboring countries.

Captain Donald B. MacMillan, famous explorer, who from his winter quarters in Refuge Harbor near Etah on the northwest coast of Greenland, has kept in touch with civilization through his radio apparatus (Station WNP). His ship, the "Bowdoin," is reported as being frozen in solid for the next seven or eight months

Liebmann Prize Awarded to Beverage

HAROLD H. BEVERAGE, an engineer of the Radio Corporation of America, was tendered a vote of honor by the membership and board of officers of the Institute of Radio Engineers at their last meeting, for the outstanding radio invention of the year which consisted of his so-called wave antenna. Beverage was also presented with a cash prize of $500, the Liebmann Memorial Prize, this amount being the annual interest on an investment made by the late Colonel Morris Liebmann, a well-known radio engineer. Each year this sum is given to the most deserving individual whose radio inventions or developments are of outstanding practical importance.

NATIONAL RADIO WEEK

The Muses Worked Overtime to Make National Radio Week a Big Event

THE week of November 25th to December 1st was set aside as National Radio Week. And more, it was National "Party" Week for radio fans.

Broadcast stations co-operated with the Radio Trade Association to make that event the biggest, recent celebration on the air. Newspapers throughout the country gave their support by running special stories, increasing their radio features and in some cases through the news columns.

The Wireless Age trusts that listeners invited those of their friends who do not own sets to listen-in one or more evenings during Radio Week. We are sure the programs were especially interesting to fans and well worth their friends' participation in the radio party.

Programs, throughout the event, were arranged to present the breadth of possibilities in entertainment through radio in the home as well as to promote the party spirit that is possible by means of this great vehicle of universal communication.

Radio parties of this sort should become very popular. How else, than through radio, can we have so much real fun in the home? By what other means can we get together so informally, and yet enjoy the full spirit of the party?

National Radio Week was designed for the purpose of extending the field of interest in radio to those who do not realize the range of entertainment to be found in broadcast programs. Those who have receiving sets were urged to spread the gospel of radio joy in the homes of their neighbors. Broadcast stations and publications have done their part, and it is hoped that BCLs. have been doing theirs.

And now, for your part, let your friends "in" on some of the good things you get with your set. Make it a National Radio YEAR.

BERLIN POLICE USE RADIO
Due to disorders in Germany, Berlin police are equipped with radio. This patrol is alert to receive calls for assistance when emergencies arise

Tube "Bootleggers" Arrested

WITH the arrest in Philadelphia of the alleged leader of a gang of "radio bootleggers," the attention of the police and public was again concentrated on an industry valued at many millions of dollars which has been built up around the counterfeiting of vacuum tubes and trade marks of the General Electric Company, Westinghouse Electric and Manufacturing Company and the Radio Corporation of America. According to John S. Harley, special investigator for the Radio Corporation, the Philadelphia arrest is regarded as the key in a situation involving six factories located in Newark and its immediate vicinity.

In order to obtain the necessary evidence against the manufacturers, detectives from New York and Philadelphia have been engaged along Philadelphia's radio row for several weeks. Close observations were kept at that point as well as in Newark, where all of the manufacturing activities took place.

According to the police, the arrest of Thomas F. Cairns, Jr., known as the "king" of radio tube bootleggers, will lead to the arrest of a number of other bootleg tube manufacturers.

The life of the bootleg tube is extremely short, and, although many of them are sensitive at the beginning they lose their value after being burned for a few hours. The dealers in many cases have lost large sums of money through the operation of this ring of radio vacuum tube bootleggers.

A simple set that any amateur can construct

The Wireless Age Uni-Control Receiver

By John R. Meagher

This is the first of a series of sets made in the office of THE WIRELESS AGE. It will be kept on display and any reader who can conveniently do so is urged to visit THE WIRELESS AGE office and examine it

WE are going to describe a receiver that is not only admirably suited for home entertainment, but is electrically one of the very best that can be built. In no sense of the word is it "new"; on the contrary, many years have elapsed since the first of its kind was introduced, but in that time countless developments, changes and improvements have been made. At present it typifies all that is good in the rather neglected quality of reliability.

Of its many excellent merits its most emphasis is placed on the extreme simplicity of operation. This receiver has but one dial on which may be marked the call letters of both local and distant stations when they are first heard. At any time thereafter that a certain program is to be received it is necessary merely to turn the dial to a definite point and, if broadcasting, the particular station will be heard! There is no fussing or fuming with countless knobs; there are no trick or delicate adjustments; there is no "combination" to be sought for; there is no waste of time in tuning nor need for "expert" operation. Simply turn the dial to the properly marked point and enjoy the broadcasting.

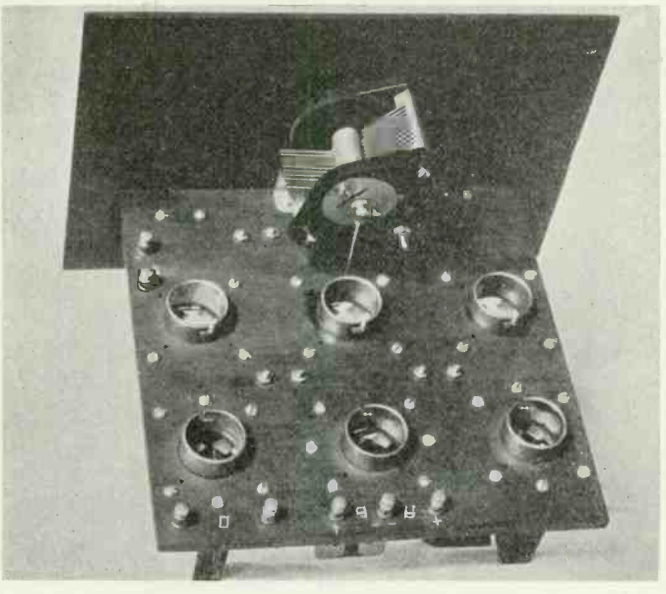
A loop antenna is employed for reception and six vacuum tubes, suitably arranged, enable loud speaker reproduction of stations 1500 miles distant. The amplification is such that it is entirely practicable to operate the set either in a large hall or in the open. Intensity is under positive control through use of a volume regulator—the loud speaker may be made to whisper, talk, shout or bellow at will. And of more than passing interest is the unusual compactness; the front panel is only 7 inches by 10 inches!

Besides being simple in operation, powerful as to amplification and compact, this uni-control outfit is very sensitive and selective. Selectivity, the ability to discriminate between stations and exclude all but the desired program, is obtained through use of a small loop antenna which experts tell us is inherently selective. Sensitivity, the ability to reach out for distant stations, is obtained through employment of radio frequency amplification—a modern adaptation of the "20 league boots" of fairy stories.

. . . . . .

Having personally supervised the construction and testing of hundreds of somewhat similar receivers, no two of which were alike—each being an improvement over the former—and having located the difficulty with those which failed to operate or failed to continue in operation we feel that we can speak with comparative certainty on the subject. Therefore even at the risk of stifling originality we plan to eliminate all uncertainties from the description. There will appear few alternatives, either in design or construction, and it is our desire that the builder adhere very closely to specifications.

This article will cover the design, construction and operation—including testing and trouble shooting hints. Then in a later issue of THE WIRELESS AGE, we shall give further information about loops, how to use an aerial with this set and how to care for the batteries. Thus the entire subject will be covered and if instructions are followed everyone building the single control receiver should have splendid results. If difficulty is encountered the Information Desk of THE WIRELESS AGE will be only too pleased to render assistance. But we do not anticipate many inquiries as the design and construction has been so simplified that a beginner will experience but little trouble in building this single control receiver.



The rear panel on the "W. A. Unicontrol" is only 8" x 8"! Six sockets for UV-199 tubes are mounted on it; from left to right in the top row—1st RF, 2nd RF and detector. From right to left in the bottom row—1st AF, 2nd AF and 3rd AF

DESIGN

In planning this receiver we were tempted to utilize reflex amplification in an endeavor to reduce the contemplated size and cost. On further investigation we found that the additional cost would be only for the vacuum tubes, a fairly low sum. And as to saving space, we were able to reduce the size to such an extent that the six tubes occupy considerably less room than most one-tube receivers. Naturally the filament current consumption of six tubes is greater than that of three or four, but through use of .06 ampere VT's this disadvantage is made almost negligible. In addition, it is our candid belief, obtained through unbiased observation and numerous experiments, that a straight cascade amplifier is superior to the usual run of reflex systems; few people will contest the statement that there is a "certainty" in the amateur construction of cascade amplifiers that is lacking in multi-tube reflexes. And as our prime motive is to describe a set that will work, and work well, and in the construction of which there will be no "guesswork" or "tryouts" we decided to pass up the reflex system.

The complete wiring circuit is shown in figures 1 and 2. It will be seen that there are two stages of radio frequency amplification, a detector and three stages of audio frequency amplification; inter-tube coupling is provided

through suitable iron core radio and audio frequency transformers.

The filament circuit is rather unusual insofar as there is not an iota of wasted energy due to extra filament resistances. The six filaments are arranged in three parallel branches of two each—the resultant current (with UV-199 tubes) being .18 ampere at 6 volts. Note especially that the circuit is so arranged as to permit the grids of the three audio frequency tubes to be at 3 volts difference with respect to the negative terminal of their filaments; necessity for a grid battery is thus obviated. Moreover, by this arrangement the voltage on the grids of each radio frequency amplifier is the same.

A positive acting cut-off switch and a high resistance potentiometer are the only extra equipment in the filament circuit.

In figure 1 particular attention is directed to the radio and audio frequency transformer connections. On the AF transformers G and P represent the outside terminals of the secondary and primary windings; F and +B the inside terminals of the same coils. The RF transformer connections are suitable for "DX"—"Virbren" type; if others are used the manufacturer's suggestions should be followed.

Great care must be taken that the grid return leads are exactly as shown. On the R.F. tubes they both are connected to the potentiometer slider; on the detector to the positive "A" battery line and on the A.F. amplifiers to the negative terminal of the filament heating supply.

It should be noted that only three battery leads are necessary; two are for the 6-volt filament battery and the other is the positive plate battery connection. The negative "B" and positive "A" are joined together at their position on the floor or elsewhere. No tap is used for the detector plate as with under 70 volts plate battery the UV-199 works quite well.

The actual layout design may be observed from the photographs and panel drawings. The vacuum tube sockets are arranged in two rows of three each with a spacing of 2⅞ inches from center to center. The R.F. tube sockets are in front, near the tuning condenser and potentiometer; A.F. sockets are in the rear. Both R.F. and A.F. transformers are placed in logical order to permit of short connections. The R.F. transformers are situated between the first and second and the second and third sockets and mounted under the sub panel. The A.F. transformers are secured directly beneath the A.F. tube sockets.

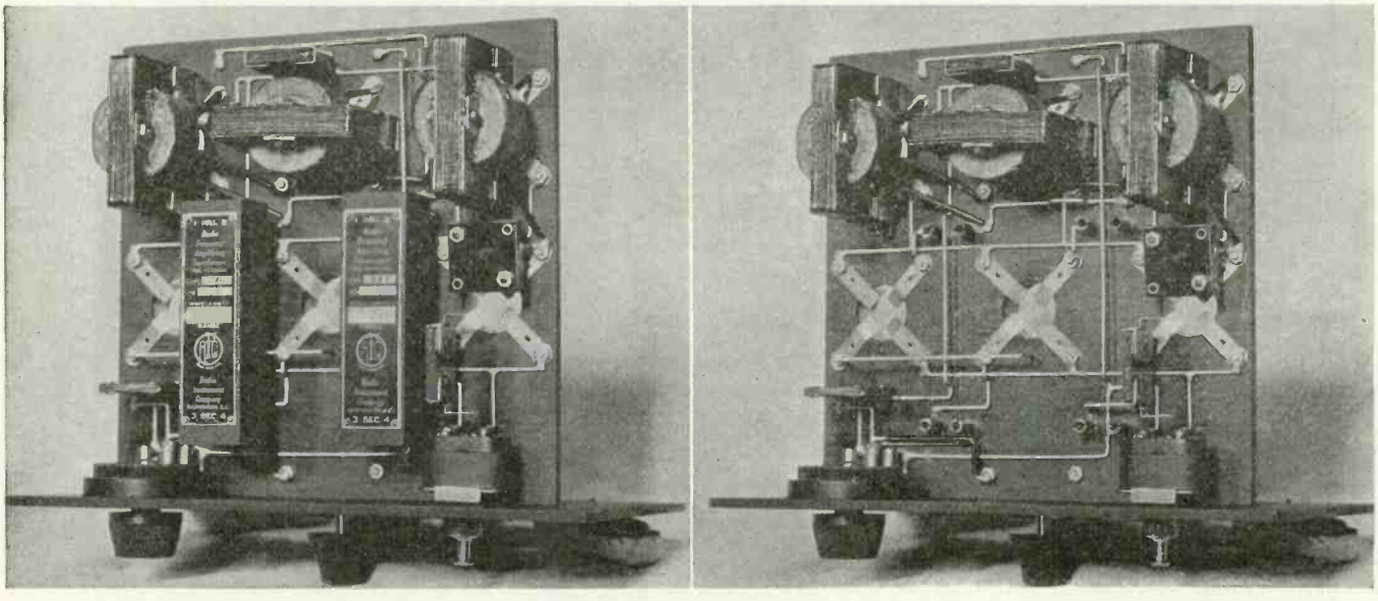
The variable condenser and potentiometer are mounted on the subpanel so all connections may be made before the front panel is attached. This is very advantageous from a manufacturing standpoint as the entire assembly is firmly arranged on one panel and results in a degree of rigidity and strength not usual in multi-tube receivers.

There are only two knobs, the condenser vernier and the potentiometer or volume regulator. The dial is screwed to a collar on the condenser shaft and is used solely as an indicator of wavelength setting. The finish is such as to permit writing on the lower portion with lead pencil or india ink.

It will be noted that there is scarcely an unnecessary piece of equipment and this fact, combined with the exceedingly compact arrangement permits of exceptionally short connections; the wiring is therefore solid and if all spring contacts are made with good phosphor bronze there will seldom, if ever, be need for repair. In addition, insulation of paneling and transformers is good. These two features, i. e., perfect connections and insulation, result in quiet operation.

A point which is frequently neglected in "simplified" receivers is the consistency of wavelength adjustment.

However, it will be observed that ample provisions have been made to retain that factor, to wit: the shunt condenser across the potentiometer slider the fixed filament resistance and the constant value tuning condenser. But still another precaution must be taken—the loop antenna must keep its original inductance value and to do this the wires should be taut, connections short and solid and it must not be moved about too much nor placed too close to large metallic objects.



No rheostats on this receiver! Note how very simple the wiring appears in these bottom views. Mounting lugs for the RF transformers are shown in the right hand illustration

It would be a good plan to read the constructional details and study the photographs before securing the necessary material. It is needless to say that only the finest components should be selected.

EQUIPMENT

One .00025 (250 m-mfd.) variable condenser with a mechanical vernier—that shown is a Veldar—not the regular extra plate type.

One 400-ohm potentiometer; the specified resistance is not essential, but it should be as high as possible. There are very few good wire potentiometers so this item must be selected with care.

Three audio frequency transformers, all low ratio. Those shown are Kardon, unmounted, for UV-199 tubes.

Two radio frequency transformers covering the range of 220-550 meters.

One front panel, 7x10x3/16 inches.

One rear panel, 8x8x¼ inches. The six vacuum tube sockets are "spun" into the sub-panel but, if desired, standard UV-199 sockets may be mounted on top of the panel in the indicated position. It is possible to purchase the sub-panel with spun-in sockets for about $8.00 from the Kardon Products Co.

One battery switch.

One .002 mfd. fixed condenser.

Two .00025 mfd. fixed condensers.

Six lengths of square tinned bus bar.

Two lengths of small black cambric tubing.

Six mounting screws for the variable condenser and potentiometer—usually flat head, 6/32, ½ inch long.

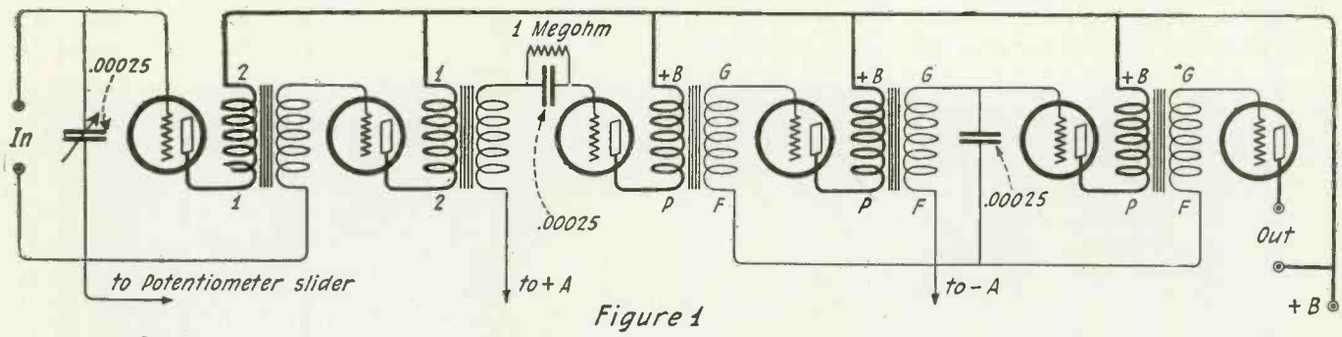
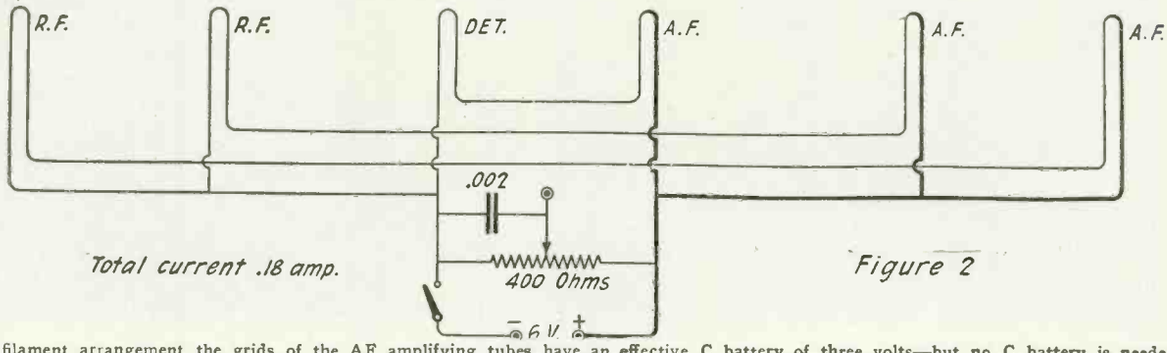


Figure 1



Total current .18 amp.

Figure 2

By a special filament arrangement the grids of the AF amplifying tubes have an effective C battery of three volts—but no C battery is needed! Complete dope about this in the text

ACCESSORIES

One loop. About 3 feet square wound tautly with 12 turns of solid hard drawn No. 20 copper wire spaced ½ inch.

Six UV-199 or C-299 vacuum tubes.

One plate battery of 67½ volts.

One "A" battery of 6 volts.

One loud speaker or a good telephone unit and suitable horn.

TESTING

Before using transformers or condensers it is not only advisable but quite essential to test for shorts and breaks; thus faulty equipment may be detected before construction and not only will there be more certainty of perfect operation at the start, but also there will be a saving of time and trouble.

A headset and small 22-volt battery should be connected as shown in figure 3 to provide a testing medium. If the free terminals are touched together for an instant a very strong double click will be heard in the telephone headset; if the terminals are joined through a resistance the clicks will not be as strong, depending upon the value of resistance. If they are applied to an open circuit there will be no definite click.

While wearing the headset the testing terminals should be applied to the primary and secondary connections of both the radio and audio frequency transformers. In each case a strong double click should be heard. If it is not the coil is "open" and the transformer must be replaced. Each transformer should be tested for shorts between windings. This may be done by touching the test terminals to one primary and one secondary connection. If a click is heard, the windings are shorted and the transformer is detective.

In a similar manner, if the test terminals are applied to opposite sets of plates in a condenser, a click indicates a short; lack of a definite click indicates that the condenser is not shorted and should be satisfactory for use. The potentiometer should be tested by touching the test terminals to the ends of the resistance element. A strong click should be heard, otherwise the winding is open.

Remember that all testing may go for naught if the soldering iron is carelessly handled while wiring. In case one is at all doubtful regarding the continuity of a circuit, use the test terminals freely.

There is a comparatively wide variety of insulating panel material to choose from; some are better than others, but on the whole any one of the numerous makes advertised will be entirely satisfactory. When purchasing, specify that the surfaces are to be sanded, blasted or grained and the edges true and square. If the product is "Radion" it is well to retain the original surface.

Discretion must be used in laying out the panels, drawings of which are not shown because the location of holes will vary with different makes of equipment. If one buys all the parts first and then arranges them on the sub-panel there won't be much trouble in this matter. Plenty of space is provided for both the audio and radio frequency transformers. The only problem which may arise will be with the sockets. Those shown are "spun-in" by a process too difficult for home duplication.

If the sub-panel is not purchased with the sockets in place, regular UV-199 sockets may be secured to the sub-panel. They may be mounted on top or on bottom with only the shells jutting through.

In drilling, clamp the panel to the bench in order to have both hands free in working and guiding the drill. Go through steadily but do not "push" as the outer surface may chip. The front panel need not be drilled until the rear panel equipment is assembled and wired.

ASSEMBLY

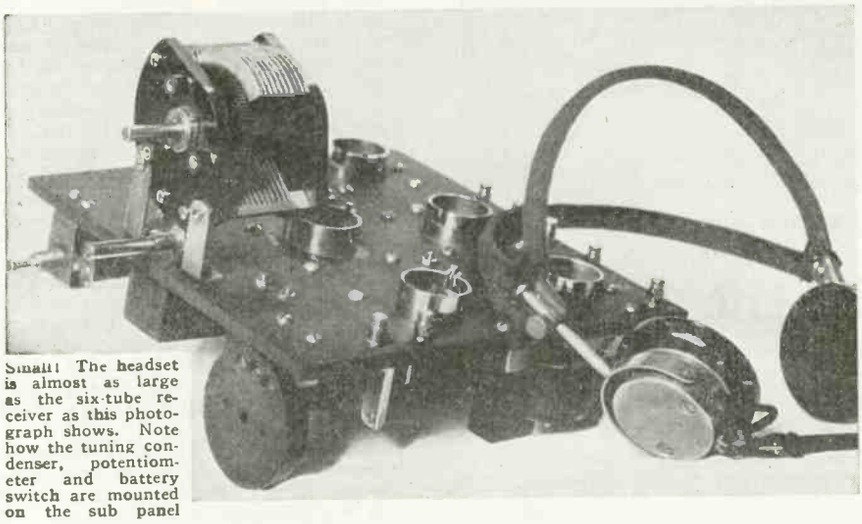
First, the sockets, using either method of the two described. Make sure that the springs are secure and will not move out of place. The three front sockets are fixed with the slots

toward the rear and the back sockets with the slots toward the front.

Then screw in the mounting jacks for the radio frequency transformers. Next the audio frequency transformers under the tube sockets and finally attach the variable condenser and potentiometer to the upper side of the sub-panel.

WIRING

Bus bar wire should be stretched before using as this gives additional rigidity to the wiring and permits of a very neat job, free from the curls and twists in unstretched wire. The usual method of stretching is to place one end of the wire in a vise and with a pair of pliers clamping the other end, pull with sufficient force to extend the bus bar a small fraction of an inch per foot.



Small! The headset is almost as large as the six-tube receiver as this photograph shows. Note how the tuning condenser, potentiometer and battery switch are mounted on the sub panel

For details of soldering and wiring we reprint here seven points extracted from another and previous article of ours:

1—Solder all joints. Soldering to a lug and screwing the lug to a terminal does not constitute a soldered joint—the wire should be soldered direct to the terminal.

2—Flow the solder in all joints so they are perfectly smooth when cold. This requires a properly heated and tinned iron with sufficient flux.

3—Do not be too sparing in the use of flux, but immediately after soldering remove all traces of paste—with scrupulous care.

4—Use square tinned bus bar wire wherever possible.

5—Make 90° bends and run stiff connections only vertically and horizontally.

6—Wires more than a few inches in length should be run against the panel or other insulating support — they should not be left unprotected in space.

7—When soldering a wire to a terminal, aim the wire toward the center of the terminal—do not solder it to the side.

The filament circuit should be wired first in exact accordance with the diagram, figure 2. Starting at the negative filament battery terminal run a bus bar to one point on the battery switch; from the other point to the left hand (from front) terminal of the potentiometer and thence to one filament spring contact of each of the first three tubes (R.F. and detector). From the positive filament battery terminal run a bus bar to the other end of the potentiometer resistance to one filament spring contact of each of the last three sockets. Join the remaining filament contacts of the first and last tube; of the second and fifth; and the third and fourth. Note that this is quite simple as the sockets are arranged perfectly; the third A.F. is directly behind the first R.F., the second A.F. in back of the second R.F. and the first A.F. socket in the rear of the detector socket. Check over the wiring a number of times and then test by applying a six-volt battery to the binding posts and inserting a pair of tubes in their sockets. They should light when the switch is on. Test with all six tubes in the sockets; if two or more fail to light the trouble is due to one of the following details:

(a) Defective tube.

(b) Poor contact between the socket springs and the tube studs.

(c) Wrong wiring due to mistakes in socket spring connections—the UV-199 has filament contacts opposite.

(d) Broken circuit. A joint which seems to be soldered may not be making good connection.

The remedy in each case is obvious and indeed the circuit is of such simplicity that we doubt if anyone will have any trouble, provided of course that he is reasonably careful.

In wiring the rest of the circuit consider the plate and guide connections as separate and distinct and finish one entirely before starting the other.

Beginning at the positive plate battery binding post run a bus bar to terminal 2 of the second R.F. transformer and to terminal 1 of the first R.F. transformer. To this bus bar connect the flexible positive B leads of the primaries of the audio frequency transformers—running these leads in cambric tubing to avoid accidental shorts. Also connect this bus to one binding post of the out-put terminals. Then connect the plate springs of all six sockets to their respective primaries.

The grid-filament circuit is shown in figure 1, represented in light lines; it is self-explanatory.

As the final step connect the fixed .002 mfd. condenser between the slider and the negative terminal of the potentiometer. Check over the wiring at least three times and of course correct any errors. Also make certain that adjacent wires are not touching each other and take care in future handling to prevent this.

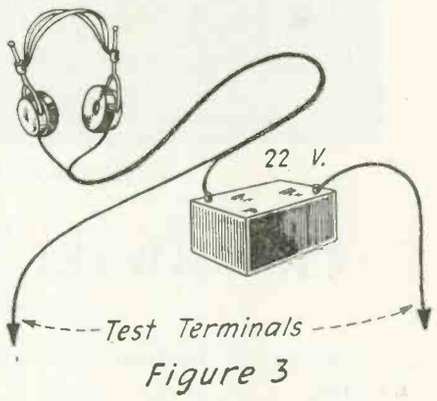


Figure 3. All the material for the "W. A. Uni-Control" is tested before being used. A simple testing outfit is shown above

FINISHING AND TESTING

Attach the front panel to its condenser; no special brackets are necessary. Adjust the condenser vernier and potentiometer so both operate smoothly and finally attach a suitable collar to the condenser shaft and screw the dial to the collar, arranging both so that when the 0° mark on the dial coincides with the top indicator the movable plates are all "out."

Insert the grid leak and R.F. transformers in their respective mountings. All these connections should be stiff and positive.

Next, connect the plate and filament batteries, the loop and the loud speaker. Insert tubes in two sockets—say the first and last—and push the switch "on." If the tubes light with their

(Continued on page 64)

Col. Samuel Reber, RCA representative in Japan

How Iwaki Told the World

(*Continued from page* 18)

and Shimotsui in the Inland Sea west of Osaka.

I had just visited Tomioka to present to Mr. Yonemura and his staff the generous bonus which the Radio Corporation donated to them with the consent of the Minister of Communications in recognition of their initiative and their resourcefulness during the first days of the crisis. With considerable reluctance, as he is very modest, Mr. Yonemura told me the following story which I have set down as best I can from memory and a few notes I made during its narration. I am also adding his letter to me in response to my request to write me his story. The letter was written before my visit to Tomioka.

YONEMURA'S OWN STORY

"At twelve o'clock on the first of September, we had the most severe shock I have ever felt. As soon as it was over, I tested the land wires and found the circuit to Haranomachi O. K. but all other lines down. I realized at once that the only way we could get anything was by radio and I kept a close watch for anything that might be sent from any station and at about seven o'clock that evening I heard Choshi calling both Shiomiasaki and Shimotsui, trying to send an official message from the Chief of Police of Yokohama to the Governor of Osaka. This message had been sent by radio from the Corea Maru which was then in the harbor of Yokohama to the Choshi station. I have read in the newspapers that the Chief of Police at three o'clock that afternoon, when, in spite of his official position, he was unable to get even a sampan, jumped into the harbor and swam to the Corea Maru to send his report. On reaching the vessel, he collapsed but, as soon as he was revived, wrote his report and gave it to the radio operator who succeeded in getting it through to Choshi. I copied this report and sent it at once to my superiors at Sendai over a temporary wire which had just been brought in. I then sent the first bulletin to Honolulu. The report to Sendai was the first news that the officials there had of the earthquake and from what I have heard from America and what you have told me, I now know that radio beat the cable, as it always can. I then continued sending whatever reliable news I could get from any source until the foreign correspondents resumed their news service on the seventh of September.

"I began trying to raise Funabashi on the morning of the second and continued until the afternoon of the fourth when Funabashi answered and began sending me official messages for the United States and Europe. The first message for the Secretary of State at Washington was received at 3:30 p. m., September 4th, and the second, at 11:55 a. m. on the fifth. The one addressed to the Commanding General of the Philippine Division arrived at 7:34 p. m. of the sixth and was relayed by Pearl Harbor to Cavite. Funabashi also sent me press copy for the Associated Press, the United Press and the Philadelphia Ledger.

IN MR. YONEMURA'S OWN WORDS

Iwaki Radio Station,
Oct. 6, 1923.

My dear Mr. Reber:

Many thanks for your letter and the eulogy expressed therein on my little service on the occasion of the great disaster.

Immediately after a rather strong earthquake shock at Tomioka at noon, September 1, we found that the wires to Tokyo and Yokohama were down and telegraphic communication with both cities was entirely stopped. I foresaw the difficulty of bringing about restoration of the telegraphic circuits, and it came to my mind that we must open up connection with other radio stations, because radio is the only means of communication in such an emergency. Therefore we at once began calling up our fellow stations and listening in for them.

At 7 p. m. on that afternoon, we picked up Choshi Radio relaying messages reporting on the disaster in Yokohama. This was the first news, sent by the Korea Maru, then in the port of Yokohama. This message and subsequently others were one after another retransmitted to our Head Office, Sendai, by a temporary wire connection.

In view of the fact that Tokyo was deprived of all means of communication with the outside world as a result of the interruption of the Bonin cable and the land lines, I saw the necessity of sending out the news to the world by our own radio. On the night of the first I sent to Honolulu the first news which reads as follows:

> "Conflagration subsequent to severe earthquake at Yokohama at noon today whole city practically ablaze with numerous casualties all traffic stopped."

The message was relayed to San Francisco at once and delivered to various papers there. It is said that the papers throughout the United States issued extras on the morning of the first or some time during that day giving the above account of the disaster. I was greeted with universal applause by the papers, some of which called me "Radio Hero" and published my picture. For some days after that, I continued sending news several times each day. These bulletins were copied direct by San Francisco Radio, which maintained a constant watch for us.

My work came to an end on the seventh, for we then saw press messages from foreign correspondents going through Iwaki.

Thanking you again for your kindness, I am,

Sincerely yours,

K. Yonemura

What to Do Until the Doctor Comes

By R. L. Duncan

THE vast number of radio enthusiasts, past, present and future, may be divided into two classes: One, the non-technical, interested solely in the satisfactory and consistent performance of their "radio" and not caring how and why it operates; and the other the "bug" possessing, or desirous of possessing, a knowledge of everything concerning his apparatus from aerial to ground.

The former class is representative of Mr. Black and Mr. Brown. Mr. Black, having secured his receiving set inquired of his next door neighbor, Mr. Brown, if he could inform him why last night's program was received in spite of the fact that he was using no ground connection while the directions specifically stated that a ground should be used. Mr. Brown's only answer was, "Don't ask me, Mr. Black, I don't even know why we receive the programs with all the wires connected."

For just such people as Mr. Black and Mr. Brown this article is written. For there comes a time when trouble is experienced even with the finest of receivers and if the owner knows nothing about the set he will have to forego the pleasure of broadcasting until an expert can be called in to "doctor" the outfit. Now usually—or at least in the great majority of instances the writer has observed—when the receiver is of reliable manufacture the "faults" that develop are of minor character and most easily remedied. Of course it is only natural that the non-technical owner should consider even the smallest part as being a bit too much for him to tinker with. But on the other hand it is always well to know something about the more common difficulties, not only because they are prone to come up at the most inopportune moment when some especially interesting event is to be broadcasted, but also in order to estimate the nature of the trouble and guard against similar occurrences in the future.

The few tests and expedients which follow, therefore, are set down for Mr. Everyman to enable him to correct by himself any of the numerous minor "troubles" that might cause his set to function poorly or cease working altogether.

What's the Matter?

When the receiving equipment is composed of good material throughout and has been working well, but for some reason ceases to "percolate" as it should, we must find the trouble and then correct it. We know that the latter is the easier of the two; it is placing a finger on the actual fault that presents the harder job, but that shouldn't daunt one, for it's easy, when one knows how.

Happily a well made receiver may be depended on for exceptionally long service without repairs of any kind. It is very seldom that wire connections jar loose or break as modern construction is far from being delicate and the makers vie with each other in producing mechanical and electrical features of durability. The one point of inherent weakness is that of spring connections such as are encountered in plug mountings, tube sockets and leak holders. Otherwise the receiver itself is seldom at fault; usually failure of operation may be traced to the batteries, tubes and their connections.

Before you call in the radio doctor find out if the trouble with your receiver isn't located in the answer to one of these queries:

1. **Are the tubes making proper contact in their socket?**
2. **Are the battery and other leads in good shape?**
3. **Are the binding posts on the receiver and other equipment tightened up?**
4. **Are all the vacuum tubes good?**
5. **Are the A battery leads reversed?**
6. **Is the A or B battery run down?**

We have three distinct but naturally interlinking subjects to consider: Connections, batteries and tubes. And if we follow a definite procedure, checking each subject in turn and conducting a systematic, but still simple search, we are bound to find "what's the matter?"

We will take up the more important first, but the correlation is such that all three are essential to a good working knowledge of simplified trouble shooting.

Connections — Broken, Bad, Wrong and Indifferent

Under one of these heads must come the description of a connection that is not electrically good.

When the receiver does not operate properly remove all the vacuum tubes and, with a lead pencil or similar object lift up each leaf spring in the tube socket so that when the V.T. is replaced there will be a noticeable and fairly heavy tension against the tube pins. Also, when replacing, twist them back and forth in the slot so that the friction will scrape both the springs and tube pins and assure a clean contact. This cleaning process should not be deferred only until the receiver stops working, but is also a good thing to do from time to time in order to safeguard against the possibility of poor contact. Then, if there are other spring connections, bend them to make positive and firm contact. Also tighten the binding posts on the receiver, batteries and other auxiliary equipment. The B battery terminals are especially apt to loosen so it would be well to go over them and be sure they are clamped securely, using a pair of pliers if necessary.

A loose connection in the B battery circuit will be characterized by a sharply defined crackling noise. And if an inspection of this section does not reveal an apparent break despite continued crackling, the B battery may be defective—this will be taken up under the subject of batteries.

Inspect carefully all wire connections leading to the batteries and output: If any are not in A-1 condition, replace them.

Also pay careful attention to the aerial and ground connections: Be sure that all antenna joints are soldered and that no accidental shorts (that is—direct connection between aerial and ground) exist. The antenna should not be permitted to sway into contact with other objects.

If the receiver is totally inoperative and a search for poor connections does not result in a material change, look to the vacuum tubes.

Vacuum Tubes—Burnt Out and Old

Do they glow or light at their usual brilliancy when the filament controls (rheostats, switches and jacks) are manipulated in accordance with the manufacturer's instructions? Or do they fail to light at all? In the latter event, presupposing that the batteries are good, the tube may be burned out. Try switching the tubes, if the receiver is of the multi-tube type, in order that it may be definitely established whether any particular tube is really "blown."

There is no permanent remedy for a "dead" tube—a new one is the only solution—and beware of "bootleg" stuff for usually it is as insidious as its namesake.

Unfortunately a tube may be a "dud" although the filament lights as usual; this is especially true of the low filament current type; being merely a case of "wearing out" in service—that is, the effective life is spent. It is well, therefore to have at least one brand new tube extra both for emergency use and also to check the efficiency of old tubes.

Now, with both connections and tubes checked and apparently proved

satisfactory, but if the receiver still does not work as it should, we must next inspect the

BATTERIES—RUN DOWN AND REVERSED

With each vacuum tube receiver there are used two batteries, the A or filament and the B or plate battery. They may be run down or the connections to them reversed; in either case satisfactory operation is improbable. So we must find out whether they are "up to snuff."

It is a very easy matter to inspect the wiring and see that the connections are not reversed—do so; and if, by chance, they are, attach them properly, being careful of course not to cause any "short circuits," that is, not to connect the terminals of either the A or B batteries together.

The A battery is of either the dry or storage cell type and the normal voltage range is from 1.5 to 6 volts, depending upon the type and arrangement of tubes. The B battery is usually of the dry cell type though of late the storage B battery has become quite popular with those who do not mind the initial cost and have facilities for recharging. The B voltage ranges from 22.5 to 120 volts depending upon the kind of set, etc. The manufacturer generally specifies the proper values and his responsibility ends there. It is up to the owner to keep the batteries in good condition—how can we?

Well, the easiest, quickest and most positive way is to take a voltmeter reading of both and see that they register between 75 per cent. and 100 per cent. of the correct value. If it falls below 75 per cent. the battery should be discarded, or recharged, if it be of the storage type.

If possible a voltmeter should be secured as the action is certain. However, the majority of us do not possess a voltmeter and some other method must be used instead.

First we can judge the length of time we have been using the batteries and by a simple calculation of the type and number of tubes estimate the condition of the cells. We must assume however that the batteries were fresh when purchased and that no defects have cropped up to shorten the effective life.

Suppose we use the receiver three hours a day for six days a week and are interested in knowing how long the filament battery will last before a new one must be substituted. We can consider the ampere hour capacity of a standard cell as being 25 ampere-hours when drained by a dry cell tube such as the WD-11 or WD-12. With a UV-199 or C-299 we may safely consider the ampere-hour capacity as 30. Therefore we should be able to use a dry cell for about 100 hours with a WD tube and about 500 hours with a UV-199 or C-299. The A battery (if standard dry cells) should last about a month or six weeks with a WD tube and almost 3 or 4 months with one UV-199.

Naturally if more tubes are used without increasing the number of cells in any way the effective battery life will be cut in half or reduced to a third, depending on whether one or two tubes are added. It is usually best with WD tubes to add another cell in parallel for each tube and keep the effective life the same as with one tube and one cell. This system of parallel connections is quite popular with the RC receivers using WD-12 tubes throughout and the three cells should last about a month or more.

The B battery should always be of the large size as the miniature affairs depreciate in value much too quickly for any service other than where quite necessary for portable service. The large size will last about five months with one or two tubes and an average of four months with three tubes.

These figures are very rough approximations as the life is also dependent upon the voltage of the B battery, the type of tubes and the proximity to broadcasting stations—for an increase in signal intensity is not solely made up by the received energy, the B battery supplies most and consequently drops off more quickly when all reception is from distant points.

Storage A and B batteries may be recharged, the duration of a charge being dependent upon the ampere hour capacity and the type and number of tubes which they supply.

The storage batteries' service may also be calculated, but it is much better to make positive tests with a hydrometer syringe. (Note, however, that all storage B batteries do not have the same density of electrolyte so the following list may not be applicable to them.)

Hydrometer Reading	*Battery Condition*
1.280 to 1.300	Fully charged
1.175 to 1.200	Half charged
1.1 or less	Discharged

Make frequent hydrometer readings for only through use of a good battery are we able to secure the most from our receiver.

Keep the A and B batteries, whether they be dry or storage cell type, in the best condition. Make certain that all connections to them are proper and before blaming the receiver, look at the batteries.

If so far it has not been possible to make the outfit "kick over" properly—why, now is the time to get the "doctor" with his tool kit and expert knowledge.

Amateur Activities

MILWAUKEE delegates reporting on the Second National American Radio Relay League Convention, held in Chicago, was the principal feature at the season's opening meeting of the Milwaukee Radio Amateurs' Club, Inc. Next was held the annual corporate meeting at which seven directors and one vice-director were elected, who, in turn, appointed the society's five general officers and seven standing committee chairmen. The directors, all prominent Milwaukee radio amateurs, are C. N. Crapo, 9VD, the A. R. R. L.'s local District Superintendent; D. W. Gellerup, 9AOE; E. T. Howell, Sc. M., 9CVI; M. F. Szukalski, Jr., 9AAP; E. A. Cary, 9ATO; F. W. Catel, 9DTK; M. H. Doll, 9ALR, West Allis; and G. F. Metcalf, 9CKW, Wauwatosa. The officers are E. T. Howell, president; M. F. Szukalski, Jr., vice-president; C. S. Polacheck, secretary; E. W. Ruppenthal, 9AYA, treasurer; L. S. Hillegas-Baird, business manager; F. W. Catel, assistant treasurer. The committee chairmen are: L. J. Topolinski, general counsel; publications, H. G. Fawcett; technical, D. W. Gellerup; membership, F. W. Catel; program, E. T. Howell; publicity, L. S. Hillegas-Baird; and traffic, C. N. Crapo.

At the annual meeting the out-going officers reported a steady growth in membership and an increase in scope of activities. However, the annual membership drive has been launched, and it is hoped that the total number of members will reach two-hundred before the season closes. The West Allis Radio Club, a suburban society, has been dissolved and its members are joining the Milwaukee club.

The committees are all in action. The technical one remains a leader, recently giving an interesting report entitled "C. W. Transmitter Circuits." Many lectures by well-known radio men are being arranged by the program committee. Two have already been given; they were "The New Tatalum Chemical Rectifier," by H. L. Olesen, 9CSR, and "Vacuum Tube Characteristics," by J. H. Miller, Electrical Engineer.

Interest in radio continues to increase in Denmark, and it is estimated that there are now approximately 10,000 radio amateurs in Denmark.

Footing the Broadcasting Bill

(*Continued from page 27*)

listeners that they should pay something, somehow, for radio entertainment. It is generally realized by now that the present situation is unsound and unfair, and that radio broadcasting will be firmly established only after some definite means of financial support has been inaugurated.

WHO SHALL PAY—LISTENER OR BROADCASTER?

How can the broadcaster derive revenue for his services? That is the question before us today. To begin with, there are two broad sources of revenue: first, collecting from the listener, either directly or indirectly, as will be outlined in what follows; secondly, collecting from seekers of publicity, at the microphone end.

The first idea which comes to mind, under the heading of collecting from the listener, is some sort of Government control and licensing arrangement, whereby receiving sets must pay an annual tax so as to derive revenue for the broadcasters. In this instance we have a precedent to fall back on. In Great Britain, the broadcasting situation is developing along quite different lines from ours. To avoid the very troubles into which we have fallen, the Britishers evolved a Government licensing system which compels—or tries to compel, rather—every user of a radio receiving set to obtain a yearly license. The Government collects the license fees and, after defraying the costs of administration, turns over a goodly portion of the funds to a broadcasting organization. Furthermore, radio manufacturing is more or less of a domestic monopoly, so that the broadcasters are assured that their efforts are not being wasted on promoting the business of rivals, especially foreign competitors.

This Government licensing system is beautiful as a theory, but somehow or other it breaks down in practice. According to reports, it has not been a brilliant success in Great Britain. Many receiving sets are operated without licenses, and there is considerable ill feeling on the part of the British public as they view the freedom enjoyed by the citizens of other countries.

Such a method of defraying the costs of broadcasting would be a very lame proposition in these United States. It would be highly resented. It would work a grave injury to the radio industry. The Government costs of administering a licensing system for receiving sets and collecting the fees might well be such as to leave very little for the broadcasters, thus defeating the very object of such a move. And then, too, we have enjoyed radio freedom long enough to protest violently at Government interference. While it may be a simple matter to check up on transmitters, when it comes to receiving sets it is necessary to count largely on the conscience of the user, so far as a license is concerned. It would be the Eighteenth Amendment all over again!

High grade programs as vehicles for publicity

From this improbable method we turn to an indirect means of collecting from the listeners. How about taxing the manufacturers and dealers in radio equipment? Surely broadcasting is the very foundation upon which they build their business, and they should pay their due share towards insuring that foundation. It is estimated that if the manufacturers and dealers were to pay their proportionate share of the expenses connected with the operation of a first-class group of broadcasting stations covering the entire country, the cost to them would be but a fraction of one per cent. of their yearly turnover. One association of electrical jobbers and dealers has figured this broadcast contribution at 1/10 per cent. of the yearly turnover.

It goes without saying that all manufacturers and dealers could not be depended upon to pay their due share to the broadcasting fund. There would be shirkers, sure enough. So in connection with such a plan it might be advisable to introduce a distinctive label to be placed on all apparatus manufactured or sold by members of the broadcasting association, so that buyers with the American spirit of fair play would give preference to wares morally entitled to broadcasting rights. In this manner it would be possible to differentiate between the parasitic and irresponsible manufacturers and dealers who would not contribute towards broadcasting activities, and manufacturers and dealers who were responsible for broadcasting entertainment. Such an arrangement would add no further burden to the radio buyer, yet it would relieve him of all further obligations to the broadcasters, since the radio entertainment would be paid for by him, indirectly.

THE PAY-AS-YOU-ENTER IDEA IN RADIO

Anyone who has endeavored to arouse an association of manufacturers and dealers into paying for something or other must realize the gigantic task ahead of that Napoleon of the radio industry who may collect from the radio manufacturers and dealers. The plan has been formulated quite a while back. It has been discussed. It has been urged upon the radio industry. And still, nothing is done. Broadcasting seems so well established at present that no one seems to be willing to bother with it. And then it's free, so why pay for it?

Perhaps a more likely arrangement would be the pay-as-you-enter plan, whereby the purchaser of radio equipment would pay a very small percentage toward the general broadcasting fund at the time the sale was consummated. This collection might either take the form of a slight increase in the cost of radio equipment, or as an additional sum of fixed percentage. The main difficulty here, no doubt, would again be the old story of the radio parasites, who thrive on radio broadcasting without ever contributing a single thing toward it. No doubt these parasites would appeal to a certain kind of trade by not collecting a broadcasting tax, thus offering radio equipment at lower prices, as they do at present.

Therefore, we must cast about for some radio article which is controlled by responsible manufacturers and suffers no competition whatsoever. Immediately we think of vacuum tubes. Aside from a handful of "bootleg" tubes which are of little or no account, the manufacture and sale of vacuum tubes is mostly in good hands and is readily controlled. Furthermore, virtually every listener-in uses vacuum tubes, not only as part of the original installation, but also as renewals from time to time.

The vacuum tube offers an excellent means of collecting funds for broadcasting. If a small charge of 50 cents were collected on every vacuum tube sold, the total amount of money thus raised would exceed one million dollars a year. Inasmuch as there is virtually no competition in the manufacture of vacuum tubes, the manufacturers could readily set a price which would include a broadcasting tax to be passed on to the consumer. Of the various devices for collecting broadcasting revenue, a small tax on each vacuum tube sold appears to be the simplest, most applicable, and—if such a thing is possible—the most favorable from the standpoint of the public.

PASSING THE HAT AROUND

In view of the demand on the part of the radio audience for nothing but the best programs, the broadcasters are finding it increasingly difficult to do their work, especially under the existing gratis-free-for-nothing basis. It has been suggested from time to time that some big-hearted individuals of a decidedly public-spirited turn of mind might well give a little thought to radio. Just as public libraries have been endowed and public concerts have been paid for and other things have been done for the general public, so might radio be supported to the everlasting fame of some far-sighted individual. A moderate sum of money, donated to radio broadcasting, would go a long way. It might serve to secure the greatest artists, the finest orchestras, the leading lecturers, and so on.

So far, nothing has been done along this line, but it seems to be only a matter of time before some wide-awake gentleman of means will see a new way of doing something for the general public. For here is an opportunity of doing something not merely for the inhabitants of a town or city, but of doing something for hundreds of thousands and even millions at one time. By means of radio broadcasting, the philanthropical offer which formerly benefited but a small number of people and a single locality, is now amplified so as to reach the multitudes and spread over a wide area. Retail philanthropy thus becomes wholesale philanthropy.

Let us not leave such a task wholly to kind-hearted individuals of surplus wealth. There is no law against the average individual considering a donation to broadcasting. The time may come when we shall have drives for broadcasting funds. If the radio listeners insist on hearing certain things broadcasted, what is fairer than to have them join in a collection for the purpose of raising the necessary funds to enable the broadcasters to secure the necessary features?

RADIO A LA SCRAMBLED EGGS

Technical progress in radio may yet evolve some simple means of collecting for high-grade programs. It seems only a matter of time when there will be two definite classes of radio broadcasting service—the regular or free service, and the subscriber service. The former is familiar to us now. The latter will make use of some secret method of transmission and reception, such as a wave-scrambling device or wave-changing gear for the transmitter and receiver, so as to preclude anyone from listening-in except a paying subscriber. In this manner it will be possible for the opera house, the lecture bureau, the leading theater, the stock quotation service and others to give a definite program in return for fixed subscription fees. The subscriber, having paid the fee, will receive a complete receiving set with the wave unscrambling device, thus insuring a "seat" in the special entertainments. This method of broadcasting will afford an important source of revenue for various theaters, lecture bureaus, special information purveyors and others, and will become an invaluable by-product to their present efforts. Such a plan is already in effect in the form of "wired wireless."

So much for the collecting of funds from the receiving end of broadcasting. Fully cognizant of the fact that it is difficult to make people pay for something which they have been receiving for nothing, we hasten to turn our thoughts to collecting from the microphone end. We are back again to the matter of publicity and propaganda via radio, and how it can be converted into dollars and cents for defraying the costs of the voices of space.

THE MODERN WAY TO "HIRE A HALL"

It has remained for the great American Telephone and Telegraph Company to evolve a means of making broadcasting economically possible, based on toll broadcasting of publicity talks and features. The original idea of the telephone organization was to operate an out-and-out toll station or a group of such stations, which would be turned over to any company or individual for a fixed charge of so much per minute. In the New York district alone, some one hundred and fifty concerns in the past year have endeavored to purchase radio transmitting equipment for the purpose of broadcasting on their own account, and it goes without saying that if all these stations had been opened up, we would have the story of the Tower of Babel brought up to date.

As it was, these various companies were induced to give up the idea of individual broadcasting stations, and, instead, to make use of the facilities of the American Telephone and Telegraph station known as WEAF. In order to attract a large and attentive audience, this station has developed the highest grade programs which serve as vehicles for a certain amount of publicity features, just as the text columns of any magazine or newspaper serve to attract readers for the advertisers.

Now the publicity features broadcasted through WEAF and, on occasion, through other broadcasting stations of the Bell System, are ingeniously prepared. In the beginning, when the plans of the telephone company were unfolded, it was feared that these publicity features would be bald advertisements, following the technique of the conventional printed advertisement. But to the credit of the telephone company broadcasters, let it be said that the publicity features have been handled in a most interesting and delicate manner, in most instances blending in with the regular program, so as not to detract in the slightest degree from the high quality of the entertainment. Indeed, some of the most interesting talks heard over the radio have been of a publicity nature, and they have been readily received by the public even though the name of the product or the manufacturer has come in for some slight mention some time during the various talks.

Then, too, the Bell System broadcasting stations have been sending out excellent musical programs the cost of which have been defrayed by certain large national advertisers. Surely these advertisers, paying for the use of the station and, in several instances, paying real money for the musicians, are entitled to a brief mention. Banquets and meetings and theatrical performances have been broadcasted, and in many instances these affairs have carried subtle publicity, but always they have been most interesting.

The success of the American Telephone and Telegraph Company has been based on making publicity features of the utmost interest to the listeners, first, last, and always. Rather than let a publicity seeker or advertiser say what he would like to say, they have seen to it that the talk would carry some real message of interest primarily to the listener. Furthermore, they have limited the talks so as to make them just long enough to tell the story, but not too long to bore the audience and lose the listener-interest.

There is no doubt but that the telephone company has pointed out the way to make radio broadcasting economically feasible under the present conditions. After all, it will probably be easier to collect at the transmitter than at the receiving end. Advertisers have not been slow to appreciate the entry of a new publicity medium into the field, and more and more of them are giving considerable thought to broadcasting in preparing their budget of advertising expenditures for the year 1924.

Meanwhile, other broadcasting stations, impressed with the progress made by the Bell System broadcasters, are considering the possibilities of publicity talks. They fully realize that many of their present speakers appear before their microphones for no other purpose than to obtain publicity, and there is no reason why that publicity

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Opportunities in Radio Today

(*Continued from page 23*)

THE ANNOUNCER
Broadcasting has created a new profession, the radio impresario

their regular engineering courses. I have in mind such institutions as Columbia University, Yale, Harvard, Massachusetts Institute of Technology and the Polytechnic Institute of Brooklyn. The College of the City of New York, although it does not give a straight engineering course leading to a degree has, nevertheless, a well organized and successful course of study in radio engineering. Therefore, a practical way of learning radio properly is to be versed in electrical engineering or at least in electrical principles; then through amateur experimentation or other means acquire enough radio knowledge to become a member in the Engineering Department of one of the large companies and specialize in designing, construction, or research.

Invention takes a prominent place here, for there are still a great many technical problems to be solved in radio. Here again all is not gold that glitters. An engineer of my acquaintance who carefully inspects every radio patent issued by the United States Patent Office, told me that there is but one out of every thousand patents issued that is really of any benefit to radio. The remaining 999 patents he calls "paper patents" that are practically worthless. Incidentally, these "paper patents" reflect the great lack of knowledge and experience on the part of these would-be-inventors. Many of these documents have been prepared by men who have but a vague understanding of radio fundamentals. It would seem, therefore, that if a competent electrical engineer contemplates specializing in radio, the field is wide open to him for fame and recognition providing he is willing to keep close to essentials and present-day needs. There is, of course, the possibility for an electrical man to pursue a strictly electrical career, at the same time using radio as a hobby, for he knows that he may, through due process of experimentation and research, construct something of real importance and benefit to the art.

MANUFACTURING

This branch offers opportunities to the man of mechanical bent. Today there are hundreds of substantial manufacturing organizations who in turn employ thousands of radio mechanics. Indeed some of the heads of these manufacturing organizations started out in minor positions, such as assemblers, later became shop foremen and finally decided to go into manufacturing on their own. This classification may also include construction, that is to say, the installation of large radio plants at land stations and on board vessels. Since the United States easily leads in radio communication, many installations are sent to Central and South America whereupon experienced and expert construction men are required to do the installing. Repair and service also take a prominent place here. In all the branches of manufacturing and construction there are many opportunities for a career.

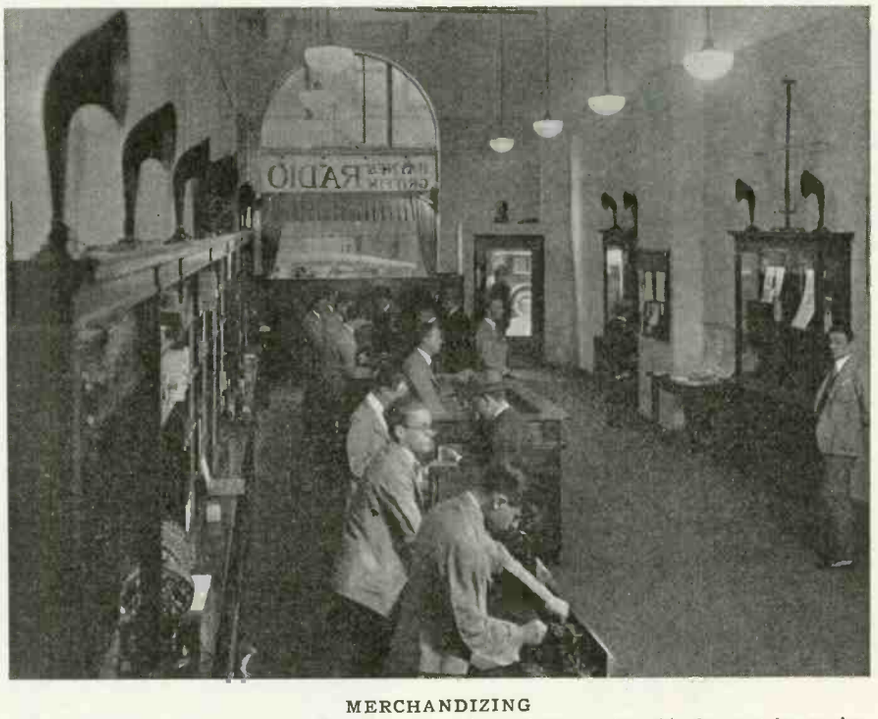
BROADCASTING

Now we come to perhaps the most popular branch of the radio game. Broadcasting involves many activities some of which I have already covered, such as engineering, manufacturing and construction, but today this branch has become so specialized that it requires specialization in the broadcasting field alone. In addition to this there are, of course, the better known positions such as announcer, studio director, program manager, operator and others. In fact, broadcasting has developed a brand new profession, that of "radio impresario." The tact, initiative and resourcefulness of the radio impresario has done much to make radio broadcasting a favorite form of entertainment for millions, as it is today.

MERCHANDISING

Here indeed is a large and profitable field. Merchandising, as many know, involves several functions known as distribution, servicing, advertising and selling. Each of these sub-divisions are simply alive with opportunities today. They become particularly profitable to men who not only have had this business experience, but who, in addition, know radio. Thus, the salesman who knows radio fundamentals has the jump on the salesman who is simply a salesman. In other

(*Continued on page 64*)



MERCHANDIZING
The novelty of radio gives the radio salesman a unique advantage, but this does not lessen the necessity that he should be a trained radio man, well equipped to discriminate between well-made and inferior goods

Distortion-Free Amplifiers

By Abraham Ringel
Member, Institute of Radio Engineers

RADIO fans have been so engrossed in the past in receiving, or trying to receive, distant broadcast stations, that they have almost entirely neglected the matter of obtaining good music or understandable speech from their radio sets. The writer does not wish to belittle the receiver that can bring in stations several thousand miles away—it is one of the great advantages of radio over other forms of entertainment. If the radio enthusiast does not care for the program broadcast by the local stations, or if he is particularly interested in a feature put out by a distant station, he can readily tune in the desired station.

It is quite safe to say, however, that most attention is paid to the local broadcasters, and it is strange indeed that the fans should be more interested in freak circuits, so highly advertised, than in securing music that one can enjoy. How many of you readers can really say, after listening to a violin recital over the radio, that you actually seemed to be in the same room with the player? How many of you have listened to people whose voices you were acquainted with? Did you hear the violin itself, or the speaker? Or did you hear something that sounded like a violin, or a voice, rather harsh and strident, that bore some resemblance to that of the speaker? Sad to relate there are many radio sets in use today that reproduce broadcast music and speech with poor quality. This is due partly to the audio frequency amplifier, and partly to the loud speaker used. For the present we will leave out of this discussion the possessors of single-tube receivers who use telephone headsets for listening to the broadcasting. They are very fortunate in that they obtain quality far superior to that of an ordinary amplifier and loud-speaker. Although the purpose of this article is to discuss distortionless amplifiers, it is important to note that the loud-speaker should also be distortionless. There is still room for considerable improvement in loud-speakers. On the other hand, audio frequency amplifiers may be made absolutely perfect through the use of resistance coupling.

In any system which is to reproduce speech or music without distortion, it has been shown by telephone and acoustic engineers that it is necessary to transmit a band of frequencies ranging from about 30 cycles per second to more than 5,000 cycles per second. Certain oscillographic pictures taken by the writer of speech and music as well as many other tests made by him supports this theory. Many notes in various musical instruments are well below 100 or 200 cycles per second, for example, the organ, piano, bass viol and drum. It is these low frequencies below 400 cycles per second, that gives background so necessary in orchestral or band music. It has been shown in recent tests by telephone engineers that most of the energy in voice sounds, both made and female, is between 250 and 300 cycles per second. The writer has found in his own tests that these low frequencies are required to make speech and music natural. Without them, the quality is undeniably "tinny," the background is gone in music; all the lower notes of the organ, orchestra, or baritone are gone; all speakers appear to have a "down east" twang to their voice. The higher frequencies are required to reproduce the other tones, such as that of violin, flute, saxophone, soprano voice, higher frequencies in the voice sounds. The extremely high frequencies, above 5,000 cycles per second, are necessary to obtain the higher tones of the violin or piccolo, and the consonant sounds especially the S, F, TH, SH and H, in the human voice.

An audio frequency amplifier must amplify all these frequencies equally well in order that no distortion will take place. If any frequencies are emphasized more than others, these tones will be more prominent in the loud speaking device. Those which are amplified less than others, will be overwhelmed by the rest. This is one of the principal causes of distortion in present-day amplifiers, and as shown above certain portions of speech or music are suppressed and others are over-emphasized. There is another source of distortion in transformer-coupled amplifiers because of the plate

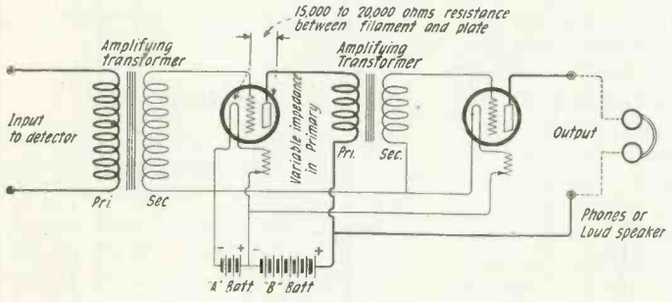


Figure 1. A standard two stage audio frequency amplifier with iron core transformers

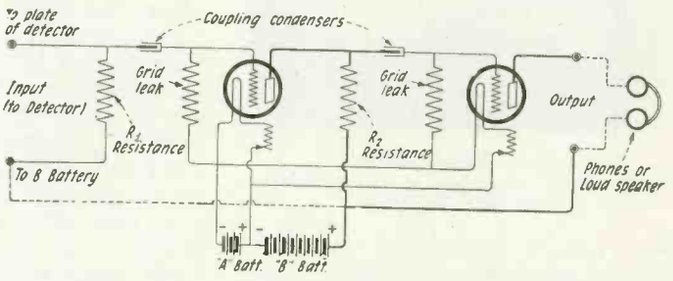


Figure 2. A simple two stage resistance coupled amplifier which, while not giving as much amplification as that shown in figure 1, nevertheless provides distortionless reproduction

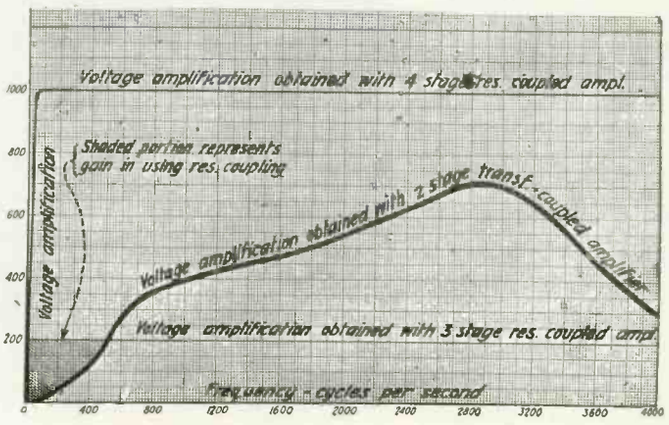


Figure 3. Here is an interesting comparison between the voltage amplification curves of transformer and resistance coupled amplifiers. Note that the latter amplifies all audio frequencies evenly.

current which magnetizes the iron cores of the transformers. This direct current generally sets up a magnetic flux which saturates the core, so that as the current is increased, no additional magnetic flux is produced. Thus, only that portion of the alternating plate current, due to the sound, which decreases the plate current is capable of producing any change in the magnetic flux in the transformer cores. The wave shape of the resulting voltage generated in the secondary of the transformer is thus different from the wave shape of the plate current, which it is supposed to reproduce, since the secondary voltage is determined by the varying magnetization of the core, and this magnetization has a different wave shape than that of the plate current. A remedy for this lies in the use of large amounts of iron so that the core does not become saturated. Existing transformers would have to be tripled in size in order to avoid this distortion. Similar iron distortion is present in amplifiers employing choke coil coupling. This type of distortion is not present in resistance coupled amplifiers, because no iron is used. A somewhat similar type of distortion results when a vacuum tube is overloaded, when the radio fan is so desirous of obtaining noise that he uses three or more stages of amplification, and uses ordinary receiving tubes for the purpose. The ordinary loud speaker requires about 20 volts of varying speech voltage to produce a fairly loud output, and this is usually obtained on local stations with two stages of transformer-coupled amplification. If a third stage is added, with a step-up transformer of say 4 to 1 ratio, we have a voltage of about 80 volts on the grid of the third audio stage. It is hard to say what the varying plate voltage will be. Suffice to say, the resulting distortion is generally enough to make the sound practically unintelligible, assuming that the loud speaker itself is able to handle that amount of energy. This form of distortion would be present in all amplifiers—unreservedly, all amplifiers—unless suitable power tubes were used for the stages handling such voltages. In this connection, it is worth mentioning, only a 50-watt transmitting tube is really capable of efficiently handling a grid voltage of the order of 80 volts at speech frequencies, without distortion.

We have already pointed out how distortion is introduced through saturating the iron cores of transformers and overloading the tubes and transformers with excessive sound currents and voltages. It remains to indicate how unequal response is obtained for different frequencies with amplifying transformers and choke coil coupling. Frequencies below 300 cycles per second and above 3,000 cycles per second are very important. The writer has tested several transformer - coupled amplifiers and compared them with resistance-coupled amplifiers at various frequencies, running from extremely low frequencies up to 10,000 and even 20,000 cycles per second. The curve of a two-stage amplifier using transformers of very good quality, as compared with ordinary transformers, is indicated in figure 4. It will be noticed that the amplification is negligible at the low frequencies, rises to a maximum value at about 3,000 cycles per second and then drops again and keeps on falling at the higher frequencies, being practically negligible about 6,000 cycles per second. The cause for this is the varying impedance offered by the primary of the amplifying transformer to currents of different frequencies. At low frequencies this impedance is only a few thousand ohms and is relatively small compared to the impedance of the tube between filament and plate. The incoming sound currents are applied to the grid of the amplifier tube, and the amplified voltage sets up a current in the plate circuit, which contains the filament to plate resistance and the impedance of the primary winding in series. When the latter impedance is small compared to that of the tube, normally 15,000 to 20,000 ohms, only a small percentage of the amplified voltage will be available across the transformer terminals. If this impedance is large compared to that of the tube, most of the voltage will be available for further amplification. The impedance in an ordinary transformer is generally sufficiently great above 600 cycles so that comparatively little of the amplified plate voltage is wasted in the filament to plate resistance. But below 300 to 400 cycles per second this impedance is so small that most of the voltage is dissipated in the resistance of the tube itself. At high frequencies, the question of the capacity of the windings enters. The secondary usually has some 15,000 or 20,000 odd turns of wire and the capacity is quite large. This capacity when transferred back to the primary side of the transformer is even greater, because of the turns-ratio between primary and secondary. It is shown in all standard transformer theory that the capacity of the secondary is in effect multiplied by the square of the ratio of turns, when considering the capacity transferred to the primary. So that if the ratio of turns is 4 to 1, the secondary capacity acts as if it were a condenser

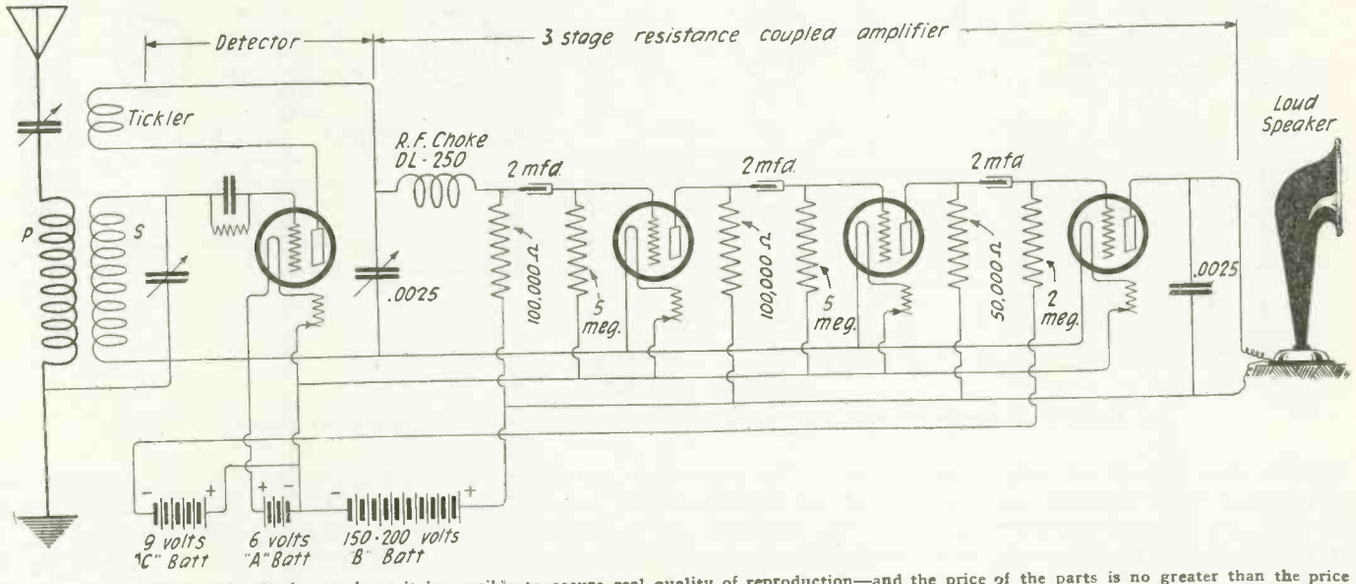


Figure 4. With the circuit shown above it is possible to secure real quality of reproduction—and the price of the parts is no greater than the price of a regular transformer coupled amplifier

of 16 times its actual value shunting the primary winding. If the ratio is 10 to 1, the effective capacity is 100 times as great. This gives rise to resonance effects, in some cases of poor transformers. Very sharp peaks are obtained in the neighborhood of 1,000 cycles per second, and while the amplification is large at this point, it is very small at higher frequencies, because the capacity tends to shunt aside these frequencies and they are lost in capacity currents in the condensers formed by the capacity between the various turns of the windings. It is almost impossible to build a transformer that can amplify over a very broad range unless the dimensions of core, etc. are greatly magnified.

from the filament and would soon paralyze the tube. The voltage across the grid is amplified by the action of the vacuum tube and sets up a certain varying current in the plate circuit. If this plate resistance is equal to the external resistance R_2, the voltage amplified in the tube is distributed equally between the two, and half of this voltage is available for further amplification. If the external resistance is seven times as great as that of the tube, the voltage will be seven times that dissipated by the tube, or seven-eighths the entire voltage generated by the tube will be available for use. This will be the same for all frequencies, from the very low frequencies around 20 or 30 cycles up to radio frequencies of about 100,000

plification at the all-important low frequencies, and somewhat less at the frequencies above 600 cycles per second. With four stages of resistance coupling, there is a vast superiority, both in amount of amplification, and uniformity of response over a wide band of frequencies. These curves are illustrated in figure 3. For practical purposes, however, three stages of resistance coupling will give results that are practically as loud as two stages of transformer coupling, and without distortion!

There is one apparent drawback to the use of resistance-coupled amplifiers. We have a resistance of say 100,000 ohms in series with the plate. Allowing a direct current of about 1 milliam-

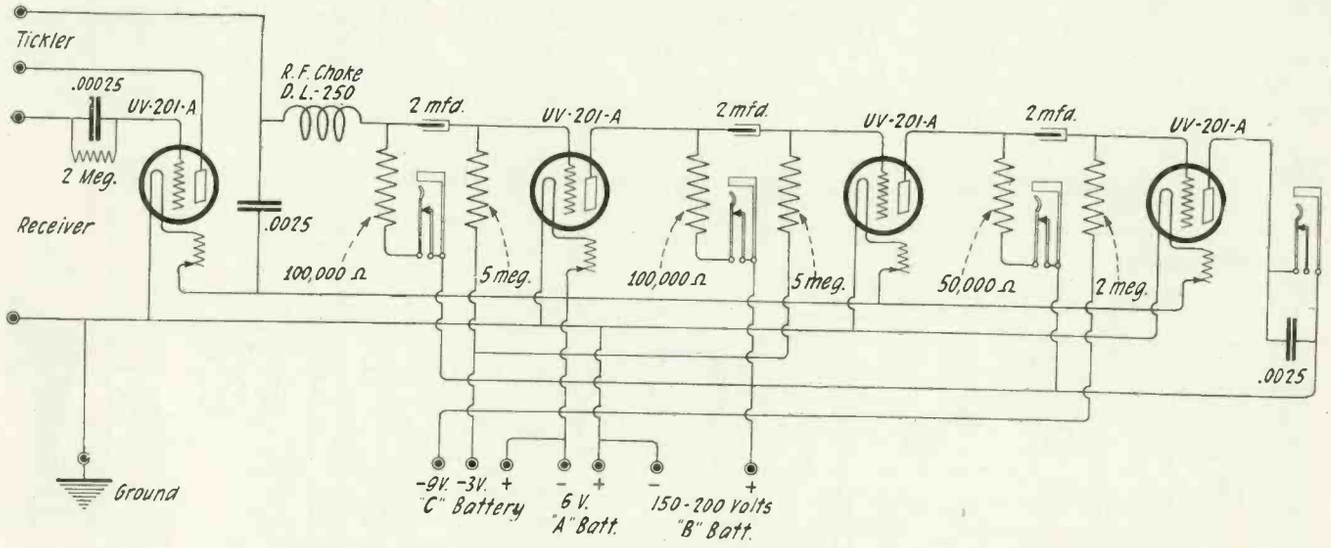


Figure 5. A detector and three stage resistance coupled amplifier. Full details are given in the text

We are thus led to the only very close approach to a distortionless amplifier, viz., the resistance-coupler type. Figure 2 illustrates the essentials of a two-stage resistance-coupler amplifier. The input is connected in the plate circuit of a detector tube and the rectified radio frequency produces a certain audio frequency current in the plate circuit which gives rise to a voltage across the resistance R_1. This resistance cannot be directly connected to the grid of the next tube, since it would make the grid highly positive and thus make the tube inoperative. Connection is made through a condenser of fairly high capacity. A condenser has the faculty of allowing varying currents to pass through, but offers infinitely high impedance to the progress of direct currents. Thus the speech currents, or rather voltage, in R_1 is applied to the grid of the first amplifier tube. A grid leak is shown connecting the grid to the negative side of the filament. If this leak were not present, the grid would acquire a very high negative potential due to the combined action of sound voltage and electron current

cycles. The writer has actually measured the amplification of a resistance-coupled amplifier up to 20,000 cycles without finding any diminution in amplification. This amplification remains constant because the external resistance is not dependent on frequency as is the case with the transformer or choke coil coupling.

There appears to be some myth in circulation, that great amplification cannot be obtained with resistance coupling. True, the amplification obtained with a single stage of resistance coupling is less than that using transformer coupling, but the amplification when using resistance coupling is absolutely the same at all frequencies, and is in fact greater that that of many transformer-coupled types below 100 cycles and above 5,000 cycles. However, it is these lower frequencies that are of vital importance. With two stages of transformer coupling, enough amplification is obtained to give satisfactory intensity of sound from a loud speaker. It requires just one more stage of resistance coupling, i. e., three stages, to give very much greater amplification as the plate current, it means that there will be a voltage drop of 100 volts across the external resistance. It is therefore advisable to increase the B-battery to a voltage considerably beyond this value. In actual practice, it is advisable to use B-battery voltages ranging upwards from 150 volts to more than 250 volts. Generally, the higher the voltage used, the better the amplification and the greater amount of energy that can be handled without distortion.

In the past, resistance-coupled amplifiers were more or less noisy, due to various causes. First among these was the lack of a good quiet tube. This trouble is obviated now by using the UV-201-A, or C-301-A, both of which are exceptionally fine tubes, which, because of their good exhaust are absolutely noiseless. The writer has used amplifiers of eight stages containing UV-201-A's and could detect no rushing, hissing, or frying noises so often noticeable in older types of tubes. Doubtless the low filament temperature is also effective in reducing these parasitic effects. Another source of

noise in former years has been the plate resistances, which were generally ordinary carbon rods, whose resistance would vary with the room temperature and humidity of the air. Now there are available excellent resistances for this purpose, namely, the "lavite" type. These resistances are made by the Western Electric Company in various sizes: 38-W = 100,000 ohms, 38-A = 50,000 ohms, 38-B = 12,000 ohms. The coupling condensers, of about two microfarads capacity, should have small leakage. For this purpose the Western Electric condensers, type 21-D, are suitable. The grid leaks are often an exceedingly important factor. Their value may be from 2 to 5 megohms, but should preserve a constant resistance, since any variation in resistance is likely to manifest itself in the form of noise in the output of the amplifier. It is, of course, understood that a reliable make of grid leak should be used here. The writer has obtained best results with the glass enclosed, moisture proof grid leaks. All of the above points are of great importance and the radio fans who intend building these amplifiers should strictly adhere to the equipment mentioned above.

Figure 4 illustrates a three-stage resistance-coupled amplifier connected to a standard regenerative receiver. A feature worthy of note is the radio frequency choke coil connected in series with the plate resistance and the .0025 blocking condenser shunting the two. The purpose of this is to prevent any of the radio frequency from getting into the amplifier. This amplifier is quite capable of amplifying these frequencies and the experimenter is then likely to be troubled with radio frequency oscillations in the system. The insertion of the choke coil, an ordinary honeycomb or duo-lateral coil of about 250 turns, and a blocking condenser will do the trick very nicely. The coupling resistances for the first two stages are 100,000 ohms each, and that for the last stage is 50,000 ohms. The condensers are all of 2 microfarads capacity. Best results are obtained with grid leaks of the values indicated. It is generally advisable to connect a .0025 mfd. condenser across the loud speaker as a further precaution against any radio frequency that may be present in the amplifier, although this is not strictly necessary. All tubes should be UV-201-A, or C-301-A. The detector may be a UV-200, or C-300, but it will require some experimenting with the plate voltage to determine the proper working point for good detection. This will probably be somewhere between 130 to 160 volts —the effective voltage on the plate itself will be only about 20 volts. The B-battery voltage should be as large as possible, at least 150 volts, i. e., seven blocks of B-batteries. The larger size batteries are to be preferred because of their longer life. It will be noticed that the grid leaks of the first two amplifier tubes are connected to the negative leg of the filament, and that the filament rheostats are in the negative leads. In this way a slight negative potential, always desirable, is imparted to the grids of these tubes. In the last tube, the grid leak is connected to a C-battery of about 9 volts which is required to prevent the grid from becoming positive when too powerful a sound voltage is produced. Such an arrangement, four tubes in all, will give very satisfactory loud speaker operation.

Figures 5 and 6 show respectively the wiring and lay-out of a practical detector and three-stage resistance-coupled amplifier unit. The unusual feature here is in the method of connecting the jacks in the circuit. They are shown so as to connect the phones on loud speaker in series with the plate resistance. This is preferable to any other method, since then the entire B-battery voltage will not be directly on the plate. The arrangement of apparatus shown in figure 6 is so designed as to make all leads connected to grid and plate extremely short. There will be no trouble at all from howling or squealing if this lay-out is preserved. Needless to say, all parts should be close together in order to keep the connecting wires short and direct. There is no need for shielding the stages, since the system is extremely stable and will not oscillate readily at audio frequencies.

Either wood, bakelite or hard rubber may be used for the panels. In case wood is used, it should be of close grained hard wood, to which two coats of thin shellac or varnish have been applied. This is to prevent the absorption of moisture by the wood, which would be likely to cause noise because of varying leakage resistances.

The quality of speech and music obtained from such an amplifier will be a revelation to the radio fan, especially when used with a good loud speaker, and he will feel well repaid for the labor expended in building the amplifier.

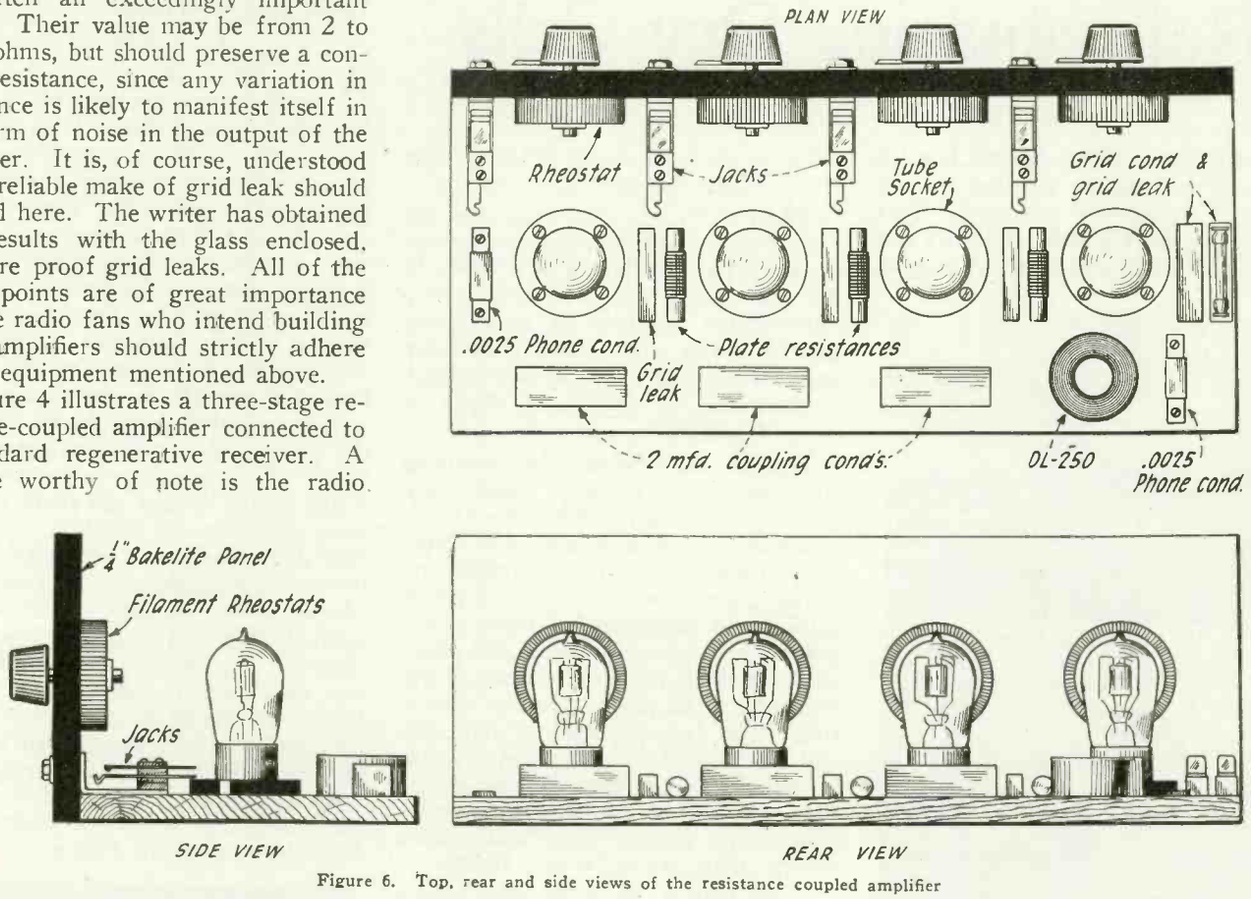
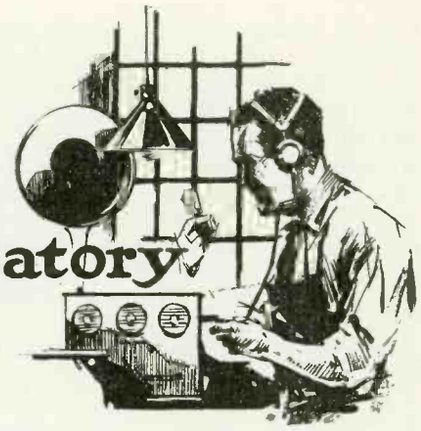


Figure 6. Top, rear and side views of the resistance coupled amplifier

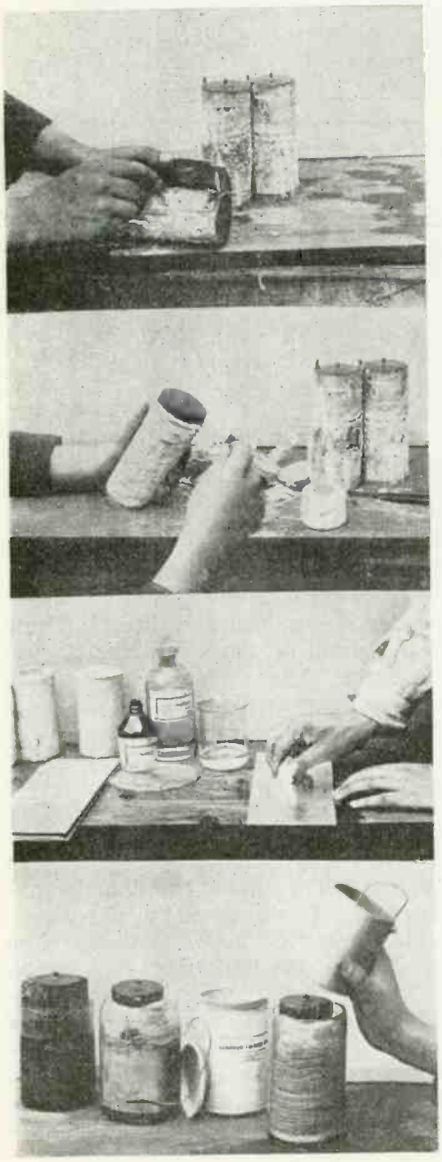
Workshop & Laboratory



Rejuvenating Dry Cells

By Dr. E. Bade

WHEN the zinc of a dry cell is eaten out, the cell is usually thrown away and a new one procured. This is not necessary; a well made dry cell of standard make can be made to give twice as much service as it has already given before new ones are required.



When a dry cell goes dead, and the zinc is still good, additional life may be given by punching a few holes in the zinc and placing the battery in a concentrated solution of ammonium chloride. But when the zinc is eaten up, no life can be added by this method. It becomes necessary to make a straight Leclanché cell.

This is accomplished by removing all traces of zinc from the outer wrapper of the dry cell. When the zinc is removed, a cardboard layer will usually be found beneath it; carefully remove it, until the black inner layer of carbon and manganese dioxide is exposed. If it is a cheap make, the paper will be lacking and a cloth wrapper will be found in its place. Do not remove this. The better grades of dry cells will fill the carbon center rod to within ¼ of an inch of the top. Cover the entire carbon and manganese mixture with a piece of cloth and wrap a strong string around it very tightly.

Then take a piece of zinc, which can be obtained in sheets of almost any thickness, and bore a hole near the top after it has been cut into strips just long enough to encircle the carbon cylinder. Into this hole a bolt is passed and a wire is bent around it, then a nut is attached and the bolt and nut tightened. This is the negative pole of the battery.

Pour into an open quart jar a concentrated solution of ammonium chloride, and into this solution place the carbon element. Then the negative element, the zinc ring, is introduced, and the cell is finished. This cell will give, on the average, 1.1 volts. When one volt is to be drawn for a protracted period as in radio tubes, then a number of these cells should be placed in parallel by connecting zinc to zinc and carbon to carbon.

How to Determine the Polarity of a Phone

A FRENCH amateur, J. Libre, of Roubaix, vice-president of the French Northern Radio Club, reports a method of determining the polarity of a phone, now used by all the members of the club. The method is as follows: The phone is placed on a table with cap and diaphragm removed, and a compass is brought sufficiently close to it to produce a deviation in the needle. When the needle has taken its new position in response to the attraction of the magnet in the phone, a current is passed through the windings of the phone. A new movement will be noted in the needle of the compass. If the needle swings still further in the same direction in which it originally was deflected, it is an indication that the current passing through the coils of the phone serves to increase the magnetic field. This is the proper connection. If, on the other hand, passing the current through the phone causes the needle to swing back in the opposite direction, the current is flowing through the coils in the wrong way, neutralizing the effect of the permanent magnets. This is wrong, and tends to weaken the phone.

Alexander Udoff, 16-year-old amateur, builds a miniature Flewelling set. Here's compactness and simplicity!

A Real 100-Volt B Battery

By John W. Brooks

THE plate supply for a receiving set presents a difficult problem to the average amateur as there are but two types of B batteries available —the dry and storage cell batteries; the first is costly and necessitates renewal, while the latter, if made at home, rarely gives the service expected of it. However, the accompanying article offers constructional details of a thoroughly efficient B storage battery, a battery easy to make and low in cost, one that has sufficient ampere hour capacity to obviate recharging over a period of weeks with a number of tubes draining it—and a battery of this type will last for five years with careful handling.

The battery here described consists of one unit containing fifty cells giving 100 volts and is of the lead type. The containers are glass test tubes 1 inch in diameter and 7 inches long, the small plates are cut from regular storage battery plates; the separators are cut from regular battery separators and the connecting lugs are cut from sheet lead. The rack can be made from pieces of wood found lying around any workshop.

A battery containing any number of cells can be made, but if a large battery is desired it is recommended that more than one unit be constructed. If a battery of 24 volts is desired make one containing twelve cells, following the directions given for the larger one. The battery described, furnishing the plate voltage for the set above mentioned, gives a month's service on each charge and is equal in quality to any radio "B" battery that can be purchased. With reasonable care the battery should last at least three years, so considering the cost (about $10.00) it makes a good investment.

For the convenience of the reader and to make the construction as simple as possible the various steps will be classified under separate letters.

Construction

(A) *Plates.* Thirteen positive and thirteen negative storage battery plates, measuring 5 inches high and 5½ inches wide, are necessary. Each plate should be composed of eight grids, counting crosswise. These can be purchased from any battery shop or garage.

The small plates are cut as follows: The plate is laid on a board, the same width as the plate, then another piece of wood is placed on the plate, where the cut is to be made, and clamped firmly to the workbench. A common hack saw is used to do the cutting. The small plates are cut from the larger one as shown in figure 1. The cut should be as near the small lead wire, running lengthwise, as possible. Care should be taken that same is not broken or the plate cracked in any way. Each large plate will give four small ones, and if care is used while cutting not one should be wasted. When handling the small plates they should be placed between two pieces of wood to protect them against breakage.

(B) *Separators.* Eleven storage battery separators are required. These should be as wide as the plate and 1 inch higher.

The small separators are cut from the large one by cutting against the grain with a sharp knife. A steel edge rule should be used to guide the knife. They should be a trifle wider than the plates. Five small separators can be obtained from each large one. Do not use any separators that are cracked or split while cutting.

(C) *Containers.* Fifty glass test tubes are necessary and may be purchased from hardware stores, drug stores or glass company. They should measure 1 inch in diameter by 7 inches long, and can be either round or flat bottomed. If this size cannot be obtained, purchase the next larger size—1⅛ inches by 7 inches.

(D) *Connecting Lugs.* Four pounds

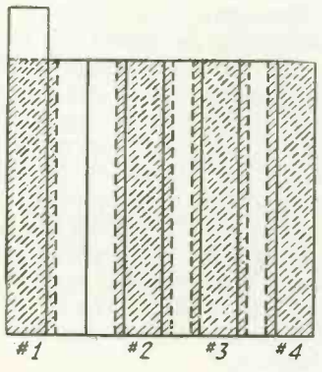


Fig. 1

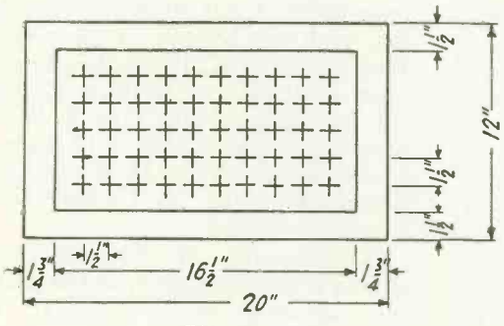


Fig. 2

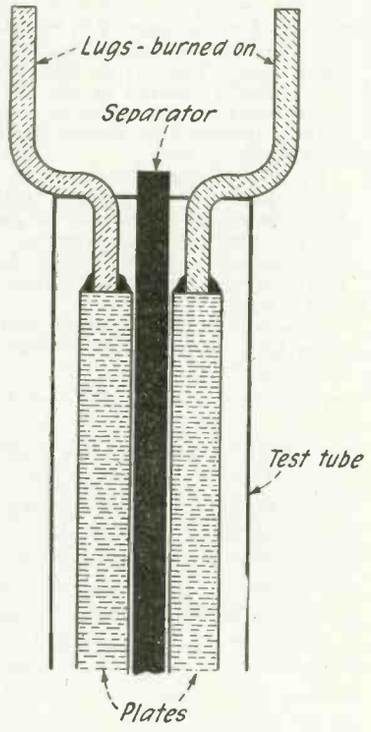


Fig. 3

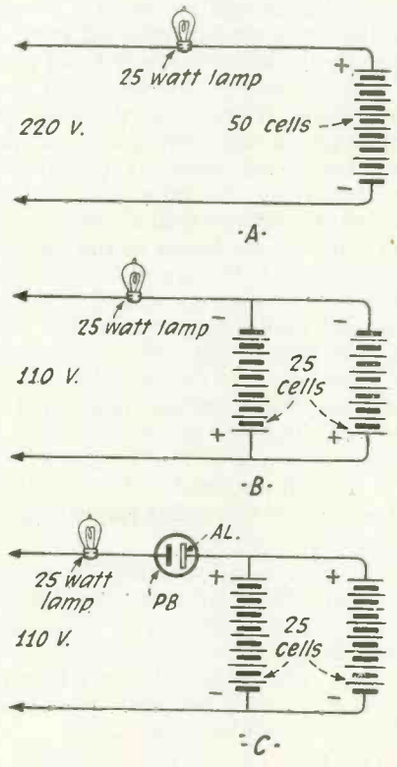


Fig. 4

of sheet lead are used to make the lugs. The thickness of the lead is ⅛ inch, which size comes 7 pounds to the square foot. The lugs are cut 3/16 inch wide and the required length. If it is impossible to obtain sheet lead, large size pure lead wire can be used.

(E) *Solution.* About ½ gallon of 1.300 sulphuric acid solution is required. This can be purchased prepared from a battery shop or garage. The solution for the battery should not have a density over 1.280 (hydrometer reading). A 1.280 solution is obtained by adding distilled water to the 1.300 solution. When adding water test often or the solution may be too weak. About three pints of the solution are required for the first filling.

(F) *Rack.* The material used in constructing the rack consists of 2 boards of white pine or cypress 1 x 12 x 20 inches, and 2 pieces of wood 1 x 1 x 4 inches.

The rack is constructed as follows: With a rule or square measure 1¾ inches from each end, and draw lines across the board, then measure 1½ inches from each side, and draw lines running lengthwise of board—this will give an oblong 9 x 16½ inches. Divide this oblong into squares by drawing five lines lengthwise and ten crosswise. These squares should measure 1½ x 1½ inches as shown in figure 2.

At intersection of lines, holes are drilled, the diameter being the same as the diameter of test tubes. A margin of 1½ inches should be left at each side and each end of board. Do not cut the remaining margin off until all holes are drilled as the board will crack at ends or sides. In the board used for the top of the rack, the holes are drilled all the way through by drilling until the screw point of the drilling emerges from the other side. Turn the board over and drill through. The holes in the base board of the rack are drilled only half way through. The upper part of the rack should be drilled first and used as a template for drilling the base. This saves measuring off both boards. Be sure the bits are sharp or the resulting holes will be rugged. The end pieces are made by cutting diagonally the length of the 1 x 1 inch material. The resulting pieces will be triangular measuring 1 x 1 x 1½ x 4 inches.

The rack is put together by nailing the four triangular pieces on the base board, one at each corner. The upper board is nailed on the other end of the pieces. The edges of the triangular pieces and base board and upper board of rack, should be flush.

The rack can be left unfinished or finished as follows: Dissolve old phonograph records in wood alcohol and apply with brush. Varnish or paint should never be used.

The battery is assembled as follows:

(1) *Preparing Plates.* If full 1 inch (inside diameter) tubes are used two plates and separator will fit tightly in the tube. It will only be necessary to file off rough edges of the plates. If tubes measuring slightly under 1 inch (inside diameter) are used it will be necessary to file the plates to the required size. When filing, the plates should always be placed between two pieces of wood to prevent breakage and care should be taken that the small lead wire is not filed through. A positive and negative plate (with separator between) should be fitted to a certain test tube. Sometimes it is necessary to file the edge on one side of plate more than the other, in order to fit shape of tube. If tubes larger than 1 inch (inside diameter) are used, it will be necessary to file rough edges of plate, assemble positive and negative plate (with separator between), wrap small rubber band around each end and the unit is complete.

(2) *Burning Connecting Lugs to Plates.* The connecting lugs should always be burned to the plate and never soldered. On account of the smallness of lead space on plate, the electrical method of lead burning is most practical. For the burning operation the following material is required: 1 6-volt storage battery; 2 pieces, size No. 18 copper wire 4 or 5 feet long, and about 2 feet of resistance wire, size No. 18.

The heavy lead wire at the upper end of plate is scraped clean. The connecting lugs are bent as shown in figure 3, and both ends scraped clean. The lug should always be burned to the side of the plate toward the oval of the tube.

To burn lug on plate attach the 2 pieces of copper wire to terminals of storage battery. A piece of resistance wire ¾ inch long is cut and bent double. This is twisted, forming an eye at one end, which is attached to one of the copper wires. The resistance wire, after being doubled, should not be over ¼ inch long. The connecting lug is laid on the plate where the connection is to be made. The resistance wire, held with pliers, is touched to the lug at the desired place, and the circuit closed by touching the other copper wire to any part of the lead forming the plate or lug. The resistance heats quickly and will burn away if held on lead too long. The heat can be governed by opening the circuit. The lead of the lug and plate must be heated at the same time, otherwise they will not run together. If the reader is not familiar with this type of lead burning he should practice burning two pieces of lead together before tackling the plates. Extreme care should be taken that the plates are not injured during the burning process.

(3) *Connecting the Cells.* The tubes containing the plates are placed in the rack in the following order: The rows run lengthwise and the positive plate in one cell is connected to the negative plate of the next cell. Care should be taken that 2 positive or negative plates are not connected together. The positive plates are of a dark red color and the negative plates are gray. The lugs are burned together by electricity. The 2 center lugs should not be connected until after charging.

(4) *Adding Solution to Battery.* The tubes are filled to top of separators with the 1.280 sulphuric acid solution, and the battery is allowed to stand for 8 hours. It will then be necessary to bring it up to the level again and let battery stand for 4 hours. After the battery has stood 12 hours it is ready for charging. Do not add acid after second filling; level is maintained by adding distilled water.

(5) *Charging.* If 220-volt direct current is available, connect the center cells and charge battery as 1 unit. Be

(*Continued on page* 66)

Our Chance to Listen to the British and French Amateurs

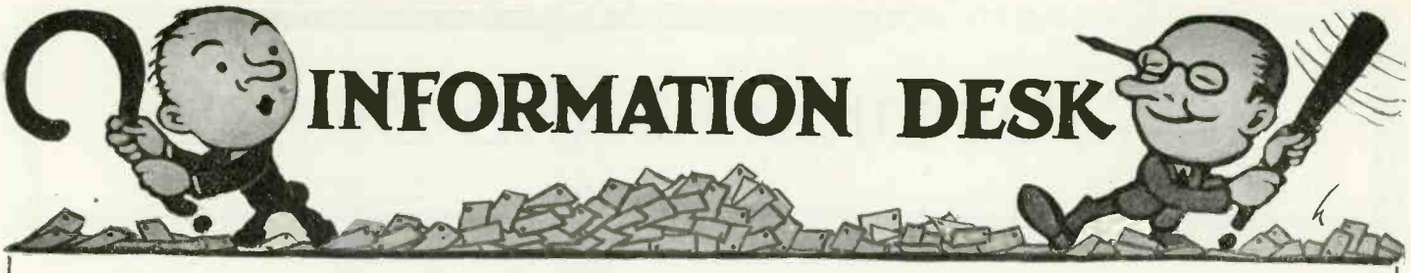
Prizes for Sharp Ears

American amateurs are sincerely urged to listen for signals from amateur stations in Continental Europe during the period of December 22, 1923, to January 10, 1924. This will be the fourth series of trans-oceanic tests under the auspices of the American Radio Relay League in an effort to promote better amateur communication between America and Europe.

To facilitate receiving at this end the French and British amateurs will transmit on alternate nights, the transmission hours from 8:00 P. M. until 1:00 A. M., Eastern Standard Time, the French starting the tests on December 22. It is absolutely essential that our fans do not "break in" during the twenty days of testing as we must lend every support to establishing two-way Trans-Atlantic Amateur Communication. Support in this direction is practically assured as the efficiency of our amateur transmitters was adequately proved last winter during the third series of tests.

By way of special inducement to insure "quiet air" during the tests, $3,500.00 worth of prizes will be awarded for the best reception reports turned into American Radio Relay League, Headquarters, 1045 Main Street, Hartford, Conn.

This will be an excellent chance to show that we can copy foreign amateur signals.



CONDUCTED BY JOHN R. MEAGHER

A self-addressed stamped envelope will insure a prompt reply to any queries on radio

New Tubes—What Voltage?—What Resistance?

Mr. George Ross of New York City wants "—— some information on the use of 'dry cell' tubes with a six-volt battery; that is, the proper way of connecting the filament, the correct external resistance value, and in short, anything of interest bearing on the subject."

This is rather a large order, but as doubtless many amateurs wish to know more about filament circuits with certain values of A battery voltage and various kinds of tubes we will cover the subject as fully as possible.

But first we should consider just what a filament circuit is: Figure A represents a simple electric circuit of two series resistances of 50 ohms each connected to a battery of 6 volts. The current in the circuit will equal the voltage divided by the resistance, or .06 amperes.

Suppose we knew the battery voltage, 6, and that the desired current was .06 ampere —find the total value of resistance. Merely divide the voltage by the current: The resistance necessary to restrict the current from a six-volt supply is 6÷.06 or 100 ohms.

In a similar manner, if we know the resistance and desired current rate, we may find the proper voltage by multiplying the two known factors. 100×.06=6 (volts). That is, the resistance multiplied by the current equals the proper value of applied voltage.

The first two conditions are those radio amateurs most frequently encounter: we may summarize them as follows.

1. *The voltage divided by the resistance equals the current rate.*
2. *The voltage divided by the current equals the resistance value.*

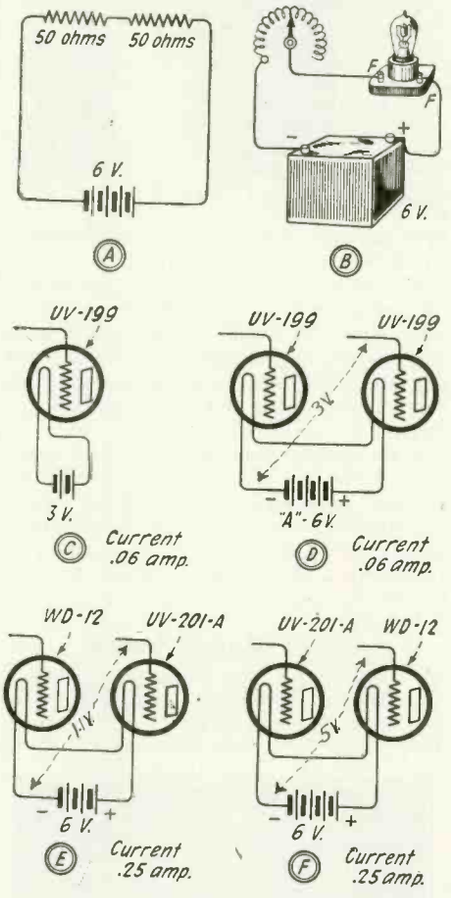
Applying this simple electric circuit to radio problems, we may substitute a mental image of an A battery for the term voltage and a combination of the particular tube and "size" of rheostat for the resistance, see figure B.

Suppose we wanted to find the proper rheostat for a UV-199 tube with an A battery of 6 volts. We know that the current in the circuit should equal .06 ampere. Applying rule 2 we have 6÷.06=100 (ohms). Note however that 100 ohms represent the *total* value of resistance; to find the rheostat resistance we must subtract the filament resistance, which for a UV-199 is 50 ohms. The *rheostat* then should have a maximum resistance of about 50 ohms.

Another case: Find the proper rheostat for a UV-201A tube with a 6-volt battery. Here the current is .25 amperes and the voltage 6. The resistance should equal 6÷.25 or 24 (ohms). As the filament resistance of a UV-201A is 20 ohms, the rheostat must be at least 4 ohms.

Now we will let the reader "dope out" one. If you had a W.D.12 V.T. and wished to use a 6-volt storage battery, what size rheostat would be necessary? (The resistance of a W.D.12 is 4.4 ohms and the desired current is .25 ampere. The correct answer will be found at the end of this department.)

It should be remembered that the filament



of a vacuum tube may be operated advantageously slightly below the specified voltage —so it is well to make the rheostat resistance higher than necessary.

In order to prolong the life of the A battery we must reduce the filament circuit current to as low a value as possible. To do this we should avoid the use of rheostats, using instead either the proper terminal voltage or special circuit connections. Thus with a UV-199 we may use two dry cells in series without a rheostat (Figure C). Or if we have two of these tubes we may put them in series and use a six-volt battery (Figure D). This latter connection would be of benefit in a detector and one-stage amplifier hookup as it would enable us to maintain the grid of the amplifier at a negative potential of 3 with respect to the *negative terminal* of the *amplifier filament*. By judicious use of series filament connections we may dispense not only with extra resistances, but also with special C batteries. Certain combinations of tubes with the same filament current rate are shown at E and F.

In E, if the UV-201A is the A.F. amplifier and the return lead from that grid goes to the negative A battery, we have, in effect a C battery of about 1 volt. By changing the tubes and making the W.D.12 the amplifier we have (in effect) a C or grid battery of about 5 volts.

A near future issue of THE WIRELESS AGE will contain an article dealing with vacuum tubes, their connections and how to get the most from them.

[*Answer: Divide the voltage by the current, 6.0÷.25=24 ohms. And as the tube resistance is 4.4 ohms, the rheostat resistance must equal 24 less 4.4 or 19.6 ohms.*]

Inductance

Mr. R. J. McCutcheon of Pueblo, Colorado, wants "information on inductance coils; which is the best type; why certain wire is specified; what effect the winding form has on the efficiency of the coil. In short, how may I design really good inductances for short wave amateur and broadcasting reception?"

Of the many different kinds of inductances it is difficult to designate one as being "the best," for comparative tests demonstrate that in actual operation there is slight difference in the results secured with any special type, provided the construction is in line with modern practice. Naturally for home construction we believe the single layer coil to be most suitable as manifestly it is one of the easiest to make and if carefully planned will be entirely satisfactory. In addition, calculations of the number of turns for a given value of inductance is simple.

The winding form may have a diameter of about 3 or 4 inches and a wall thickness of not more than ⅛-inch, as it is well to keep the volume of the form as small as possible. Bakelite, formica, hard rubber, wood or sturdy "mailing tubes" may be employed.

The size of wire is usually governed by the amount of space available; No. 24 and 26 are the more common, being a compromise between excessively fine and medium heavy wire, each of which has certain disadvantages. We prefer fine wire and usually wind our own coils with No. 30

(*Continued on page 68*)

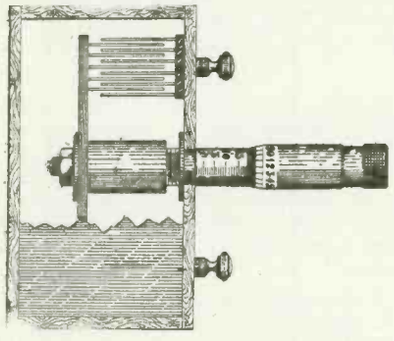
NEW APPLIANCES AND DEVICES

A "Super Condenser" from France

A FRENCH inventor has designed a new variable condenser using a micrometer handle, as shown in the illustration. Movable and fixed plates are made of sections of tubing, mounted concentrically and one set of tubes sliding within the other with a helicoidal movement.

In one of the first models constructed, the capacity varied from zero to .001 mfd. in 20 turns of the handle, or, in other words, a variation of .00005 mfd. per turn. This gives an extraordinary sensitivity to tuning, while use of the micrometer form of handle makes it easy to set the condenser at any desired value. It should not be thought that the twenty turns make it laborious to make large changes in capacity, for the rotating member of the condenser acts somewhat as a flywheel, and a sharp twist is enough to spin the plates all the way in or all the way out in a jiffy, if speed is wanted.

The dimensions of the condenser are such that it can be used easily in present receiving sets. As apparatus of extreme delicacy of adjustment it will be most appreciated by those experimenting with super-regeneration, with heterodynes, and with wave meters.



The new device has the additional merit of being practically indestructible under ordinary use, needing no adjustments. And such is its manufacturing simplicity that when it appears on the market it should be available at about the same price as any good condenser of the blade type.

More Space for Brandes

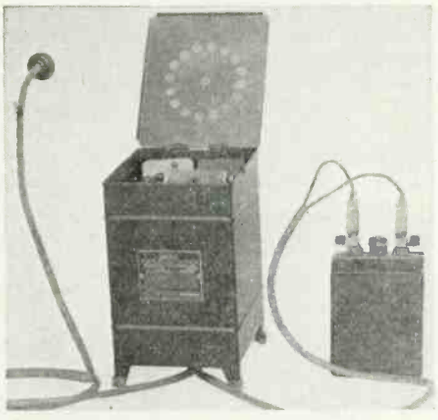
C. BRANDES, INC., New York City, announce the lease of another 5,000 square feet of space in the building at 237 Lafayette Street.

This is the third addition that the company has made in the past year. Early in March, they leased the ninth floor consisting of 5,000 square feet of floor space. In August they purchased a new plant in Newark containing about 48,000 square feet. With the newly leased space, they occupy four floors of the building.

The main office will be continued at 237 Lafayette Street.

Charger for Dry Cell Tube Battery

TO meet the demand of radio operators for a device for charging storage batteries of from two to four volts, to be used in connection with the Tungar Battery Charger, the General Electric Company has developed and is now placing on the market an efficient adapter.

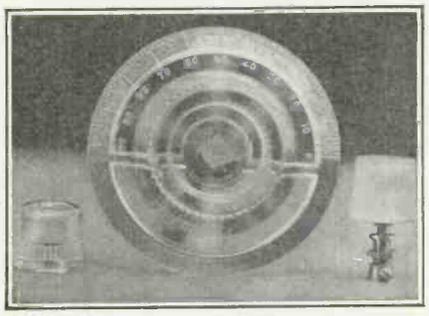


This is a resistor of sturdy construction, the resistance wire being wound on a porcelain tube. It is designed for mounting on the inside of the top edge of the Tungar casing, which brings it beneath the cover, where it is out of the way and is protected against contact.

It is expected that there will be a great demand for this device because of the increasing popularity of the storage battery for operating the small, or so-called peanut, types of tubes, the storage battery being preferred by a large number to the dry cell for this purpose.

Glass Radio Parts

AS glass is a very good non-conductor, Peterson & Hoffman, Millville, N. J. decided to manufacture radio parts of glass. They claim these parts are moisture proof and with the lines and figures being moulded in the glass there is no chance for static leakage and no chance for the figure to wear or rub off. They make the parts in sizes to have the bushings fit the various size rods and screws.



Pacent "Everytone" Headset

THE Pacent "Everytone" headset, manured by the Pacent Electric Co., New York City has several novel features, not least of which is the special design and arrangement of the magnetic circuit. Instead of two poles each with its separate windings, the "Everytone" has a single soft iron pole piece in the center of the case. As a result, the magnetic pole is concentrated on the center of the diaphragm. It is claimed that additional selectivity is secured through this feature.

The "Everytone" headset is somewhat lighter than usual, weighing less than ten ounces. And, because of the sturdy construction, interior terminal and safety spark gap, this headset is quite "foolproof."

New Type "B" Battery

A "B" battery which has recently been placed on the market by the Burgess Battery Company marks a distinct progress in the utility and convenience of "B" batteries. This is a new type of vertical "B" battery, the dimensions and weight of which coincide exactly with the No. 6 dry cell commonly used for filament current.

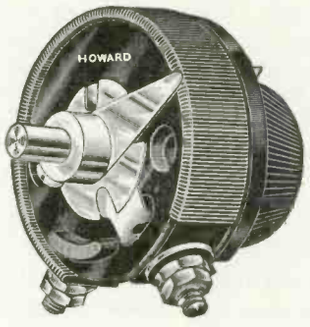
The new battery is a 22½-volt "B" battery known as the No. 5,158. It is six inches in height with a base two and one-half inches square. The terminal connections are brass binding posts at the top. By an ingenious method of construction, the fifteen cells, individually insulated, are placed in a vertical position in two inner compartments. These compartments are arranged one above the other, and the whole is enclosed in a non-metallic, non-inductive, waterproof container.

The electrical capacity of the battery at 2 milli-amperes is about 500 hours, which places it in the group of so-called medium-sized "B" batteries.

The Howard Midget Rheostat

TO meet the long felt want for small rheostats, the Howard Radio Company is now manufacturing a Midget Rheostat, made in three different resistances, 6½, 25 and 40 ohms. The diameter of the base is 1⅝ inches.

These rheostats are identical in design and construction with their Standard Rheostats, being built of the same high grade materials. This rheostat has been designed more particularly for use in small portable sets where space is limited and where such tubes as the UV-199 and C-299 are used.



The Transinductor

THE limitations of both air and iron core transformers have been overcome to a great extent by a device called the Transinductor, made by the Signal Electric Co. Control of the magnetic inductance, the capacity and the amount of iron in the core is possible with the Transinductor. With it selective tuning is possible, increased amplification is obtained and operation over a broader band of frequencies may be accomplished.

The number of combinations for tuning purposes to be secured through the use of two Transinductors, is very large. Experience will enable the user to tune the set down so that he can receive nearby broadcasting through severe static. Because of the large number of combinations to be secured, he will receive any particular station in a number of different settings; but there is always one combination which is best.

One of the surprising features of the Transinductor is that the entire set of two stages of radio amplification, detector and one-stage audio amplification can be operated on a "B" battery voltage of only 22½. However, for extreme volume it is advisable to use 22½ volts on the detector and 45 to 90 volts on the amplifiers.

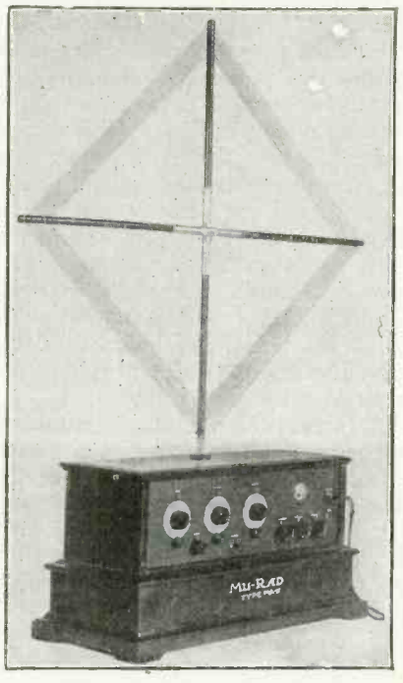
The Transinductor is a new transforming principle and device, used very successfully on radio frequency amplification. A single unit controls the iron flux with respect to position and amount, induction and capacity, bringing out a high degree of refinement of radio frequency amplification. It has 360-degree control; and, in all of these 360 degrees, the important feature of selective tuning of radio frequencies is accomplished through the control of the transforming electromotive-force and the magnetic iron-core flux as well. The induced currents set up in the secondary windings of the Transinductor are always in the same relationship to the impulses of the primary windings, regardless of difference in other functions. Its inter-winding capacity-control brings out the highest efficiency in selective tuning.

The control of the electromotive-force induction in both its primary and secondary windings produces the greatest possible amplification. By being able to control the iron flux the Transinductor is also able to broaden the band of frequencies received.

An Ideal Radio Receiver

THE Mu-Rad Laboratories of Asbury Park, N. J., have designed a new receiver, known as Mu-Rad MA-17, which has sensitivity, selectivity, simplicity and ease of operation to satisfy the most exacting radio enthusiast.

One dial does all the tuning, covering the entire range of wave-lengths. Interference is eliminated and stations selected very easily with two other dials, which are entirely independent of the tuning dial and of each other. The powerful, close stations can be blocked out and far distant stations brought in clearly and distinctly.



The simplicity of the circuit of the MA-17 makes filament adjustment seldom necessary. Rheostats are however, provided. As a further aid to selectivity and elimination of interference, the MA-17 has a two-foot loop aerial fitted into the top of the cabinet. The loop picks up only stations in its plane.

The Mu-Rad MA-17 circuit is a combination of radio and audio amplification to produce signals loud and clear enough to operate a loud speaker. A voltmeter in the panel provides an instantaneous reading of the "A" and "B" batteries.

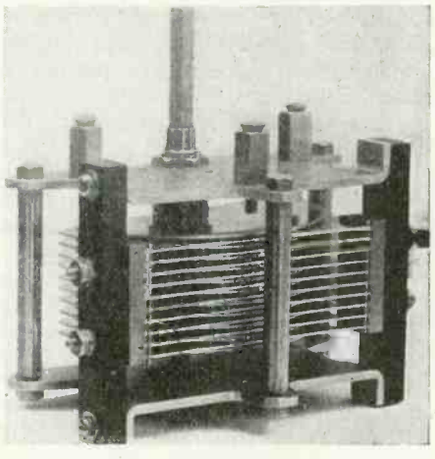
The set is enclosed in a solid mahogany cabinet with an Adam Brown hand-rubbed finish. A compartment is provided in the base for "B" batteries, which are removable from the rear.

Pacent Duo-Lateral Coils and Mounts

FOR reception of wavelengths between 200 and 20,000 meters, the Pacent duo-lateral coil and mountings may be used to form an extremely flexible and efficient receiver. The duo-lateral winding system is endorsed not only because of its electrical and mechanical qualities, but also because of the resultant sharp and selective tuning.

Recently the Pacent Electric Co. developed a new mounting plug which is much superior to the old type in which a fibre strap around the outer circumference of the coil was used to clamp the coil and plug. In this new design a very small strap passes through the coil and is fastened to the side of the plug in such a manner that tightening a single screw on the front face of the plug makes it grip the coil with a vise-like hold.

Various clever Pacent panel mounting plugs are also on the market; they have the good features of rear panel mounting, positive connections and vernier adjustment. All of these devices are described in a catalogue, "Pacent Radio Essentials", 1923 edition, of the Pacent Electric Co., 22 Park Place, New York, N. Y.



New Cardwell Condenser

THE new type "B" condenser made by the Allen D. Cardwell Mfg. Corp'n of Brooklyn, N. Y., is essentially the same as the old type, but has these special features: ball bearing; white-nickel end plates; special spring contact; drill holes for mounting special coils for Cockaday, Hazeltine and other popular circuits.

The new types are being made in 11, 17, 21, and 41-plate sizes.

Opportunities in Radio Today

(*Continued from page* 53)

words, a man who has sold phonographs or pianos or automobiles will be handicapped when he attempts to sell radio, until such time when he has learned the fundamentals of radio reception, what goes to make an efficient receiver and how it is installed and operated. As a matter of fact, some of the radio schools today are devoting a part of their curriculum to radio merchandising. Equipped with this dual knowledge, radio men are ready to take important positions in this fast growing industry. Your modest radio clerk of today is frequently the head of a respectable selling organization of tomorrow.

PUBLISHING

Here, too, is a branch of the radio industry which accommodates individuals who have a bent towards publishing. First there is the radio writer, the man who understands the various phases of radio and who is able to express his ideas in writing. In short, the man who is gifted with the art of self-expression and who is able to impart the knowledge he has gained to the masses who seek information.

RECENT FACTS AND FIGURES ABOUT RADIO

As an indication of the potential field of radio and the many opportunities which are open today, I have a few facts and figures to give here which speak for themselves.

Let us start at the top. Latest census figures tell us there are approximately 120,000,000 in the United States. This means approximately 25,000,000 families or homes. Of this number about 2,500,000 people are already enjoying the benefits of radio. In fact when on Nov. 1 and 2, that famous orator and world figure Lloyd George spoke over WJZ and WEAF, it is estimated that nearly 3,000,000 tuned in to hear his parting messages to America.

Broadcast fans, not only in America, but in Canada, England, France, Cuba, Mexico and elsewhere intercepted part or all of Lloyd George's words. Prior to this perhaps no other man in history ever had so great an audience.

There are at this moment 562 broadcasting stations serving these broadcast listeners throughout the United States. Impressive also is the fact that there are over 1,000 city newspapers and over 5,000 country weeklies publishing daily and weekly radio sections containing program schedules and timely information on how to receive broadcast stations and derive the greatest benefit therefrom. Over 250 text books on radio have been published during the past two years. Something like 3,000 manufacturers are catering to the needs of the broadcasting fan. 1,000 wholesale distributors and over 20,000 retail dealers are selling radio devices today. The number of people engaged either directly or indirectly in radio totals about 250,000. Finally it is estimated that the total volume of radio sales during the year 1923 will reach the huge figure of $150,000,000 and still it is said that this business is yet in its infancy.

Somehow I cannot help but feel that radio offers indeed exceptional opportunities to the man or woman who has the right viewpoint, who is willing to learn, who is honest and who is imbued with a real desire to serve, whether the service be as a radio operator on the high seas or a clerk behind the counter of a radio store.

The Wireless Age Uni-Control Receiver

(*Continued from page* 47)

normal brilliancy it is safe to place the other four UV-199s in their sockets.

Move the potentiometer slider to the negative side of the filament and slowly vary the condenser between minimum and maximum settings. If a whistle is heard, center the dial at that point and slowly move the potentiometer slider toward the positive side of the filament until a point is reached at which the whistling ceases and speech or music is audible; or, if the first tube is tapped lightly a loud ringing sound should be heard, the volume of this sound decreases as different tubes, from the first to last, are jarred.

Of course, the above is what should happen and will happen if the receiver is properly built, but in the event that something goes wrong it is necessary to locate and then remedy the fault. The "symptoms" of poor operation may usually be classified under one of these headings:—

a—No sound whatsoever.
b—Lack of volume.
c—Howling.

In any case, first inspect the wiring, look for wrong connections, missing connections and shorts. Test all the transformer windings again and make certain that the vacuum tube socket contacts are pressing hard against the tube pins. If no sound is heard look particularly at the battery connections; see that the negative B is joined to the positive A and that the A battery polarity is correct.

Lack of volume is usually due to an "open" in the primary of one of the audio frequency transformers.

When there is not much volume and a periodical "click" is heard, there is usually a break in the secondary of one of the audio frequency transformers. The "click" being due to the charge and discharge of the grid through the windings. A break in the secondary does not necessarily cause poor operation however, especially if the break is near the inner turns and the windings have considerable inter-capacity and sufficient leakage to prevent an accumulated charge on the grid.

Howling is usually due to poor transformers; we have never experienced this annoying trouble with the make shown when used in conjunction with UV-199 tubes. But in order to minimize this possibility we have shown a small fixed condenser in shunt to the secondary of the second A.F. transformer. The purpose is to give this winding a differing resonant frequency from the rest so as to prevent self-oscillation at audio frequency. Another method is to reverse the secondary connections of one transformer, thus giving it a different value of shunt capacity; this usually works well on the third stage.

We do not like to slide over this trouble shooting section without giving the reader some information, but on the other hand, if we prolong it and make it at all comprehensive it becomes wearisome and indeed is apt to scare the prospective builder.

One should not imagine he has an immense job on his hands in building this six-tube set for we are confident that if a bit of common sense is used in the construction, everything will sail along smoothly and the results will not only be up to expectations but far beyond even the most imaginative.

OPERATION

The receiver may be set up anywhere in the home though it is advisable to keep it as far removed from large metallic objects as possible. The loop should be connected to the receiver with a duplex silk covered cord (as short as possible). The batteries may be located at any distance from the receiver, but the connecting cord should be well insulated to prevent accidental short circuitings.

To receive, push the filament battery switch "on" and—

1—Turn the potentiometer slider to the negative side of the filament.

2—Vary the condenser between minimum and maximum, centering it at any point where a whistle is heard, then—

3—Move the potentiometer slider slowly toward the positive side of the filament until a point is reached at which the whistling ceases and speech and music is audible.

When the call letters of that station are determined, mark them on the dial in small letters directly in line with the indicator, making a small mark to locate the exact point of reception. Do the same with all other call letters heard.

Footing the Broadcasting Bill

(*Continued from page* 52)

should not be paid for. It would seem to the author that broadcasters, sooner or later, must organize their broadcasting activities on the same basis as a magazine. The reader of any magazine pays only a part of the cost of producing the copy which he receives. Indeed, if circulation expenses are taken into consideration, the reader pays nothing to the publisher in most instances. The burden of footing the cost of publishing falls on the advertiser, who must carry his message to the reader through the columns of the magazine.

In broadcasting, we may yet have the same arrangement. The listener will receive sixty per cent. of purely entertainment features, free from publicity of any kind. And then, ingeniously interlaced among the entertainment features, there will be forty per cent. of publicity features, which will not vary greatly from the present talks, except that they will be more interesting because of the greater thought and care brought to bear in their preparation. He will be a great impresario who will blend the various entertainment features and the wonderfully interesting talks into a program of such strong appeal that the receiving set dials will remain fixed.

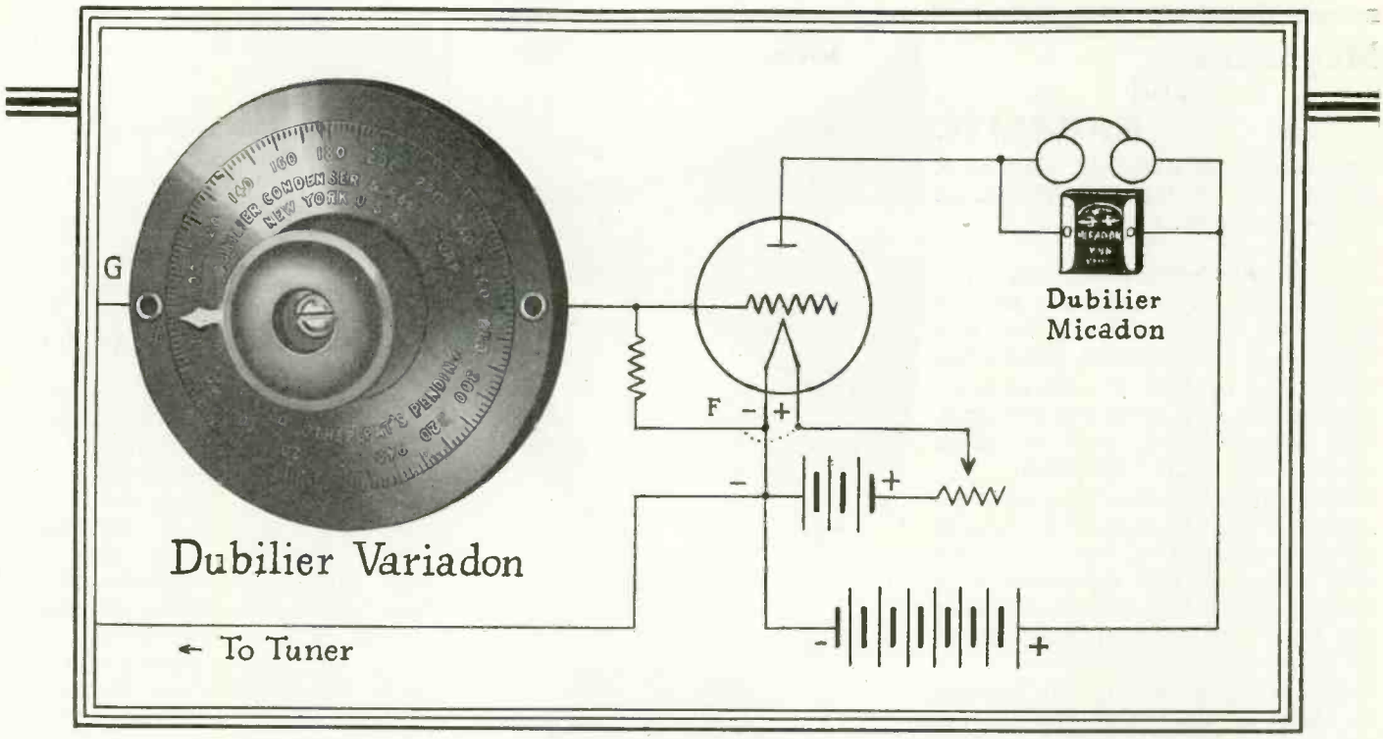
Meanwhile, and until the broadcasters solve their own troubles, we may continue to enjoy the gratis-free-for-nothing programs to the utmost. All that we are asked to do is to write an occasional line to the various broadcasters and their artists, assuring them of our deepest appreciation for their efforts to please us.

A Real 100-Volt "B" Battery

(*Continued from page* 60)

sure the positive terminal of the battery is connected to the positive wire of the current supply. To control the charging rate a 40 or 50-watt lamp is connected in the circuit as shown in figure 4a. If 110-volt direct current is available the battery must be charged in two units as shown in figure 4b. If the battery is to be charged from 110-volt alternating current chemical rectifiers are used to convert same to direct current. The battery must be charged in 2 units as shown in figure 4c. A good rectifier can be constructed for a few cents by following the directions below:

One piece of aluminum 1½ x 3 inches, 1 piece of lead 1½ x 3 inches, and a glass cup are required. The aluminum may be cut from an old pail or cooking utensil.



At F the filament terminal of the grid leak is shown connected to the negative side of the tube. Occasionally better results are obtained by connecting grid leak terminal to positive side of the tube.

The Variadon—A Variable Grid Control

Better than a Variable Grid Leak

BETTER than the average variable grid leak and a fixed condenser in a grid circuit are the Variadon, the Dubilier variable mica condenser, and a fixed resistance.

Better because it is difficult to control the resistance with the average variable grid-leak but certain and easy to control the capacity of the grid-circuit with the Dubilier Variadon.

Thus used with a fixed resistance the Dubilier Variadon greatly increases both the selectivity of the set and the volume of the signals. Thus disappear the difficulties experienced when poor variable grid-leaks are used.

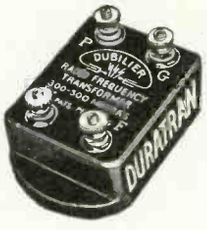
Because of its compactness the Dubilier Variadon readily finds a place in the average cabinet. It is no larger than an ordinary dial.

Price $2.50. At all good dealers.

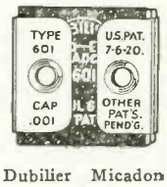
Write for further information to department 125.

DUBILIER CONDENSER AND RADIO CORPORATION
48-50 West Fourth Street,
New York.

Dubilier Duratran
Radio - Frequency
Transformer



DUBILIER DEVICES



Dubilier Micadon
The Standard
Fixed Condenser

Dubilier Ducon
The Standard
Socket Plug

As this aluminum is not very pure the plates will have to be renewed often. A borax solution (saturated) is used. Holes are drilled in one end of the plates to hold the binding posts. The plates are then bent to fit the edge of the glass and prevent same from touching the bottom. The lead plate is connected to the current supply and the aluminum plate is connected to the positive terminal of the battery. This rectifier will charge batteries of from 1 to 25 cells at .5 amperes (with a 50-watt lamp in series).

The battery should be charged at a rate of .4 or .5 ampere for the first time, and not over .75 ampere thereafter. It will take about five days for the first charge. If possible a hydrometer should be used to determine the condition of the battery while charging. The solution should test 1.300 when the battery is fully charged. If a small enough hydrometer is not available, a voltmeter or gassing sign can be used. By voltmeter test, the cells will register 2.4 when fully charged. By the gassing sign the solution will be cloudy and bubbling lively when the battery is fully charged.

(6) *Care of Battery.* The battery should be kept in a cabinet to prevent dust or dirt falling into the tubes. Keep the battery in a cool place in Summer and warm place in Winter. After first month's use examine the battery for loose connections. Only pure distilled water should be added to keep solution at proper level.

LIST OF MATERIAL

½ Gallon Sulphuric Acid Sol. (1300)	$ .40
4 Pounds Sheet Lead @ .10	.40
13 Positive Plates @ .22	2.86
13 Negative Plates @ .22	2.86
50 Test Tubes 1 x 7 inches @ .05	2.50
11 Separators @ .03	.33
	$9.35

The writer will be pleased to answer any questions pertaining to the construction of the battery.

Information Desk

(*Continued from page* 61)

double cotton covered, for in our estimation the increased direct current resistance is more than counterbalanced by the decreased distributed capacity; and the D.C. resistance is of less importance in a regenerative or radio frequency amplifying receiver than is the value of distributed capacity.

For amateur use we firmly believe that solid copper is preferable to stranded conductors (litzendraht). Unless the "litz" is of *perfect* quality and each strand shows a complete circuit and unless, in making terminals, each strand is soldered, this type of wire will not give as much satisfaction as solid copper. There is also the question of "workability" and cost; litzendraht is difficult to use and is quite costly; solid

copper is very easy to use and is not at all expensive.

The covering or insulation is of importance for two reasons. First, it acts as a spacer between the copper conductors and in this way determines, to a large extent, the value of distributed capacity. For this reason alone it is well to use at least a *double* covering of cotton. Secondly, the insulation keeps adjacent turns from short circuiting; *i. e.*, touching each other. On this last account it is advisable to employ white insulation as the dye in colored coverings affords leakage, detrimental to sharp tuning.

From the above statement it is evident that an efficient inductance comprises a form of small volume wound with fairly fine double white cotton covered solid copper wire.

In finishing the coil, one should dry it thoroughly in an open oven (to drive out any moisture in the cotton insulation) and apply to the winding a very thin coat of collodion (which may be purchased in any drug store). In mounting the coil keep it removed from large metallic and insulating bodies—use a simple bracket. Further, in connecting the inductance, endeavor to eliminate the necessity for taps—that is, design it so that with a small loss-free variable condenser in shunt, the wavelength range will just cover the desired band.

Possibly our saying "design it" may be cause for a "way down east" feeling. We assure you that it isn't as hard as it may seem. Almost every radio textbook contains "dope" on how to find the value of inductance, and though we have striven to answer your inquiry as completely as possible there is a great deal more to this interesting subject and, without trying to act as a press agent for anyone, we suggest that you get hold of E. E. Bucher's "Wireless Experimenter's Manual" if you want some good non-technical information on the proper design and construction of inductances. We personally have a well thumbed copy on our desk.

Selectivity

Mr. R. Irvin of Salmon, Idaho, writes: "I have a radio and audio frequency amplifying loop receiver which has given excellent results not only in the quality of reproduction, but also in the high degree of sensitivity and selectivity which it affords. However, in an effort to increase my range I have been using an outdoor antenna. It is entirely satisfactory, but there is still room for improvement in the selectiveness. Do you know of any system which will give me more selective results than an ordinary inductively coupled tuner?"

Yes, it is quite possible to improve an *ordinary* inductively coupled tuner to meet the requirements of a radio frequency amplifying receiver, and the necessary changes may be made easily. The difficulty with the usual type of coupler in such circuits is due to the high residual capacitance and inductance coupling even at the minimum point.

In addition, because of the proximity and size of windings, every variation of coupling effects a noticeable change in the self-inductance of both the primary and secondary circuits, consequently retuning is necessary.

A method of reducing the effect of both objections is shown in the diagram, figure 1. Here, the secondary coupling coil is comprised of only five turns and change of

coupling has but slight effect on the self-induction of either circuit. More important, very loose coupling is provided when the secondary is at right angles to the primary. It is evident that any standard coupler may be used if the rotor is rewound with only five turns. The only other change is the addition of a secondary loading coil which, for short wave reception, may be comprised of 40 turns of No. 30 D.C.C. wire on a thin 3-inch form; this load should be placed away from and at right angles to the primary inductance.

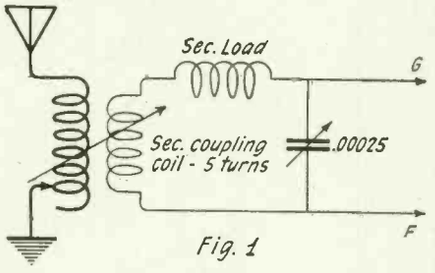


Fig. 1

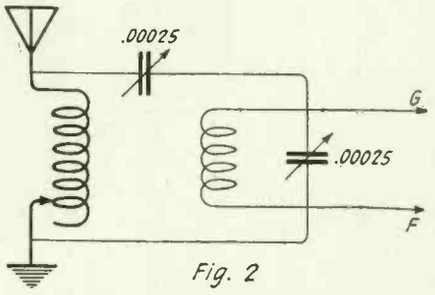


Fig. 2

Another system is shown in figure 2. Here a variable condenser is connected between the antenna and grid and, as the primary and secondary inductances are separated and fixed at right angles to each other, the only noticeable coupling is that provided by the variable condenser. Very loose coupling may be obtained if the minimum capacitance value is low. The advantage this system offers is that of ease in construction as no movable parts—other than the small coupling condenser—are required.

For all around purposes the first circuit is probably the better, although there is very little difference in actual results.

Regenerating Above 400 Meters

Mr. Edwin Garbutt of Stapleton, New York, has trouble making his variometer-tuned-plate regenerative receiver oscillate above 400 meters. He asks: "Is there any way of making the set oscillate throughout the entire range up to 600 meters?"

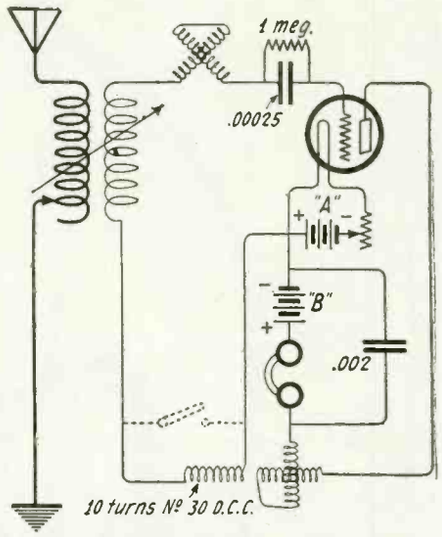
It appears that the maximum inductance value of the plate variometer is not sufficiently high to enable tuning of the plate circuit over the range covered by the grid circuit. There are numerous ways of overcoming this difficulty but probably the most effective and simple scheme is that shown in the diagram.

Here a small coupling inductance connected in the grid-filament circuit is placed in inductive relation to the plate variometer. This coil may be wound with 10 turns of number 30 D.C.C. wire on a form of approximately the same diameter as the stationary winding on the variometer.

In connecting this coil there is only one proper way. The correct connections may be found by experiment while the receiver is in actual operation.

If the oscillations persist at the lower end of the band despite adjustment of the plate variometer a short circuiting switch may be provided to short out the extra coil.

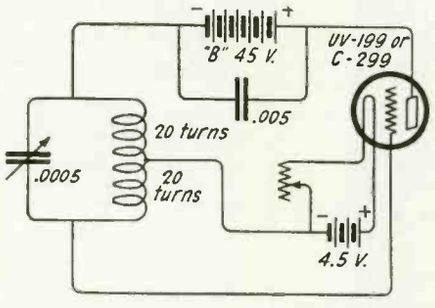
Also, look over the wiring and make certain that the return lead from the grid goes to the positive terminal of the A battery and that the grid leak also goes to this side. Frequently, with a hard tube, increase of the plate voltage increases the range of self oscillation for any given setting of the plate variometer.



Separate Heterodyne

Mr. J. H. Cordy of Toronto, Canada, writes: "Will you please publish a hookup of a good separate heterodyne for use with a radio-frequency amplifying receiver in the reception of C.W. signals; may the same device be used equally well with a super-heterodyne?"

We are showing on this page a complete wiring circuit of a short wave oscillator of very simple construction. It may be used with the super-heterodyne system or in conjunction with a non-oscillating receiver for C.W. reception. In addition, it is a valuable instrument for the experimenter as numerous tests and measurements may be made with it. If desired, the one tuning control, the variable condenser, may be calibrated in wavelengths.



The construction is exceedingly simple. Only one .0005 mfd. variable condenser, a suitable inductance, tube socket and resistance are required. The condenser should be of a very good make and of the "straight line" type if the oscillator is going to be calibrated. The inductance is wound on a thin 3-inch form with 40 turns of No. 30 D.C.C. wire with a tap at the exact center.

We would suggest the use of a UV-199 or C-299 as the oscillator may then be made up complete in a shielded cabinet with the

A and B batteries inside. Another advantage of using this type of tube is that of low filament current consumption; permitting operation over a period of months with very little attention.

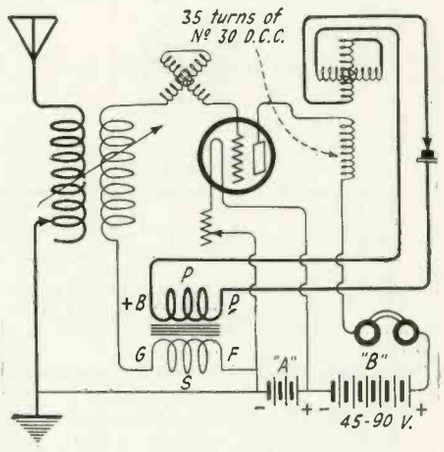
It is urged that the oscillator be made independent of other equipment and instruments as it may, at some time or other, be used for different purposes than those originally thought of. Indeed a short wave oscillator of this type finds its most useful sphere in radio measurements and once the amateur has learned how to use it the value of making it a separate unit will be fully appreciated.

Changing a Three-Circuit Regenerative Receiver into a Reflex

Mr. W. E. Jones of Denver, Colo., writes: "I have a standard variometer-variocoupler receiver using a UV-201A tube as detector. Is there any way in which I could use this material in a reflex circuit?"

If you care to go to the extent of making part of the circuit over, all your present equipment may be used in an extremely good reflex hookup.

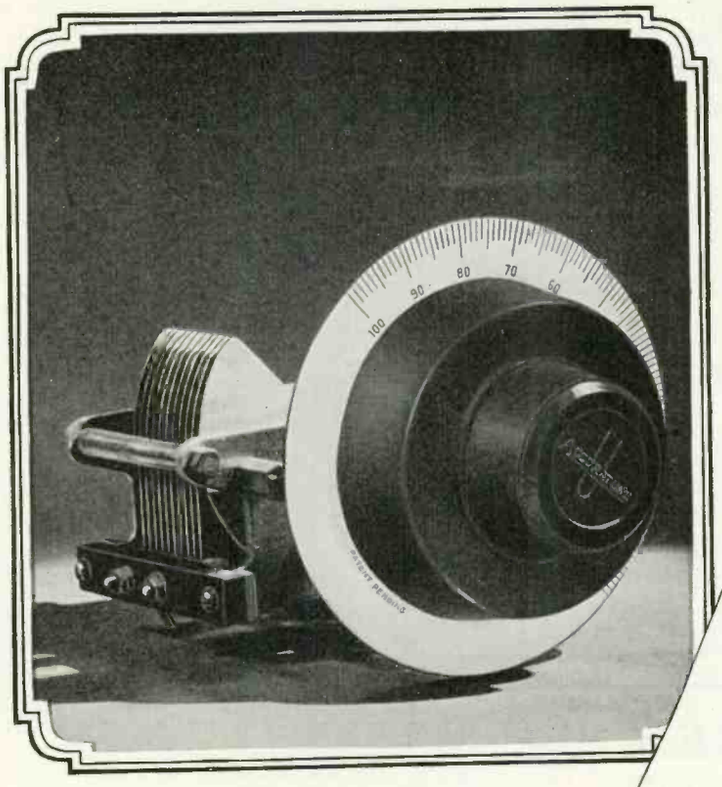
You will need one audio frequency transformer, preferably of a low ratio, and a good crystal detector in addition to the other apparatus. Also, it will be necessary to make a "major operation" on the plate variometer. This change is noted in the diagram.



A small coil of 35 turns of No. 30 D.C.C. wire is placed in close inductive relation to the outer winding on the plate variometer; and this coil is substituted in the plate circuit for the variometer. Both terminals of the variometer are connected to the crystal detector and primary of the audio frequency transformer.

In rewiring, leave the antenna circuit as it is now in your receiver. But short out the grid condenser or remove it entirely and run the lower lead of the secondary of the audio-frequency transformer to the *negative* side of the A battery. Be sure that the rheostat is in the negative A battery lead and that the secondary is grounded as shown. Disconnect the leads to the plate variometer and connect them to the extra coil. Then connect the terminal of the variometer to the crystal detector and primary of the audio frequency transformer. Use from 45 to 90 volts of B battery.

Tuning is in many ways similar to the regular variometer method. But in this case the second variometer is tuned to resonance with the other circuits *not* to effect self-



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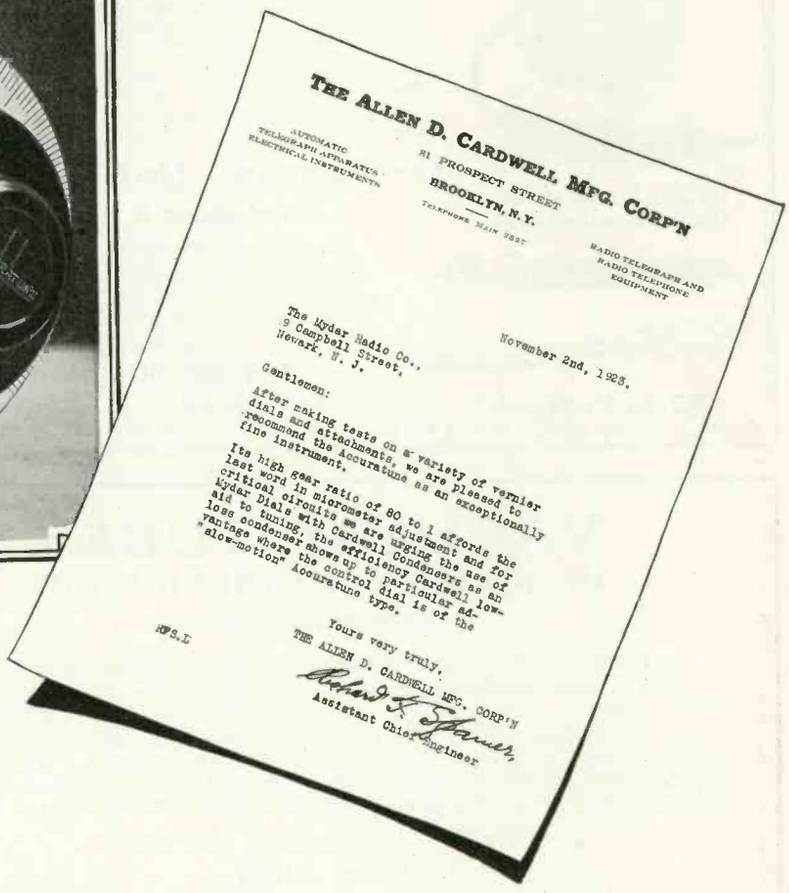

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Because of the inherent selectivity of this circuit, the antenna coupling may usually be fixed at a position near maximum coupling; however, for extreme selectivity the variable coupling control has many advantages.

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Of the Wireless Age, published monthly at New York, N. Y., for October 1, 1923.

State of New York, } ss.
County of New York }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared J. Andrew White, who, having been duly sworn according to law, deposes and says that he is the Editor of the Wireless Age, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Wireless Press, Inc., 326 Broadway, New York, N. Y.

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Managing Editor, None.

Business Manager, J. O. Smith, 326 Broadway, New York, N. Y.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is .....(This information is required from daily publications only.)

J. ANDREW WHITE, Editor.

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[Seal] M. H. PAYNE, Notary Public.

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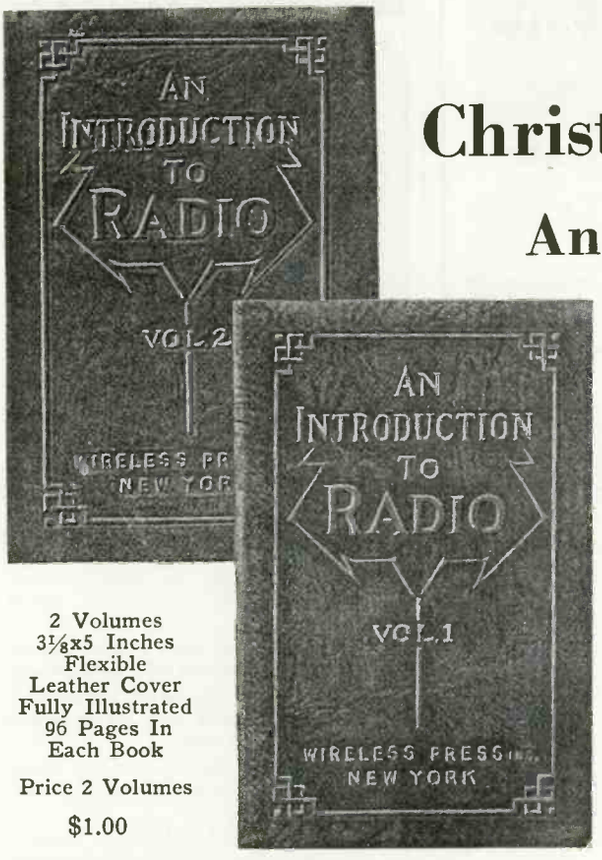

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8 BXV Edward J. Govern, 25 Vick Park B.Rochester, N. Y.
8 BYP Fred Whitney Redding, 1162 Franklin Ave., Columbus, Ohio
8 BYX Charles B. Young, Jr., 522 S. Prospect St., Grand Rapids, Mich.
8 CAK Paul W. Heasley, 677 Blaine Ave....Akron, Ohio
8 CAL Laurence M. Evans, 1018 Tomlinson Ave., Moundsville, W. Va.
8 CAN Walter T. Sweigard, 3153 Chapin Ave., Erie, Pa.
8 CBP Floyd Williams Bell, 379 E. N. Broadway, Columbus, Ohio
8 CCI James C. Lisk, 902 S. Elizabeth St....Lima, Ohio
8 CCK Keefer R. Ling, 419 Third St.....Cresson, Pa.
8 CET Edward J. Miller, 28 Railroad St.....Ilion, N. Y.
8 CFI Harold L. Passenger, 105 S. Carver St..Warren, Pa.
8 CFM John H. Botbyl, 514 Monroe St..Grand Haven, Mich.
8 CFN William Peuser, 1019 Sunset St....Scranton, Pa.
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8 CHP Cecil B. Delaney, Fourth St.....Dennison, Ohio
8 CIK William E. Battison, 3040 Merwyn Ave., Pittsburgh, Pa.
8 CJS Clyde J. W. Smith, 417 Russell St....Sharon, Pa.
8 CJZ Bert Greenspoon, 155 Broadway..Saranac Lake, N. Y.
8 CMF Homer D. Wood, 900 James St....Wilkinsburg, Pa.
8 CPE Harry F. LeMasters, 1264 Second St., East Akron, O.
8 CQL Edward H. Wallace, Jr., 1012 Chestnut St., Erie, Pa.
8 CRI Howell Jones, 132 Louisa St.....Utica, N. Y.
8 CTG William A. Mason, 304 Delaware Ave..Lorain, Ohio

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8 BWP Chris Hobson, 27 Chestnut St....Wilkinsburg, Pa.
8 BWY Elmer W. Reeve, 1001 W. Washington St., Ann Arbor, Mich.
8 CIA Richard P. Kuntz, S. View Road.....Dayton, Ohio
8 DFC Owens A. Hutcheson, 812 Stealey Ave., Princeton, W. Va.

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8 SK John A. Cameron, 134 N. Barry St....Olean, N. Y.
8 TY Carl A. Entrokin, 321 W 10th Ave..Columbus, Ohio
8 VS Kirke E Davis, 194 Glendale Ave., Detroit (Portable), Mich.
8 AGR Jesse O. Ellison, 130 E. Ludington Ave., Ludington, Mich.
8 AJH George F. Miller, 2232 W. 101st St., Cleveland, Ohio
8 ANP Ernest F. Goodwin, 803 Congress St., Ypsilanti, Mich.
8 APZ Carl Crawford Jones, Main St.....Clayton, Ohio
8 BBM Reginald L. Downey, 103 Hale Ave., Princeton, W. Va.
8 BDG Frank R. Day, 41 Canal St., Schuylkill Haven, Pa.
8 BDQ Herbert DeWeese, 618 Chestnut St., Greenville, Ohio
8 BEI William H. Johnston, M.D.....Collins, Ohio
8 BEW Edward H. Klinke, 102 Elesbree St....Sayre, Pa.
8 BEZ Maurice H. Pancost, 1101 Climax St..Lansing, Mich.
8 BFF Robert J. Hunter, 426 Arnett Blvd..Rochester, N. Y.
8 BFU Frederick R. Thomas, Jr., 1400 Second St., Moundsville, W. Va.
8 BFW Robert Zinn, 1429 Academy St.....Kalamazoo, Mich.
8 BGS William M. Ambrose, Ridge Road.....Girard, Pa.
8 BHB Frank C. Richardson, Avenue A & Grove St., Cambridge, N. Y.
8 BHK Wayne Snyder, Box 28.....White Haven, Pa.
8 BHM Ellsworth N. Willis, 16 Palmer Place, Lancaster, N. Y.
8 BHN Don R. Canady, 3439 W. 119th St..Cleveland, Ohio
8 BHP Ralph S. Wiebusch, 219 Gray Ave..Greenville, Ohio
8 BHT Clarence A. Arntz, 1826 N. E. Third St., Canton, O.
8 BHV John M. Jeffords, Camp Brooklyn....Paupack, Pa.
8 BHX Harry J. Mills, 1501 Corporation St....Beaver, Pa.
8 BIM Harry A. Neville, 4234 Lydia St....Pittsburgh, Pa.
8 BIT Edwin A. Hadden, E. 55th St. & Scoville, Cleveland, Ohio
8 BIW Forrest I. Phippeny, 136½ W. Grand River Ave., East Lansing, Mich.
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8 BKU Judson K. Prosser, 616 Ontario St....Buffalo, N. Y.
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8 BQJ Eugene John Huber.....Fairfield, Ohio
8 BRB Lawrence K. Garland, 304 S. Fourth St., Apollo, Pa.
8 BRU Lawrence O. Cook, R. F. D. No. 2....Bryan, Ohio
8 BSN Carl J. Brinkman, 1944 Maple Ave....Norwood, Ohio
8 BVD M. E. Johnson, 93 Sawyer St....Rochester, N. Y.
8 BVO George M. Cooper, 202 Beaver Ave..Sewickley, Pa.
8 BZG C. B. Darling, 14516 Shaw Ave..East Cleveland, Ohio
8 CSD Branko Lazich, 16 Eureka St.....Pittsburgh, Pa.

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8 IY Roy T. Van Niman, 119 S. Buckeye St., Wooster, Ohio
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8 WG Emery Quaiman, 538 Broad St.....Elyria, Ohio
8 AFG Robert S. Mehard, 1509 Market St., Youngstown, Ohio
8 AHL Harry W. Butler, 2837 Albion St....Toledo, Ohio
8 ALY H. Hartwell Hurd, 915 Helmsdale Road, Cleveland Heights, Ohio
8 AMH George T. Hart, Clifford & Thomas Sts., Rochester, N. Y.
8 AQL Charles W. Brestle, 1 Ingram Ave....Grafton, Pa.
8 AVM Wesley B. Hargraves, 1223 H. Howard St., Akron, Ohio
8 AWB Kenneth Stettinius.....Lakemont, N. Y.
8 AXO Howard E. Mohler, 50 Van Vorst St....Utica, N. Y.
8 BMY Robert F. Faudree, 325 Third St., Chester, W. Va.
8 BTX Oran D. Baldwin, 410 S. Collingwood Ave., Eastwood, N. Y.
8 BUT Eugene E. Noble, 509 Pearl St., South Brownsville, Pa.
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8 CMN Glenn & Ray Boundy, 513 State St., Grove City, Pa.
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8 CTA Joseph B. Gardner, 4514 Whetzel Ave., Cincinnati, O.
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8 CVY Samuel Dewey Conley, 2803 Frontenac St. Pittsburgh, Pa.
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8 DAJ Robert H. Collingnon, 2222 Willow Ave., Niagara Falls, N. Y.
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8 DDY Pliny W. Sigafoose, Cor. Main & W. Saffel Aves., Sycamore, Ohio
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8 DIY Jesse R. Leach.....Middletown, Ohio
8 DJS Tremain M. Hughes, 311 Lenox Ave..Oneida, N. Y.
8 BLT George H. Ransom, 178 Washington St., Bradford, Pa.
8 DPZ Harold Lockwood, 3 Easton St.....Kane, Pa.
8 CFY William A. Hausding, 908 State St., Traverse City, Mich.
8 BI George E. Bourne, 859 Washington St., (Name changed) .....Dayton, Ohio

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8 ZH Frank D. Fallain, Police Bldg. Beach St., Flint, Mich.
8 ZI Henry Grossman, 12343 Forest Grove Ave., Cleveland, Ohio
8 ZJ Alvin L. Anderson, 17 E. Liberty St..Hubbard, Ohio
8 ZK Elmer W. Reeve, 1001 W. Washington St., Ann Arbor, Mich.
8 ZL F. I. Phippeny, 136½ W. Grand River Ave., E. Lansing, Mich.
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8 ZW J. S. Strobel & Earl Weimer, 42 Poplar Ave., Wheeling, W. Va.
8 ZX Harry S. Weber, 1113 Walnut St.....Dover, Ohio
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9 ADR George R. Scrivner, 324 N. Elmwood St., Kansas City, Mo.
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9 AJA Omie E. Sheckler, 916 15th Place, N. E., Mason City, Iowa
9 ANP Maurice H. Nelson, 1914 Kishwaukee St., Rockford, Ill.
9 ARO Martin Mayes, 314 Ash St....Jefferson City, Mo.
9 ATE Leslie G. Van Slyke.....Shickley, Nebr.
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9 AWY John C. Harrower, 1138 N. Waller Ave..Chicago, Ill.
9 AYF Virgil Binder, 628 Walnut St....Ft. Wayne, Ind.
9 BCN Herbert C. and Charles L. Valley, 1100 Irving Pl., Racine, Wis.
9 BDZ Henry Stubenrauch, Jr., 3118 Park Ave., Kansas City, Mo.
9 BMC Ralph B. Spindler, 602 Franklin Ave., Valparaiso, Ind.
9 CBN South High School Radio Club, Cedar Ave. and 24th St. .....Minneapolis, Minn.
9 CBT Roy Towne, 1133 Kentucky St....Lawrence, Kans.
9 CCJ LeRoy E. Freiberg, 3728 St. Louis Ave., Chicago, Ill.
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9 CEM Miles B. Houghton, 916 Madison St....Elkhart, Ind.
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9 DXP Raymond C Machler, 1203 Lee St....Evanston, Ill.
9 EFB Herbert J. Elle, 1615 Meade Ave.....Chicago, Ill.
9 XW Westinghouse Elec. & Manufacturing Co., Hastings, Nebr.

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9 GF Arthur Elkins, 10215 Vernon Ave., Chicago, Ill.
9 ACH Ralph R. Leach and Charles C. Proudfit, 2733 E. Grand Ave.....Des Moines, Iowa
9 AEY Earl H. Beardmore, 903 N. Hersey St..Beloit, Kans.
9 AKI Charles A. & Earl L. Frase, Box 74, Ravenna, Nebr.
9 AWL Ray C. Schryver, House No. 30.....Primero, Colo.
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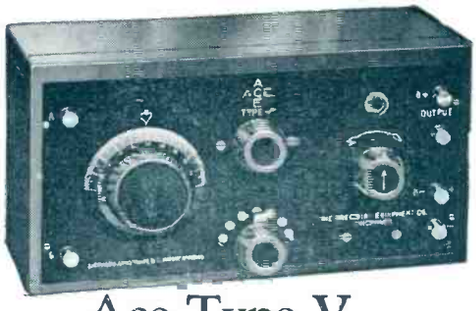

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