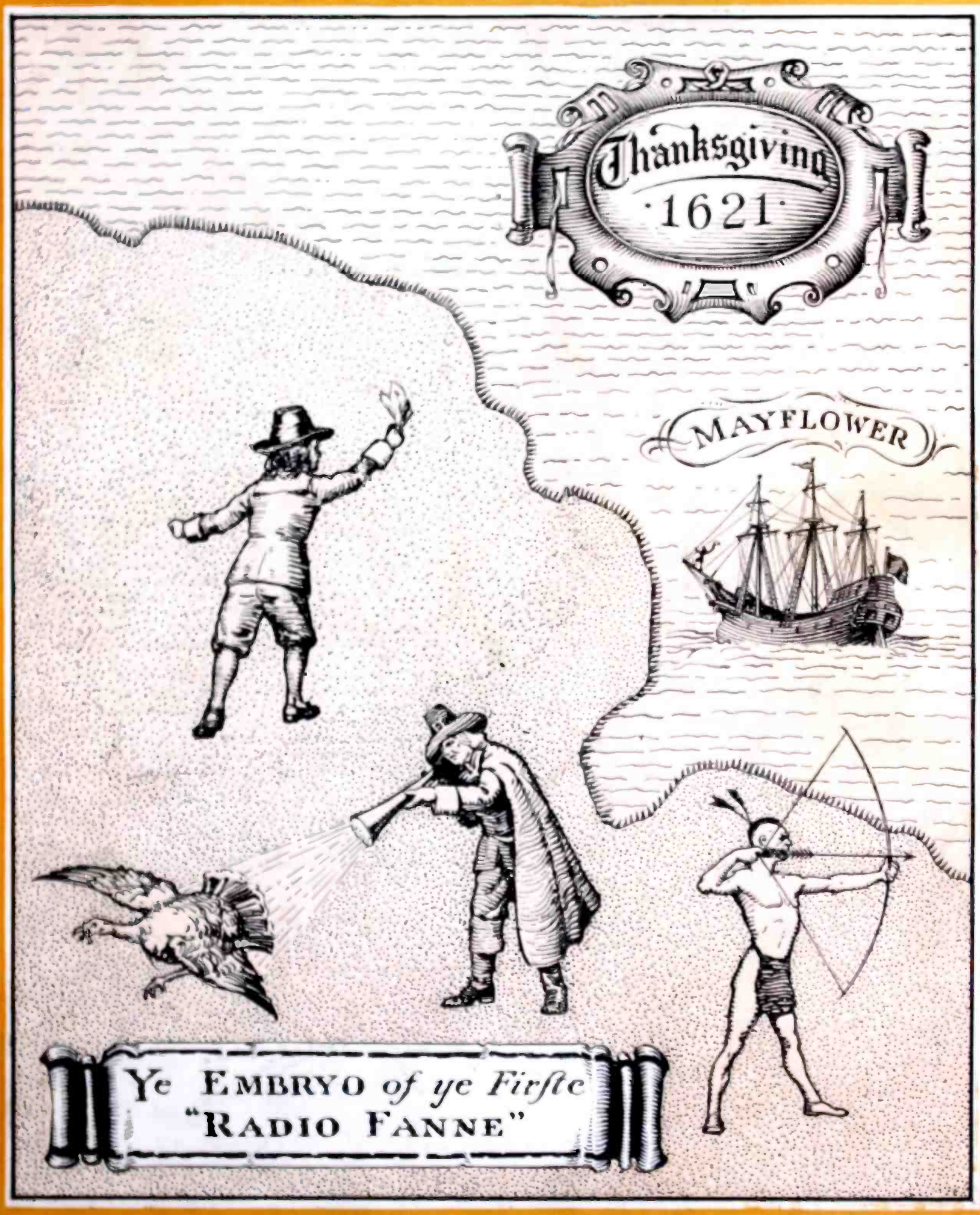
"America's Foremost Radiophone Review"

November
25 Cents

The WIRELESS AGE



Ye EMBRYO *of ye Firſte*
"RADIO FANNE"

It Bridges the Vastness of Space

SINCE Marconi first successfully spanned the Atlantic Ocean, with the wireless telegraph, radio has ever been outstanding as an invention of unlimited importance to humanity.

In 1909 the broadcasting of that now famous distress call, CQD, from the sinking passenger liner, S. S. Republic, established in the eyes of the entire world the tremendous importance of radio on the high seas.

In 1912, when that gigantic liner, the S. S. Titanic, struck an iceberg far from shore, in the north Atlantic, with thousands of passengers aboard, it was the SOS call of her wireless that brought rescue ships from all parts of the ocean. Here again radio demonstrated to the world its great service in the saving of human life.

During the war communication controlled the destinies of armies. Here radio played an exclusive part in the establishing of communication between ships at sea, from ship to shore, and from aeroplane to ground, where the use of wires was impossible.

In recent years the development of the vacuum tube has not only improved radio for the purpose of marine, commercial and military communications, but through radio telephony and public broadcasting, has established a new and even greater service to humanity.

Cunningham Vacuum Tubes are the product of years of research and experimental work by the Engineers of that great scientific organization, the Research Laboratory of the General Electric Company.

Cunningham Tubes are standard for all makes of receiving sets. Each of the numerous types have been designed to operate with maximum efficiency in one or more of the various applications of vacuum tubes to the radio art.

A Specially Designed Tube For Every Radio Use

Cunningham Radio Tubes

C-301A—6 Volts ¼ amp. Amplifier	$6.50
C-299—3 Volts .06 amp. Dry Battery Det. & Amp	6.50
C-300—6 Volts Gas Content Detector	5.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base	6.50
C-12—Similar to C-11 with standard base..	6.50

Patent Notice: *Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.*

C. J. Cunningham Inc.

Home Office:
182 Second Street
San Francisco, Calif.

154 West Lake Street
Chicago, Illinois

30 Church Street
New York City, N. Y.

Radiotron UV-199

A Small Tube That's a Big Performer

Radiotron
UV-199
For detection or amplification
$6.50

The new UV-199 is proving a mighty popular member of the Radiotron family, particularly for portable sets.

Only three-and-a-half inches high. And drawing so small an amperage that it will work on flashlight batteries. It has been called the "tube with nine lives." Battery economy, long life and sensitivity are the big points of Radiotron UV-199. And if by accident it should be operated at too high a temperature, instead of burning out like the other tubes, it becomes inoperative and can be brought back to normal operation all over again by disconnecting the "B" battery and lighting the filament for twenty minutes.

For quiet operation—great ruggedness—uniform operation Radiotron UV-199 is unsurpassed. Each new Radiotron has marked a big step in radio advancement. The RCA mark is the foundation of radio growth—and your protection when you buy. Ask for Radiotrons—and look for the mark.

This symbol of quality is your protection

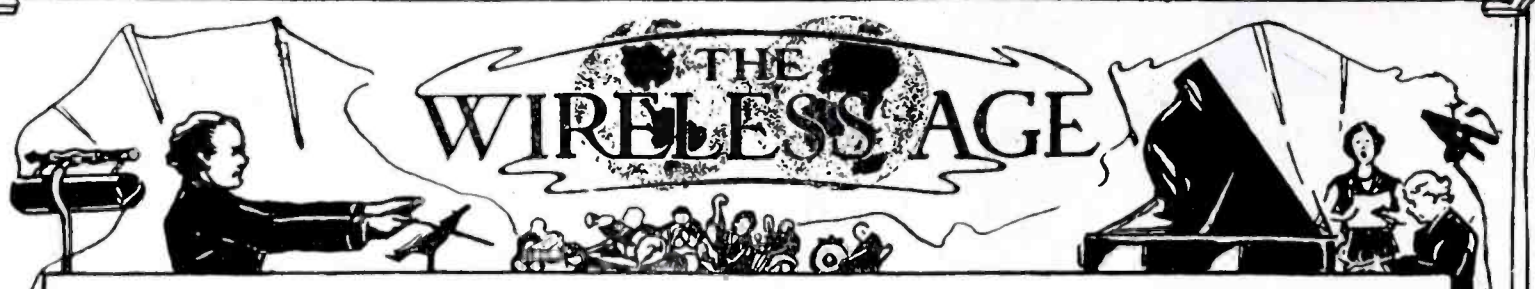
Radio Corporation of America

Sales Dept., Suite 2061: 233 Broadway, New York

District Sales Offices:

10 South LaSalle Street, Chicago, Ill. 433 California Street, San Francisco, Cal.

Radiotrons



Volume 11

MAJOR JEROME W. HOWE, *Editor*
C. S. ANDERSON, *Associate Editor*

Number 2

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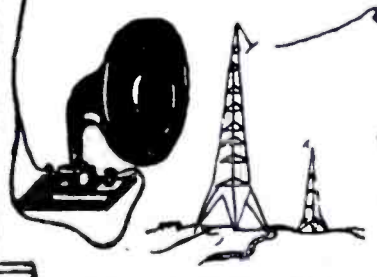
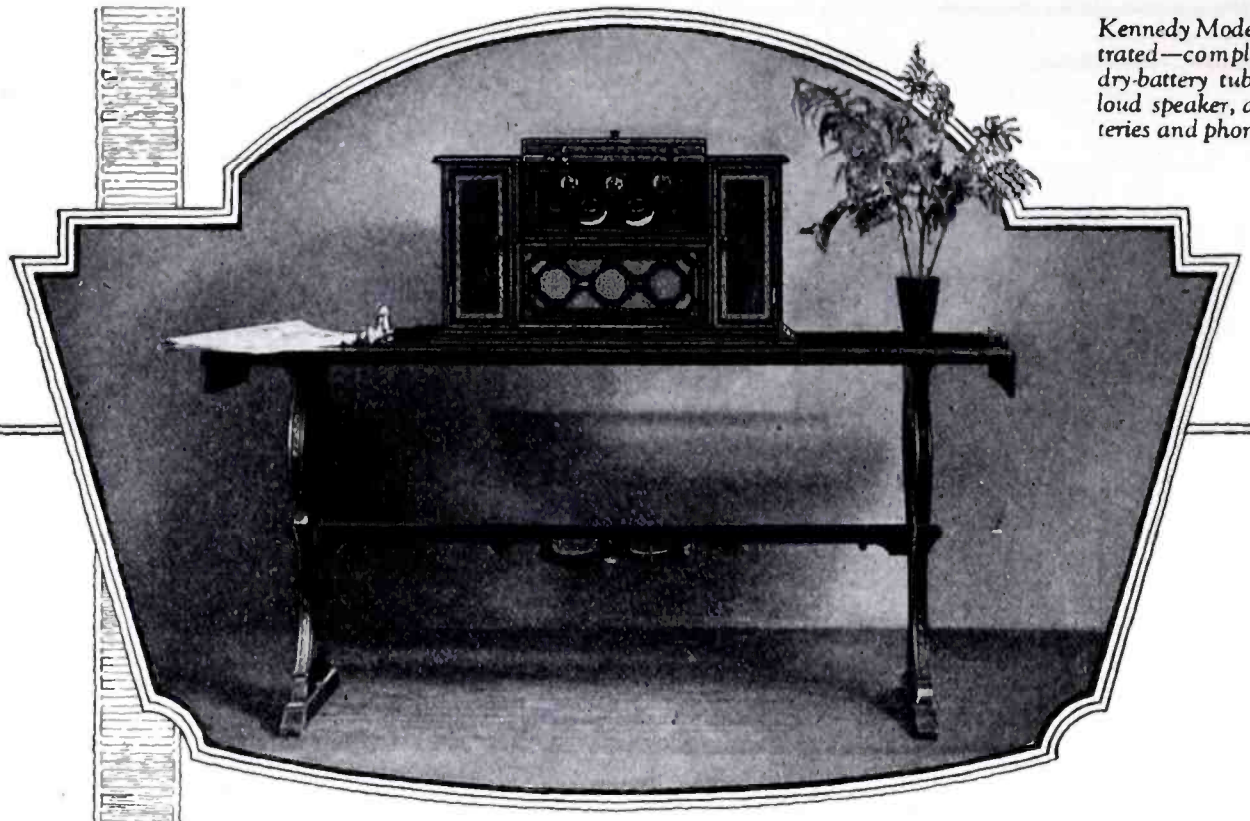
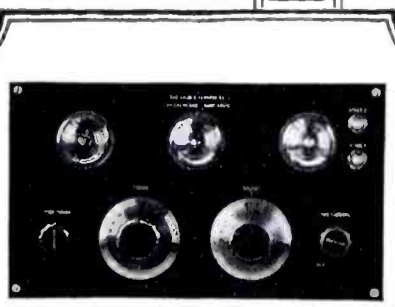




Kennedy Model X—illustrated—complete with 3 dry-battery tubes, built-in loud speaker, all dry batteries and phones, $285.00

Radio Refined and Simplified



The New Radio Unit

Simplicity is apparent—anyone can use it with complete success. No switches—only two dials. Responds to all broadcasting wave-lengths on any type or size antenna. Highly polished Formica control panel. Gold-plated metal trimmings on front, including dials.

All Kennedy Radio Receiving Sets are regenerative—Licensed under Armstrong U. S. Patent No. 1,113,149.

THERE is an air of elegance and *refinement* in the new Kennedy Furniture Model radio sets that truly makes them "The Royalty of Radio." They are designed to harmonize perfectly with artistic furniture and home surroundings. In designing the radio units incorporated in each of these sets the Kennedy Engineering Staff has scored a notable achievement in obtaining high selectivity (avoidance of interference) and long distance reception with the utmost simplicity of operation. Only one dial is required for tuning, and a second dial to control the sound volume.

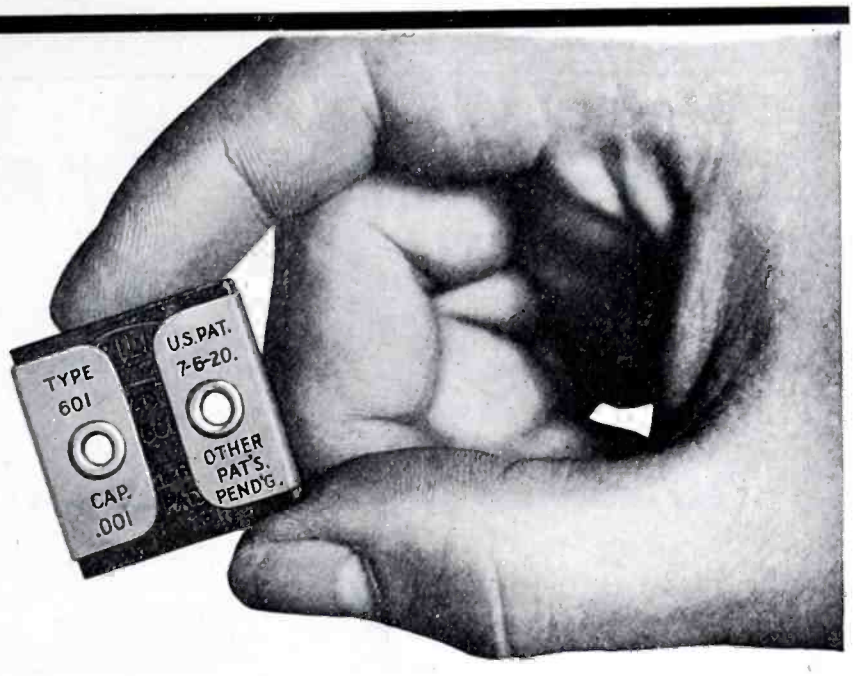
Each of these new models is complete and self-contained, with internal space for all dry batteries. A built-in loud speaker assures ample volume with remarkable clarity and fidelity of reproduction.

See a Kennedy dealer for demonstration or write us direct for descriptive literature on the new Furniture Model sets.

THE COLIN B. KENNEDY COMPANY
SAINT LOUIS SAN FRANCISCO

KENNEDY

The Royalty of Radio



The BIGGEST LITTLE THING *in radio*

Here is the Dubilier Micadon, Type 601, full size.

It is the standard fixed condenser of radio—adopted by nearly all the leading manufacturers of sets and accessories and by discriminating amateurs *because it is permanent in capacity*.

Made in many styles and capacities for any circuit.

Price 35 cents up.

Your dealer will tell you more.

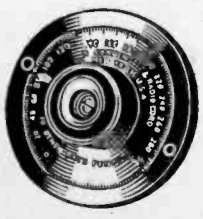
DUBILIER
DURATRAN

(Radio Frequency Transformer)

Micadons are specified by the principal manufacturers, among whom are:

Adams-Morgan Co.
F. A. D. Andrea, Inc.
Bisselo Engineering Co.
Bristol Co.
Central Radio Laboratory
Clapp Eastham Co.
Crosley Mfg. Co.
Cutting and Washington Radio Corp.
De Forest Radio Tel. & Tel. Co.
Durham & Co.
Eagle Radio Co.
Freed-Eisemann Radio Corp.
Garod Corporation
Independent Wireless Tel. Co.
Michigan Radio Corp.
Midwest Radio Co.
R. Mitchell & Co.
Murad Laboratory, Inc.
National Airphone Co.
O. & T. Electric Corp.
Operadio Corp.
Pfanstiehl Radio Serv. Co.
Q. R. S. Music Roll Co.
Radio Distributing Co.
Sec-Tron Radio Co.
Signal Elec. Co.
Sleeper Radio Corp.
Telephone Maintenance Co.
J. S. Timmons
Ware Radio Corp.
Western Coil & Elec. Co.
Westinghouse Elec. & Mfg. Co.
Whiteland Mfg. Co.
Wireless Improvement Co.
Chicago Radio Laboratories.

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



DUBILIER
VARIADON

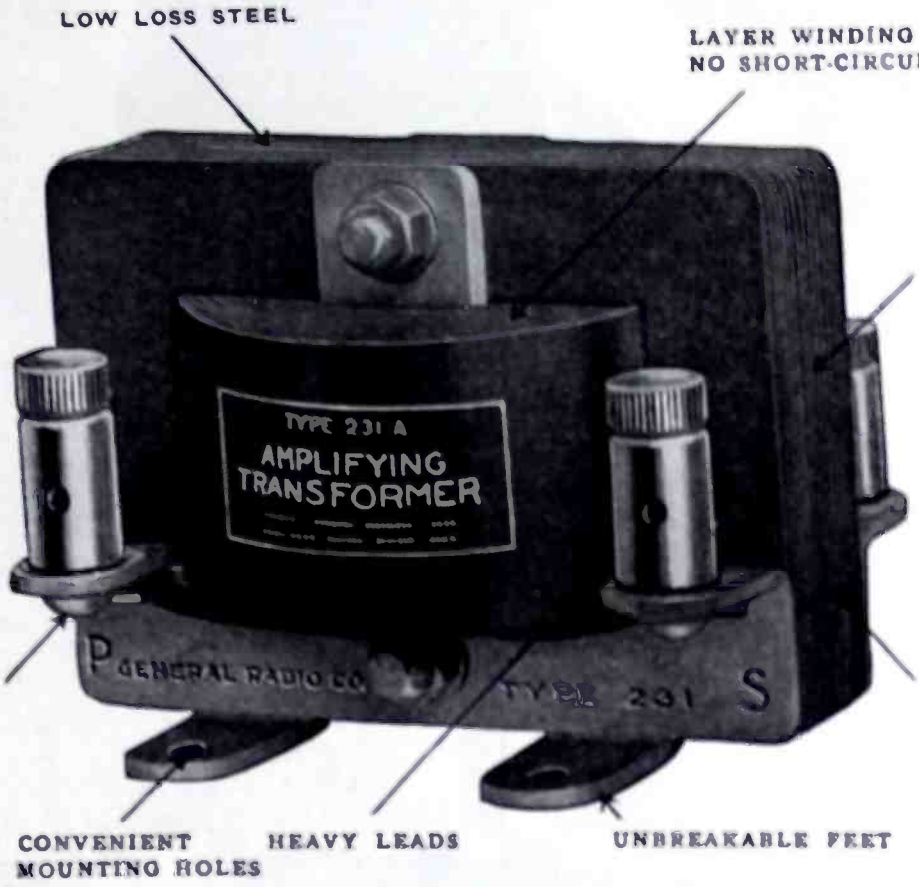
(Mica Variable Condenser)

DUBILIER DEVICES

DUBILIER
DUCON

(The Standard Socket-Plug)

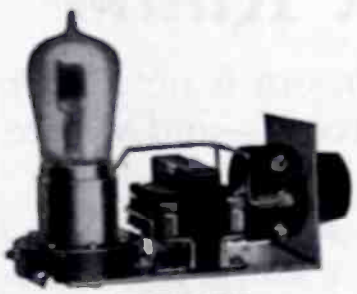
Quality Amplification



High mu or low mu, when you amplify you must be sure that you do not distort because maximum amplification by itself does not necessarily mean satisfaction. You should seek maximum amplification with minimum distortion over the entire audio frequency range.

This problem has been studied for nearly a decade in our laboratory. Its result is expressed in our Type 231A amplifying transformer. Not only has this transformer a high amplification factor but the amplification is nearly uniform throughout the audio range. This flat curve makes it unnecessary to employ the cumbersome method of using different makes of transformers for 2 stage amplification. Use an engineering designed transformer. It costs no more.

Turns ratio 3.7 to 1 **Impedance ratio 10 to 1**



TYPE 300

Do not overlook the fact that a complete audio frequency amplifying unit using the Type 231A Amplifying Transformer and our standard parts may be had for but very little more than the price of the parts alone. This unit is completely wired ready for external connections. Adapted to table or back of panel mounting.

Type 300A Unit for WD-11 Tubes	$7.50
Type 300C Unit for UV-199 Tubes	7.75
Type 300D Unit for Standard Base Tubes	8.25

Send for Bulletin 916W.

GENERAL RADIO COMPANY

Manufacturers of Electrical and Laboratory Apparatus

Massachusetts Avenue and Windsor Street

Cambridge Massachusetts

Talk about "Arabian Nights" Gene!

We're going all over the country tonight on a brand new "magic carpet."

I know you have a set with CURKOIDS as a foundation, but I'm still a step—or rather two steps—ahead of you.

What's new? Now, *wait a minute* till I demonstrate and then I'll tell you.

There, we've left New York behind—now we're three hundred miles away in Pittsburgh. That's a fine band, isn't it? Yes, they're at KDKA.

Oh, here's a pipe organ in Cleveland—now back to Buffalo—then a little jump to Chicago—listen to that jazz band in the Crystal Palace.

All right—we'll wait till they sign—There you are!

You're going through just what I did last night. Sounded like local stations and I nearly fell off the chair when Kansas City came on the air. Their announcement sounded like it came from just across the river.

CURKOID Tuned Radio Frequency is the answer. You know, Gene, if you take a weak signal and build it up at radio frequencies before it hits the detector tube, you can hear a lot of stations which are otherwise too weak to actuate the detector tube.

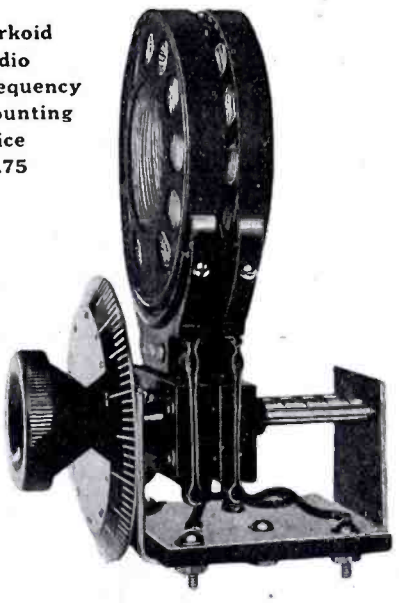
After these signals are built up at radio frequencies and shot into the detector, your audio amplifiers have something to work on and you get distance and volume. That's why you can make a station a thousand miles away sound like a local one.

Another thing, when you amplify signals at radio frequency, you amplify the signals only. You don't build up extraneous noises along with the signals. That means quality.

CURKOID Tuned Radio Frequency adds a lot to the selectivity of your set. A hair either way can shut out one station and bring in another on approximately the same wave length. That's real tuning efficiency.

It's just as if you had a lane of curtains that you swing around. All the stations except the one you want to visit are shut off, and the program you want to hear comes in clear, sweet and uninterrupted by the other stations.

By all means, add two steps of CURKOID Tuned Radio Frequency to your set and break all the records you have ever made in reception.



Curkoid Radio Frequency Mounting Price $2.75

There Is No Better Foundation

for an efficient radio set than the CURKOID three coil inductance mounting. Being wound in the form of the curtate epitrochoid, CURKOID coils give a highly concentrated magnetic field combined with minimum capacity and resistance. Minute variation of coupling is attainable by the worm-driven moveable coil carriers.

The CURKOID radio frequency unit is the solution of the radio frequency tuning problem. It is the only radio frequency transformer which permits adjustment of coupling between the primary and secondary and employs interchangeable inductances so that the correct ratio for your particular tubes and your particular antenna and receiving set can be selected. The coupling adjustment moves the coil but 1/400 of an inch per scale division on the dial.

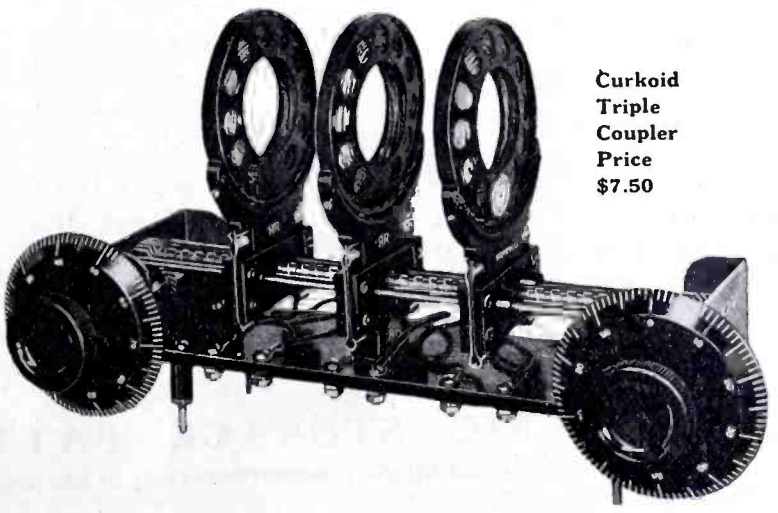
Our New CURKOID Booklet

Send ten cents for the booklet which tells you how to make simple, single, two and three circuit receiving sets, regenerative and non-regenerative, Reinartz, Cockaday, superregenerative and reflex circuits, including full construction data.

CURKOIDS THE SUPREME INDUCTANCE RIEGER RESEARCH CORP NEW YORK CITY **PRICES**

Radio frequency mountings	$2.75
Triple coupler	7.50
Dual coupler	4.50
20 K inductance	1.40
25 K "	1.50
35 K "	1.50
50 K "	1.60
75 K "	1.65
100 K "	1.70

(Made up to size 1,500 K)



Curkoid Triple Coupler Price $7.50

RIEGER RESEARCH CORPORATION

116 West 44th Street, New York

How often do you get a new B battery?

THE current from a B battery is relatively small. But it must be always on the job. B batteries that run down quickly are the bane of the radio fan's existence. Your B battery can help you get the most pleasure from radio, or it can be your greatest nuisance. It all depends on the kind of battery you buy.

The wise radio amateur knows it pays to get a good B battery in the first place. And that means an Exide. The new Exide B Battery is built with extra-heavy plates. That is one reason why it lasts so much longer than the ordinary battery. It can be recharged again and again, saving you the annoyance of frequent replacements.

Exide A Battery for six-volt tubes
Supplies uniform filament current. Is dependable and long-lasting. Comes in four sizes, of 25, 50, 100 and 150 ampere hour capacities.

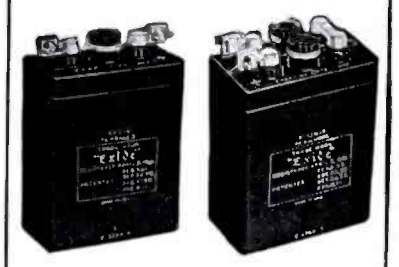
Exide B Batteries give steady, noiseless current. They are strangers to the hissing, frying noises caused by internal discharge. The 12 cells are encased in rubber, with special vents to allow gas to escape when the battery is being recharged. They are designed throughout to prevent electrical leakage.

Two low-voltage A batteries

If your set operates on low-voltage tubes, it will be worth your while to examine the new Exide two-and four-volt A batteries. They are right in line with the latest developments in radio receiving. The one-cell Exide A Battery will heat the filament of a 1.1 volt .25 ampere tube for 96 hours; the two-cell Exide A Battery will heat the filament of a 3 volt 60 milliampere tube for approximately 200 hours. They are specially adapted to WD-11 and UV-199 vacuum tubes.

The Exide A Battery for six-volt tubes gives full-powered, care-free service. It requires only occasional recharging. Like all Exide Radio Batteries, it is built of the finest materials available, is sturdy and long-lasting.

When you hook up your set with Exide A and B Batteries, you are sure of getting maximum signal strength. You can reproduce broadcast selections in clear bell-like tones.



Two- and four-volt A batteries
Consist of one and two cells, respectively, with rated capacities of 24 and 12 ampere hours. The two-volt battery weighs 5 lbs., the four-volt battery 6 lbs.

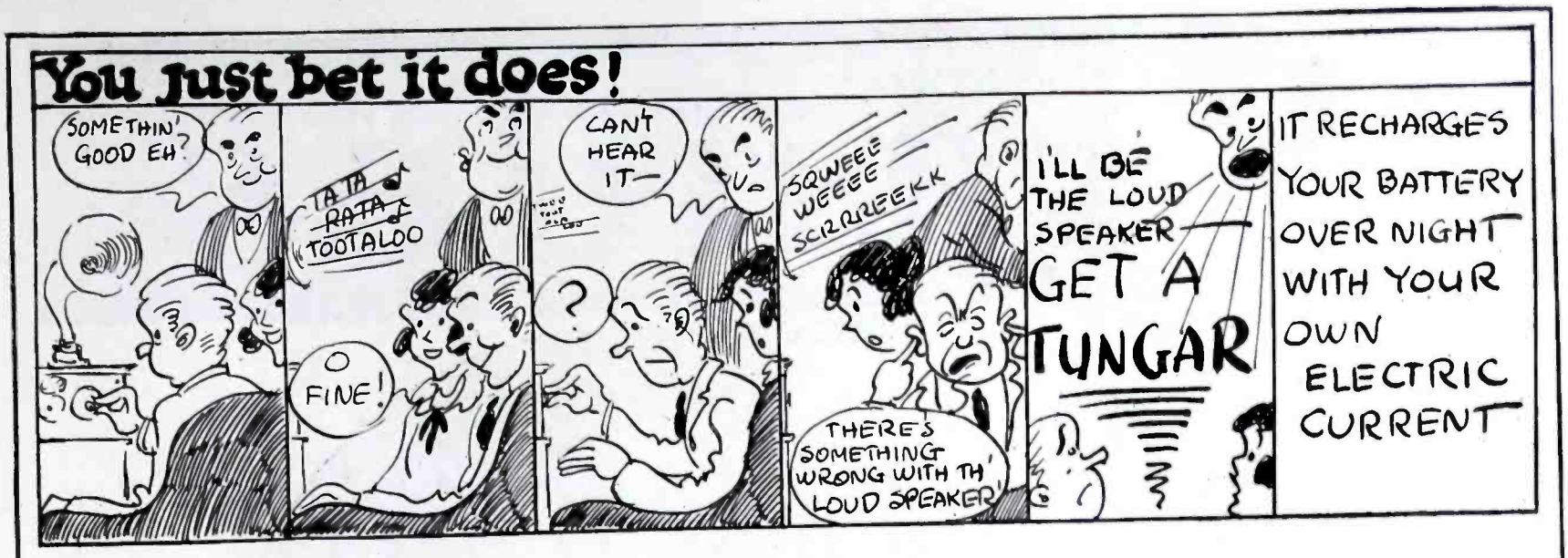
Wherever reliable storage batteries are required, you will find the Exide doing its work ungrudgingly. It is recognized as the leading storage battery in every field of industry. A majority of all government and commercial wireless plants are equipped with Exide Batteries.

Don't let inefficient batteries spoil your pleasure in radio. Go to any radio dealer or Exide Service Station and ask for Exide Radio Batteries.

If your dealer can't supply you with free booklets describing the complete Exide line, write direct 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**



Full radio tones will not come from "empty" radio batteries

Even the finest radio instrument will not give results unless the battery is doing its full duty.

For complete and satisfying reception from near and far, no other combination equals the reliable storage battery and the Tungar for keeping it tuned up.

With Tungar in the house you are prepared for perfect reception always, without having to move the battery an inch. You renew again and again with Tungar and your regular electric light current.

Tungar attaches wherever there is a lamp socket or a convenience outlet. Just turn it on and leave it, any time, day or night. Its cost of operation is low. There are no moving parts to get out of order.

For years motor car owners have used Tungar for charging their automobile batteries.

See it at any good electrical shop, or write for literature. Address Section W. A. 11.

Merchandise Department

General Electric Company

Bridgeport, Connecticut

Tungar Battery Charger. Operates on Alternating Current.

(Prices east of the Rockies)

2 Ampere Outfits Complete—$18.00

5 Ampere Complete—$28.00

Special attachment for charging 12 or 24 cell "B" Storage Battery—$3.00

Special attachment for charging 2 or 4 volt "A" Storage Battery—$1.25

Both attachments fit either Tungar

Charge 'em at Home, with

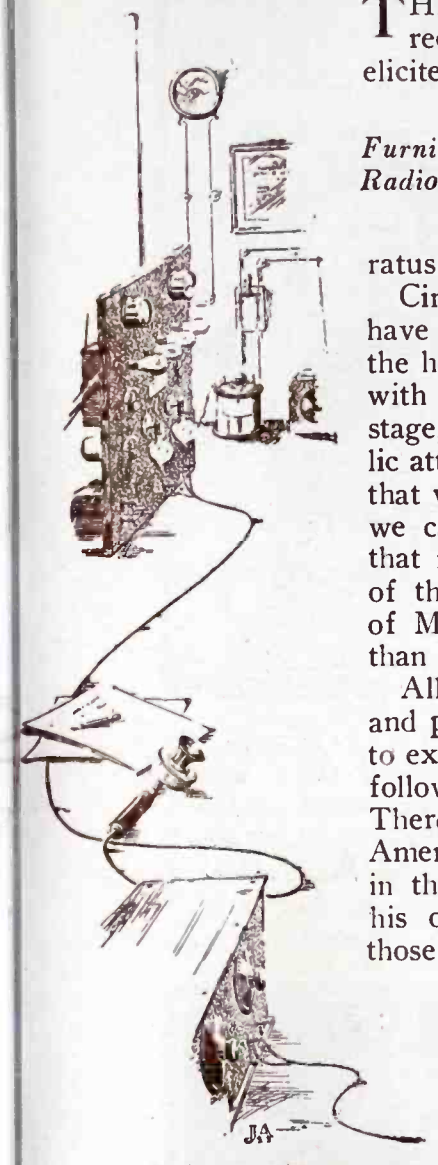
Tungar

BATTERY CHARGER

35A-104

A GENERAL ELECTRIC PRODUCT

In Our Opinion



Furniture Radio

THE great progress in developing radio receivers as articles of furniture has elicited favorable comment from everybody who has seen these new models. Surely this can be counted the year's greatest single accomplishment in receiving apparatus for the home.

Circuits we have had, and many. We have seen them dash from the wings to the heralding trumpet of publicity, vying with one another for the center of the stage, and enjoying the limelight of public attention. But, as the impartial critics that we propose to be in this little sketch, we cannot resist the desire to say also that it has been observed that very few of these circuits held the rapt attention of Mr. and Mrs. Radio Public for more than three or four months.

All this is well, for radio is yet young, and promises to hold its romantic appeal to experimenters and the enthusiasts who follow their doings, for years to come. There is no tendency more typically American than the disposition of the man in the street to examine and verify, for his own satisfaction, the statements of those whose business it is to find things out for him. Ask almost any John Citizen why he drives the make car he does, and the chances are he will give you instantly a list of technical features of that particular motor which caused him to make the choice. The average American thrives on "reason why" copy in advertisements directed to him, because he is a human interrogation mark, hungry for facts and as much technical information as he can assimilate.

Granted that the impulse to make radio sets and experiment with various circuits is a symptom of a wholesome desire to learn, we submit that, when we seek to find the most important development work of the year, we must return to furniture radio.

It was not until the phonographs in cabinet models made their appearance on the market that this great invention was accorded a place in any great number of homes. It remained for Radio to meet the appearance requirements of the fair sex before it could gain entrance to thousands of family circles. All credit to the manufacturers, who have so successfully adapted incongruous radio sets to articles of furniture that lend decorative value to living rooms in the finest homes, while they reproduce the many delightful features of entertainment.

Now that the demand for embellished receiving sets has been so well satisfied by the makers, attention may again be directed to the improvement and simplification of the apparatus.

What the next year will bring forth is an interesting subject for speculation.

The Increase in Sport Interest

THERE'S no denying the fact that Radio has been the cause of a greatly extended interest in sporting events. Many's the man who, for some reason or other, never became really interested in sports, is now caught up and held alert by the vivid description and the contagious enthusiasm of the crowd, as the returns come over his radio set.

But it hasn't stopped at this by any means. We have observed staid old ladies, who never read a line of baseball news, hanging breathlessly onto the words of an announcer at the World's Series Games, and showing a ready ability at picking up enough points about the game to enable them to follow almost every word of description as it came from the loud speaker or headphone. More than once we have come upon whole family groups in tense, silent attentiveness listening to a colorful description of some boxing contest.

Almost everybody who reads this can multiply these experiences by a host more, from his or her observations.

Consider the extent of this awakened interest in sport throughout the country, and there will remain little room to doubt that radio broadcasting is doing more to further a public interest in sport than perhaps all other agencies put together. With the gospel of clean, healthy sport thus carried to every city, town and village, into every home that is equipped with a radio receiving set there must result a quickened appreciation for the rewards in health of all sports, and a keener desire on the part of everyone to engage more in these intensely interesting diversions that put color into cheeks and set the pulse pounding with the sheer joy and excitement of the games.

♣ ♣ ♣

Radio and Thanksgiving

PERHAPS it has occurred to our readers that the first radio fan very probably came over in the Mayflower, in embryo: that the sturdy forebears who made the perilous voyage to this continent brought to the country the vigorous spirit of pioneering that serves us so well today in radio development. This was the flight of fancy that gave rise to the cover illustration for this issue: Pilgrim pioneers, the forerunners of radio!

Of course it was a long-drawn-out process, and the first definite radio tendencies were not evidenced as such until 1898, when some American experimenters were hard at it with Rumkorff coils that seldom "korffed" and coherers that just would not cohere.

How striking the contrast today, with nearly three million radio fans in the United States listening attentively to all manner of talks and entertainment, when they are not feeling the Pilgrim impulse to further pioneering by the process of tinkering and experiment.

Well might we give thanks this month for such ancestors as these, whose spirit, passing down the generations, has supplied the healthy urge to that enterprise and pioneering endeavor which places America to the fore today in Radio, and many other fields.

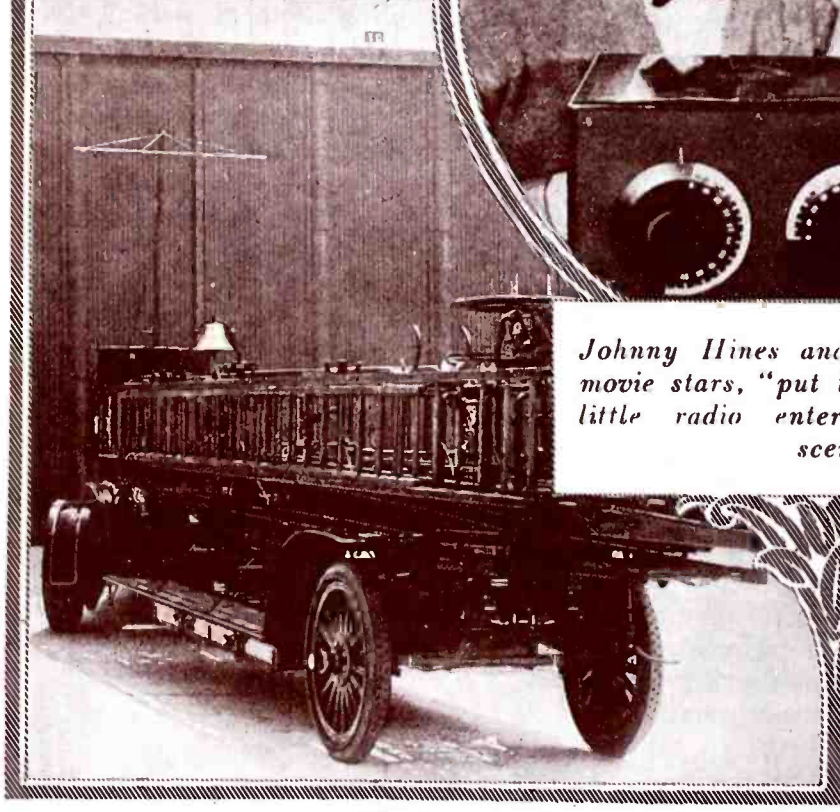
—The Editor.

A Little o' This and That

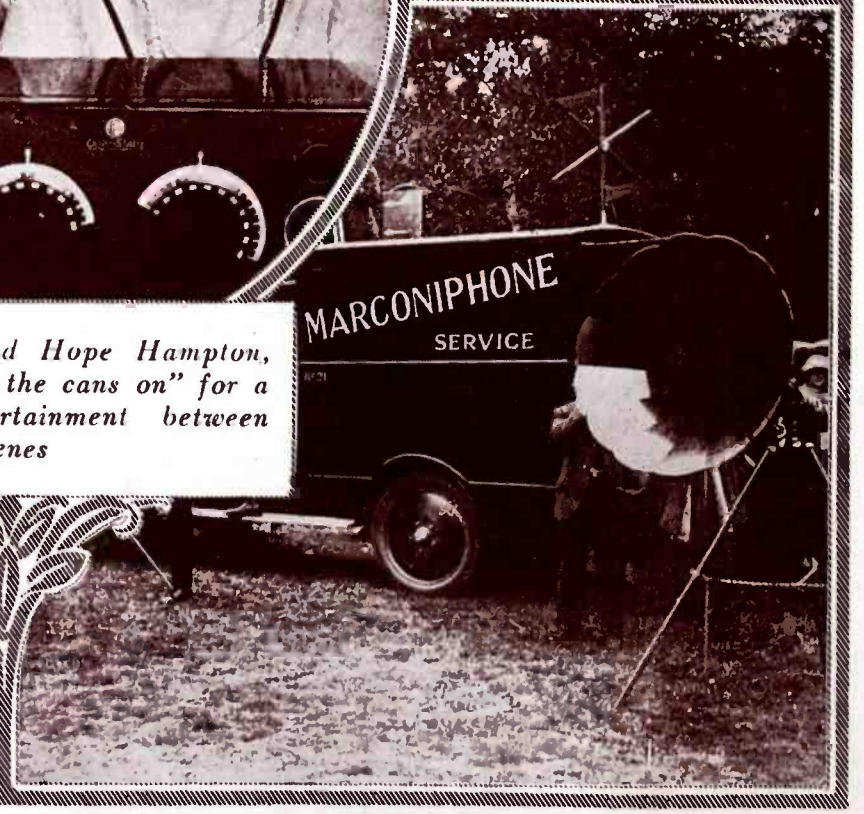
A real treat is in store for the children on Christmas eve. It is planned now to have Santa Claus speak to the kiddies via the radio phone from the various broadcasting stations

"It's never too late to learn," said Mrs. Alta Stirt, who celebrated the event of her 110th birthday by becoming a radio fan. Photo shows her listening to her first radio concert

Johnny Hines and Hope Hampton, movie stars, "put the cans on" for a little radio entertainment between scenes



The fire ladder motor truck of U. S. Air Service at Crissey Field, San Francisco, California, is now equipped with a complete radio apparatus. Will we have this some day in all our large cities?



This is the way they "put over" a radio picnic in England. The loud speaker, of unusually large proportions, was ample for a gathering of several hundred people, at Burnham Beeches

Movie of a Man Who "Rolled His Own"

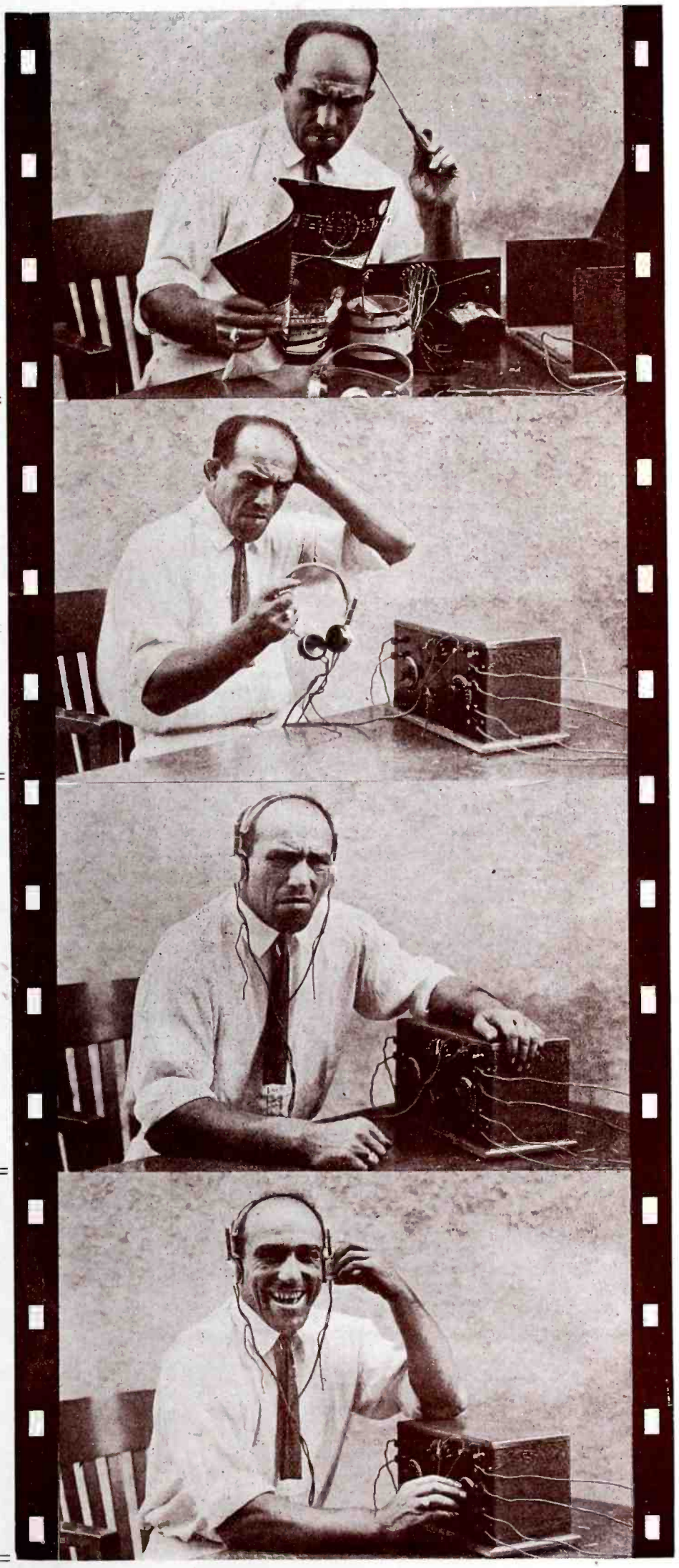
Bull Montana Joins the Ranks of the Fans

LET'S see now. It says "go over all connections, and be sure that the B battery wires don't get too familiar with the filament." Kinda deep stuff to me

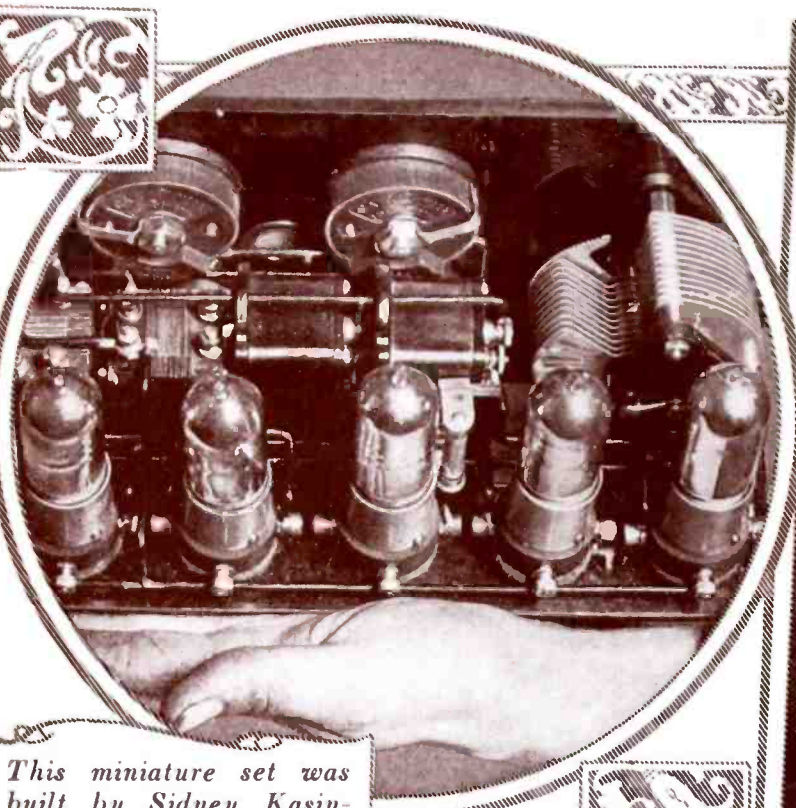
GOOD night! Listen to it, will you! Sounds like a couple of hyenas being boiled in oil.

WELL at last I've got it so I can stand the phones on my ears. Can't seem to lose that funny sizzle though. Too much tickling, maybe

OH Boy! Here's a bird singing that one—"You gotta see mama every night um-te-dum"—Gee, I can hear it just as ***plain!***

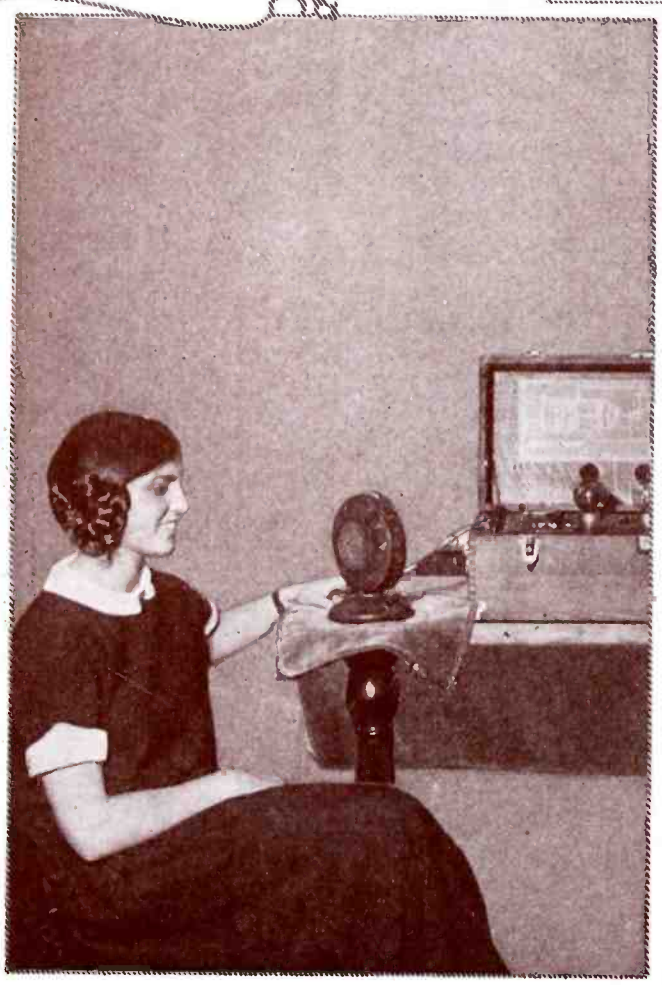


The New York Radio Show



This miniature set was built by Sidney Kasindorf. It consists of two stages of radio frequency, detector and two audio

General J. G. Harbord, former deputy chief of staff, U. S. Army, now head of RCA, examines a captured German trench set



Loud speakers throughout the floor connected to microphone in picture helped to locate lost children at the radio show. The crowds were so great that many children were separated from their parents

Even the Japanese radio station was there, in a realistic model of the district in which this powerful station is located. This station was the only link with the outside world, for several days

More About the Show and Its Unique Exhibits

Here is the grandfather of the WD12 dry cell tubes, held by Miss Marjorie Allison. It made a very pretty sight, when lighted

This model of the Eiffel Tower was among the many novel amateur sets on exhibit

"I want to hear more of that last artist," said Miss Agnes Leonard. So she borrowed this receiver of heroic proportions

NOTE—See page 22 for story of New York Radio Show

New York's Big Radio Show

In Which We Express Our High-Spot Impressions of What We Saw at the Latest Gathering of Radio Bugs

As told by Austin C. Lescarboura

Mrs. D. Sarnoff tuning in

WELL, folks, I've just returned from the big radio show held at the Grand Central Palace in New York, during the week of October 6th to 13th. And believe me, it was a real good show. Just now my head is buzzing with all kinds of new radio ideas and lots of radio enthusiasm. It may take weeks for the effects of this latest attack of radio fever to wear off. Nevertheless, while I am still in this delirium I am going to rave about the many interesting things I saw for your entertainment as well as benefit, I hope.

To be perfectly frank with you, I had been sort of fed up on radio shows. You know as well as I do that we have had too many of them. It seemed for a while that we had struck a veritable epidemic of radio shows until the public got tired of them and the radio manufacturers found the pace too strenuous and dropped out one by one. Finally, a group of safe and sane business men organized the American Radio Exposition Company for the purpose of giving us one real good radio show each year in New York City and San Francisco. They studied all the other radio shows, made careful note of their shortcomings as well as good points, called in the leading radio authorities and got their ideas and suggestions, and then set to work organizing a real good radio show.

The recent radio show represented the polished product of the American Radio Exposition Company. As I looked about the various corners of this show there came back to me a scene in the Bankers' Club room up on the roof of the Equitable Building in New York City, with a long banquet table surrounded by some twenty members of the radio four-hundred or whatever you wish to call the potentates in this game. Somehow or other I was invited to the affair. We all sat about, ate a bit, then talked, ate some more, then talked, ate some more, and still talked. We raked all former radio shows over the coals, said some pretty mean things about their management, gave our views of an ideal radio show, waxed eloquent over a Radio Week, set the date for the proposed radio show, and then passed the buck over to the American Radio Exposition Company in as graceful a manner as you could imagine. The result of all this was the radio show held during the Christmas season last year. Perhaps it was the unfortunate time selected; perhaps it was lack of appreciation on the part of the public; perhaps it was the fed-up condition of the public; perhaps—oh well, getting down to brass tacks, the thing fell more or less flat.

This Year's Show—A Different Story

But with the present radio show we are dealing, all I can say is that it turned out a big success. All our ideas have been vindicated, and the promoters deserve unstinted praise for having stuck to their job. They have scored a big success at last. It now begins to look as though we shall have at least one real good radio show a year, to which we can all look forward. I have been strongly reminded of that memorable first radio show which we had on the roof of the Pennsylvania Hotel back in 1921, when the fire authorities and hotel management had to step in and turn back as many folks again as got into the place. I distinctly recall one stage of that great event when the crowd was so jammed full in the spacious roof garden that it no longer could circulate comfortably.

The recent show was staged on the fourth floor of the Grand Central Palace instead of the main or ground floor. There were large crowds during each day and evening, with Saturday's gathering topping them all for attendance. I understand that over 80,000 persons visited this show, yet at no time was the crowd so dense that free circulation was impeded. All of which speaks volumes of praise for the management.

The crowd, too, comes in for a word of praise. It was an interested crowd, rather than a bunch of curiosity seekers and mere catalogue grabbers. And how they could ask questions!

Still another word of praise, this time for the exhibitors. Many of them displayed real daring and originality, and it was quite obvious that real money was spent to make their booths attractive and distinct from the cut-and-dried formula of other shows.

To mention the more impressive exhibits in the order in which they made an impression on my mind, I must start off with the Radio Corporation of America, which followed its customary practice of striking the dominant note for the entire show, through its liberal display, size of space, educational features, and large corps of attendants ready to answer all questions and hand out attractive literature. It was made quite evident to all that RCA casts an all-covering mantle over the entire field of radio communication.

The pyramid of vacuum tubes, illustrating the development of the magic bottle of Fleming to the present day Radiotron, was an exhibit that everyone at the show had to see

The Army and Navy exhibit displayed many sets used in the World War as well as some foreign apparatus

Visitors were gently but firmly reminded that radio broadcasting is but one of the many activities of the RCA, and that the less fascinating but far more important businesses of trans-oceanic radio and marine radio must be carried on day by day.

The Japanese Earthquake Was There Too

Following the current of the moving crowd, I found myself in front of an interesting miniature Japanese landscape which, upon close examination, showed signs of earthquake devastation. In one corner rose the concrete stack-like tower of the great Iwaki radio station which, through the Radio Corporation stations, maintained communication with the United States during the recent trying days of the stricken Japanese nation, when the cables failed to perform.

Another educational feature of the RCA exhibit was an animated map of the world, showing the various kinds of stations and their locations. Onlookers were shown, by means of variegated lights, the number and distribution of broadcasting stations, the Navy stations, the RCA stations, and the stations abroad operating with the RCA stations. Here again we were struck with the cold fact that there are other uses for radio aside from broadcasting daily programs.

I rather doubt that another educational exhibit got the attention to which it was justly entitled. Here I have in mind a revolving display in the form of a mountain, with a winding path leading up to the summit. Along this winding path were mounted vacuum tubes, beginning with the crude lamps with which Edison discovered the so-called Edison effect, then the early Fleming valves, the De Forest audions, the early three-element tubes, and finally, at the very summit, the present well-known members of the radiotron family. What a review of vacuum tube history! I was held hard and fast for at least a quarter of an hour by this display.

And Now "Furniture Radio"

So far as radio equipment is concerned, there was one undeniable fact which hit me smack between the eyes; the trend toward "furniture radio." Yes, sir; radio receiving sets are making way here and there for these "furniture radios" which are as much at home in the living room of any home as the pianola and the console phonograph. No longer will it be necessary for Friend Husband to keep the radio receiving set in some obscure corner of the home, there to be heard but not seen.

Listening-in on the largest ear-phone at the show

Following the example set by the Radiola Grand and the Radiola IV, other similar radio instruments have appeared. I could not help but admire the beautiful workmanship of such exhibitors as Amrad, Crosley, Moon, and Colin B. Kennedy. "Furniture radio" is exceptionally attractive, being available in period furniture styles to harmonize with any given home surroundings. By the way, be sure to pronounce this name as though it were written "Coal-in." I was severely reprimanded by one of Mr. Kennedy's lieutenants for pronouncing it as though it were written as Collin. What's in a name!

However Mr. Kennedy may like to have his name pronounced, I am glad to see him and the rest of the boys get on the band wagon so far as "furniture radio" is concerned. This trend is a happy one indeed, for it is aimed at The Woman. At last we fellows are beginning to realize that Milady is the main "poobah" of the home and controls the family exchequer, even unto radio. She has some very definite views as to just what she will permit to invade the sacred premises of the living room. We have finally taken a leaf from the automobile manufacturer's notebook, in recognizing the feminine appeal.

Circuits for the Tired Business Man

Circuits, did you say? Oh yes, that's important, too. One had his pick at this show. There were something more than the fifty-seven varieties to select from, ranging all the way from the standard RCA single-circuit tuner to Sleeper's one-thousand-and-one circuits. I gathered from my visits to many "parts" manu-

facturers' booths that a goodly portion of the crowd were out to "roll their own," so to speak. My visits to the booths of "set" manufacturers, on the other hand, conveyed the positive impression that more and more broadcast listeners were buying complete receiving sets, especially that national figure, Mr. Tired Business Man. And why not? After all, the average radio broadcast listener is simply out to get the programs. Whether he receives them on a flivver single-cylinder roustabout or a DeLuxe twelve-cylinder limousine makes little or no difference. The service is the thing, first, last and always. Of course I will admit that Mr. Tired Business Man and other broadcast listeners start with a single-tube outfit and wind up with the finest "furniture radio" set money will buy. Indeed, it is this steady evolution, more than any other single factor, that keeps radio manufacturers busy and removes all fear of a saturation point in radio merchandising.

As for brand new ideas in sets, I came across the CR-13, which is intended at this particular moment for the dyed-in-the-wool radio bug engaged in dot-dash work on the usual amateur wave lengths, but must ultimately come into its own when once the broadcasters get down to low wave lengths so as to reduce still further the possibilities of interference. Al Grebe's sets continue to be characterized by the well-known Grebe workmanship and finish.

Another surprise was the Radiola VII. This latest addition to the Radiola family consists of a neat cabinet-type receiving set which, in general appearance, somewhat resembles the Radiola IV, and which contains radio-frequency and audio-frequency amplification. It is entirely self-contained except for the loud-speaker. I was told that this set performs remarkably well on a small loop, with its UV-199 tubes and dry cells.

There were many other sets laying claim to distinct novelty. On the one hand it was evident that the effort behind the set was towards simplicity, to interest the broadcast listener, while on the other the effort was decidedly towards greater efficiency irrespective of the multiplicity of controls and tubes. My impression was that the loop type of receiver, which figured so prominently in previous radio shows, was losing in favor with radio manufacturers, and in its place we were getting tuned radio frequency receiving sets, working in conjunction with very small antennas.

LOUD SPEAKERS THAT WERE NOT HEARD

Of loud-speakers, I had my fill. To me they represent a most interesting phase of radio broadcasting. Often have I cussed one of those blamed things squawking in front of a radio shop, turning away person after person from ever bothering with radio except, possibly, after a long and tedious educational campaign waged by ingenious publicity and aided by the informal and sincere demonstrations of friends possessing radio sets. Fortunately—or unfortunately, whichever way you feel about it—these loud-speakers could be seen, examined, but not heard. The management of the radio show had laid down the law to the effect that no loud-speakers were to be operated except those installed

This immense loud speaker which is a stock model of the manufacturer attracted considerable attention at the show

for the common cause. My curiosity was aroused as regards the loud-speakers of RCA, Geraco, Bristol, Amplitone, Murdock, and other makes, not forgetting the new Brandes Table Talker which represents a novel departure for that pioneer manufacturer-specialist of famous radio head sets.

Of course the show would not have been complete without radio literature. Tons upon tons of literature were passed out to extended and grasping hands. That was the gratis stuff, you know. And it didn't stop at catalogues. No indeed; for many of the radio magazines and newspapers were liberal with their sample copies—so much so that we may look for some welcomed increases in their November circulation reports. At this point I want to register a little word for the radio periodicals. They are improving steadily. In editorial contents as well as in advertising clientele, they are showing healthy signs of growth and marked stability of character. More power to them!

Periodicals depend on advertising for their financial success. Every schoolboy knows that fact by now. It is no mystery, I am sure. Hence my compliment to the periodicals must be accompanied by one to advertisers. So here goes: radio advertisers, you are doing a good job. You are supporting the radio press in their good work. You are doing a great job for the radio public. And the fact that many of you have been advertising year after year has not only served to establish you, individually, in the minds of the radio public, but it has served in a most unselfish way to lend a touch of true stability and permanence to the radio industry as a whole. It has helped in no uncertain terms to offset the destructive influence of the radio fakers, charlatans and "gyp" artists—the parasites of radio.

"BY THE RADIO CLUB OF AMERICA"

No doubt the most altruistic service performed at this great show was that of the Radio Club of America in furnishing the musical entertainment by means of a battery of loud-speakers distributed throughout the large space. In the Club's booth, giving part of his time to an elaborate loop receiving set and the other part to answering a volley of questions aimed at him from all sides, I found that arch priest of the radio broadcasting cult—Major Edwin H. Armstrong. Inventor of the regenerative circuit and other phases of present-day radio work, Armstrong, an ardent member and worker of the Radio Club of America, installed and operated his latest type of super-receiving set which, by means of a small loop, intercepted the broadcasted programs of stations both near and far and boosted their signals up by means of elaborate power amplifiers so that they might be heard and enjoyed by all. The Major saw to it that his super-regenerative set especially built for the occasion hit on all seven—not cylinders, please understand, but tubes, UV-199's. I, as a member of the Radio Club of America, got in behind the scenes. Under the table on which the set was placed I discovered dozen upon dozen of standard dry cells. There must have been well over a hundred of these cells supplying a steady flow of current to the loud-speakers which filled the large hall with excellent music. The reception and rendition were positively the finest I have ever heard—and I have a pretty critical musical ear at that.

In the same booth with the Major stood George Burghard, President of the Radio Club of America, John Grinan, John Stanley, Ernest Amy, and others. Everything was done to entertain the visitors, and also to get

(*Continued on page 28*)

Reporting Baseball Series to Millions

Radio Stretches Diamond Over U. S. and Fills Phantom Grandstand With 2,000,000 Excited Fans

By Raymond Francis Yates

"HE'S winding up. Here it comes. He hits it! It's going into center field. He's safe on first."

A million loud speakers from Seattle to Philadelphia, from Ottawa to Mobile, echoed this thrilling description of the World's Series and held countless baseball radio fans in breathless suspense. It was one of those radio events that causes the blood to tingle in the veins with its many tense moments and dashing realism. The broadcasting of the recent world series will long stand out as one of the greatest heart-bumping events of American sport. It made the game bigger; it made it mean more to hundreds of thousands of sport lovers. The game was not confined to the Polo Grounds or to the Yankee Stadium, but like a great wave, its attending excitement and enthusiasm poured over the country to again blare forth from the husky throats of a million horns.

The cheering, the yelling, the usual stream of fan advice to the players; the booing and hat-throwing was not all done by the eye spectators for at thousands of street corners, public buildings, parks and theatres, to say nothing of countless homes, the fans held their sway. So rapid was the radio fire that the fans in Washington, Philadelphia, Baltimore, Detroit, Cleveland, Chicago, Kansas City, San Francisco and other big cities yelled in almost perfect synchronism with those at the Polo Grounds or the Yankee Stadium. What mighty cheers must have gone up and what a mighty thing radio is to bring about this perfect unison in a country so large as our own!

Behind the Scenes

Baseball is a national sport, but this is perhaps the first time that a world series has been a really successful national event. Heretofore the newspaper was the first harbinger of victory or defeat. Now a living voice back of the home plate describing every detail of the action in split-second style is able to reach the ear of every sport lover who cares to listen in.

Those who listened-in probably never dreamed of the elaborate preparations that were made necessary to handle an event of this magnitude. It was not merely a matter of leasing a Western Union wire that would connect WJZ with its outposts. That is a simple matter, but not so with the negotiations that have to be conducted with the "powers that be." So important was this matter that the actual approach for permission to broadcast was made during the middle of last summer. Nor were Messrs. Huggins and McGraw, the respective managers of the Yankees and Giants, the only "pebbles on the beach." The final request for permission had to be carried to the high and mighty Judge Landis himself, and since there was "no appeal beyond Caesar," those who did the presenting anxiously awaited the fateful answer. The answer was fateful because there was opposition from the direction of the Baseball Sport Writers' Association, whose members thought that radio would interfere with the sale of the evening papers that carry the work of their faithful scribes. The gray-haired judge overruled their objection and gave to WJZ and WEAF the right to broadcast.

J. Andrew White broadcasting the World's Series through WJZ and the score board used to follow the plays

A few days before the opening game of the series, trial communication was established between WJZ and the Yankee Stadium, using the leased wires of the Western Union Company. Major J. Andrew White, who is probably the greatest word-picture painter of sporting events today, was the first to employ the new portable amplifier built in the laboratories of the Radio Corporation of America especially for sporting events. With the aid of J. O. Smith, White's silent partner, the entire thing was rehearsed with care. White used a special diamond which was always held in front of him and manipulated by Smith, who worked with the speed of a one-armed paper hanger in an effort to check up White and to keep him informed. It is generally believed that Smith follows only radio as a hobby. Ah, but he is a versatile hobbyist. He not only owns and operates one of the best ama-

One of the many telegrams sent to express appreciation of the baseball broadcasting. Note the reference to the direct contact by radio between reporter and linotype operator for news publishing

CLASS OF SERVICE | SYMBOL
Telegram
Day Letter | Blue
Night Message | Nite
Night Letter | N L

WESTERN UNION
TELEGRAM
NEWCOMB CARLTON, PRESIDENT — GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

RECEIVED AT

1923 OCT 13 PM 4 52

B200 60 COLLECT NL 3 EXTRA

WASHINGTON DC 13

R F YATES CX1005

81 NORTHER AVE NEWYORK NY

FANS VERY WELL PLEASED WITH SERIES BROADCASTING ALL RADIO STORES I TOWN HAVING LOUD SPEAKER PARTIES TWO LOCAL NEWSPAPERS FURNISHING LOUD SPEAKERS IN CONNECTION WITH ELECTRIC SCORE BOARD WHICH IS WORKED FROM RADIO EVENING STAR HAS RADIO LINE DIRECT TO LINOTYPE OPERATOR FIRST TIME IN HISTORY WORLDS SERIES REPORTED DIRECTLY FROM PRESS BOX TO LINOTYPE OPERATOR

WILLIAM T PIERSON MANAGER OF BROADCASTING.

Mr. E. F. Grossman on duty at the WEAF station in the Polo Grounds

teur radio stations in the United States, but has a keen eye for beauty in motor boats as well, and what is more interesting, he is an ardent baseball fan with the name of every record player on the end of his tongue. Consequently White and Smith are an admirable team and they work together like Siamese Twins. White announces with his eyes on Smith's hands while the latter shifts little pieces of cardboard labelled with the player's names around the diamond.

How 2,000,000 Fans Are Served

This matter of announcing is serious business. Imagine yourself sitting there amidst the roaring crowd of 75,000 people, responsible for an accurate account of every detail to perhaps 2,000,000 people! You can't guess. You've got to be right. Every emergency must be prepared for, every play recorded with the pitiless consistency of a mathematical process.

It is 1:45 P. M. eastern standard time. The game is on! White clutches his microphone, all tension, while Smith sits on the edge of his chair with his little pasteboards ready to be swung into place as the action of the game calls for them. Countless ears await the first word.

"Witt is up," White calls out. "Scott's winding up. He is about to throw. Here it comes. It's a called strike." There is not a moment of silence. "Witt is waiting for second pitch. Scott's winding up. He is going to throw. Here it comes. He hits it. It's going over second. Witt safe on first." Smith checks up White instantly and moves his little pasteboard marked "Witt" over to first base. It is all done in the twinkling of an eye, but the men in the broadcasting box must be on their toes every instant and they work under a mental strain that is little appreciated by the listener-in. As this article is written White has been responsible for only one error and that was corrected almost immediately, due to Smith's watchful eye. There is every opportunity to make a mistake, however. Imagine, if you will, a hot grounder driven between first and second base. The shortstop and the second baseman are after it and they almost collide. How easy it would be to pick up the wrong man and to say that Ward had it instead of Johnson.

Input apparatus and the special microphone used by Major White in broadcasting the World's Series for WJZ

There were many features of White's broadcasting that brought out the picture of the game so clearly that practically every fan who listened-in was a spectator. In one radio sport party, of which the writer was a member, a listener said, "I can 'see' great with White." This was just the situation. White was simply allowing about 2,000,000 baseball-radio fans to use his eyes—he painted word pictures that other minds could feast upon. So accurate were his descriptions that anyone who had ever attended a game at the Polo Grounds could visualize the plays perfectly. Very little imagination was required for this, especially when White turned his microphone on the roaring, booing or cheering crowd. These little inserts of realism transplanted the atmosphere of the diamond to every nook and corner of the United States. At all other times the external noises were excluded as much as possible and the special microphone used permitted the speaker to exercise considerable control over this feature.

Radio Reporting Now a Science

Those who listened to J. Andrew White could not help but admire his painstaking attention to the details, side lights and human interest stuff that permitted every listener to be one of the excited fans in the grand stand. Every ball pitched was described as being high or low, inside or out. This made it possible to even anticipate the withdrawal of a pitcher, for every good fan could tell when he was weakening. Such was the case with Shawkey in the eighth inning of the fourth game. So it was with Bush, who weakened in the seventh inning of the fifth game. A seasoned fan could see it coming, for Bush had pitched six straight balls before he was signalled off the field. When the ball lit in the grand stand the listeners knew whether it was a male or female who got it; whether they caught it or fumbled it. When the Bambino restlessly kicked up a little dirt while standing on third, the picture came out of the loud speaker. With all these little humanisms and a little imagination you were seated comfortably in one of the first row boxes at the Polo Grounds or Yankee Stadium.

A wonderful bit of announcing was also done by McGeehan of WEAF. While White's voice was only modulating the transmitter of WJZ, McGeehan's was used for four different equipments, WEAF, WGY, WCAP and WJAR. It goes without saying that McGeehan was also responsible to an enormous audience. His clear voice, his close attention to detail and his apparent knowledge of the game kept all of his listeners well informed at every minute.

An "SOS" Call Between Innings

There were many high lights during the series. One of them came between the third and fourth inning of the fourth game, when the voice of the radio reporters suddenly left the air while the studios broke in and told the audience that a short intermission was necessary because of SOS signals that were on the air. The writer instantly retuned his equipment in time to get the tail end of an SOS call, which was answered by some "op" who was going too fast for a rank ham to read. However, the world series was back on the air in a few moments and the game went serenely on.

Those who listened intently could probably hear the incessant clicking of the telegraph instruments in the background. The writer mentions this because it helps to form an amusing reminiscence. What a slow, snail-like thing the telegraph is when compared to the speech-carrying radio wave? Yet what a horribly important thing these clumsy little clickers were two or three years ago when the fans in distant cities had to depend upon them for the results of the games! The telegraph operators at the series had only sufficient chance to start the first word before those listening on the radio had the complete details of the play.

To prove that the radio broadcasting of the world series was really a tremendous event, national in scope, the writer dispatched eleven wires to some of the principal broadcasting stations in the country asking what success was being had in this work and inquiring about the interest and enthusiasm of the fan listeners. In every instance return wires were received telling of the great success of the series and of the good that it was doing radio in general. The writer quotes from a typical telegram from WJAR in Providence.

"Public address system furnished by the American Telephone & Telegraph Company drew a crowd of 3500 to Garnet side of our store. Cheering eminent during the entire announcements keeping the crowd well keyed. Enthusiasm running high. Receiving many personal replies from listeners as to fine way in which series is being put over."

Another answer from WCAP, Washington, brought more interesting news. William J. Pierson, Manager of WCAP said that practically every radio store in town had loud speaker parties and that two of the local newspapers were furnishing the loud speaker to gatherings in connection with electric score board.

The Evening Star did a very practical and original thing when a direct radio line was run from the receiving set to a linotype operator, and we have for the first time in history the direct transmission of the world series from the press box to the linotype operator. This means that a play made in one instant is a few seconds later immortalized in the form of a hot slug, waiting to be gathered up and taken to the press room. Here is an innovation that radio made possible. Just another instance of how we find it wedging itself into our daily existence from practically every angle.

Loud speaker outfit installed in an auto outside the Stadium reported the games to overflow crowds

Input equipment installed at the Yankee Stadium with E. F. Grossman at left and A. W. Protzmann standing, who operated the input apparatus, and at right Graham McNamee, who described four of the games for WEAF, WGY and WJAR

What is radio doing for the sport of baseball? Is it making us too lazy to go to the games or is it injecting new life into it? Fortunately we have facts and figures that show that radio has brought about a healthy revival of interest in the game. It is to be noted that there were plenty of seats left on the Polo Grounds a few years ago, but since the first series was broadcasted both the Polo Grounds and the Stadium, although the latter has the largest seating capacity of any baseball field in the world and the former has been greatly enlarged, have been unable to accommodate the crowds that sought their gates. The writer has many friends who had sort of lost interest in it until they heard one of the series reported by radio which brought back to them the old thrills and the intense desire to see at least one of the games. It goes without saying that there have been a lot of tickets sold on this account, and it looks as though it was up to the radio fans to claim this victory for it.

RADIO IS MAKING US A NATION OF SPORT LOVERS

Other high lights were added to the broadcasting of each game when White produced famous sport writers and sport leaders to say a few words to the fans. Grantland Rice, that polished veteran of the sporting page, gave a most interesting talk on the psychology of players. Fred Lieb, President of the American Baseball Writers Association followed up at the beginning of the second game with some baseball facts that had never before been brought to the attention of the fans. In fact, Lieb was so interested himself in addressing the radio audience that he overstepped his time

limit and entirely forgot that the game had started. Other talks by men like Johnny Dundee, Bozeman Bulger, Hugh Fullerton and Christie Mathewson kept the baseball fever running high among the listeners.

There is another highly interesting detail that the writer would like to comment upon before putting the cover on his typewriter. Even the most casual listener was able to hear the players hit the ball and sometimes the characteristic "plunk" of the pill could be heard as it embedded itself in the cavity of the catcher's mitt. The sound of the hitting was particularly interesting because the nature of the sound allowed one to tell whether or not it was a good solid strike. When the ball was ticked, the sound in the loud speaker lacked that fullness that a well struck ball hit fairly in the center and with full force would give. By thorough attention to this detail one could often anticipate White's announcements. Again and again after a good solid crack he would announce that a two-bagger had been made. When Ruth and Stengel made their home runs every fan in the country must have known that the ball was on a long, long journey before White had a chance to announce it in his microphone.

The writer has but to wish that THE WIRELESS AGE would increase its size by 10 pages so that he might continue to tell all the interesting things that took place during the broadcasting of the series. They are not important things, but they are interesting. Take for instance, the odd requests that the announcers at the games receive. Not one of the games passed without fifty or a hundred people coming to the announcer and asking him to mention their name for the benefit of friends at home. Some fond father would come forward and ask White or McGeehan to please tell little Johnny, who is listening in with a $2.00 crystal set, that Daddy is safely at the game. Of course this would have been an important bit of news for the 2,000,000 odd listeners, to say nothing of the intense aggravation that Johnny would have experienced with Daddy at the game and himself at home with Baby Sister. Then too, both the announcers had to be careful that theatrical press agents who always swarm such events do not succeed in "putting over" one of their classy little tricks. They tried again and again but White's and McGeehan's vigilance successfully prevented them from getting a single event across. In all of the mad scramble for publicity and mention over the radio, not one woman presented herself. Every request was received from a man. What's this about vanity? Probably the real curse of radio is that it will make men more vain.

Diagram of the baseball score card sent out to broadcast fans to help them follow the description of the game

And this is the end of the story of the broadcasting of the world series by radio. It will be a long remembered affair in the minds of baseball-radio fans especially in the inaccessible parts of the United States. It brought to them news of the game that might otherwise have taken days to reach them. It is almost useless to rave wildly over the greatness of radio. The thing is so big that words lose their meaning when one attempts to point out its benefits to civilization, but it does go without saying that when White and McGeehan spoke their last word in the last game every baseball-radio fan in the United States voted radio one of the greatest forces in the world today.

New York's Big Radio Show

(*Continued from page 24*)

before them the salient facts about the Club in the form of a leaflet with membership application blank attached.

MAJOR ARMSTRONG IN A NEW RÔLE

In parenthesis, I might add at this point that Major Armstrong, the originator of so many important developments in radio broadcasting, has recently sprung another radio surprise. Darned if he hasn't tuned in the call letters of Miss Esther McInnis, the fair secretary of commercial radio's big man, David Sarnoff—yes, sir; taken this fair lady's hand for matrimonial purposes this fall!

Are you a member of the Radio Club of America? If not, you should be a member of that pioneer organization. In view of the growing popularity of radio broadcasting, it has widened its scope to take in broadcast listeners. The advantages derived through membership are well worth while. Obey the impulse—now. Mail your application to Mr. George Burghard, 10 Warren Street, New York City.

A picturesque feature of the show was the "amateurs-who-build-their-own contest." The various entries were exhibited to the critical public gaze. Some of them were quite presentable, while others were really awfully crude. One which caught my eye was made in the form of the famous Eiffel Tower, with three hinged inductance coils as the only visible radio feature. The first prize of $50.00 went to Oliver Parker, the second prize of $25.00 went to Joseph Dorothy and the third prize, $15.00, to Frank Adams.

Well, folks, there is lots more to tell about that wonderful radio show but my space is up and I am signing off. Good day!

Large Scale Rural Radio

Nation-Wide Campaign to Develop Radio in Rural Sections for Practical Purposes

By J. Farrell

WHEN the city goes to the country these Summers it encounters a new experience. The country store, the proverbial meeting ground for the exchange of local news and gossip, is a deserted place. But up the street, in the country bank, the crowd will be found—grouped around a Twentieth Century Pandora's box more wonderful than the Greeks ever imagined.

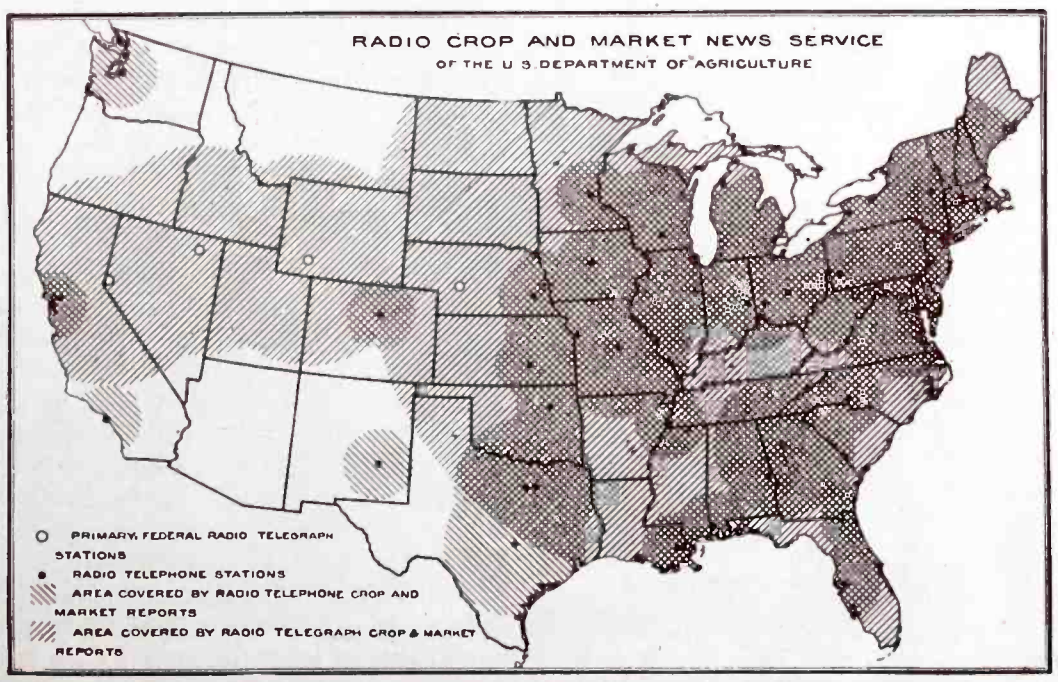
Journeying anywhere throughout the land one is struck by the lead that country banks have taken in the use of radio. Here and there a local editor or merchant will be found who has been quick to grasp the opportunity afforded, but by and large it is generally the country banker to whom credit is due for breaking the barriers of isolation.

At Raymond, Ill., in the heart of an important grain and live stock country I talked with C. McNaughton, cashier of the First National Bank. The general offices of the bank had the appearance of a miniature stock exchange. At one end of the room a clerk was busily recording price and news bulletins on a large blackboard. In front of the board there was a miscellaneous group of farmers and local business men.

"Each morning the grain buyers, stock buyers and farmers call to learn the quotations and to compare notes," Mr. McNaughton told me. "They are all strong for the service. Heretofore they had to depend on the commission houses and country branches for commercial news. The service was not altogether satisfactory. Price discrepancies were frequently disclosed and the farmers could never be certain that the news was accurate. The information was often delayed and by the time the farmers entered their trades anything may have happened to the market.

Any morning at the bank, where flows the radio stream of farm market quotations

"But now," Mr. McNaughton expanded, "the folks hereabouts get accurate quotations almost as fast as they occur. Particularly to the grain and live stock dealers this has frequently prevented considerable money losses through enabling them to enter buying or selling orders as the market might indicate. Another feature is that the service brings people in closer contact with the bank."



Map showing the diffusion of the crop and market news reports of the U. S. Department of Agriculture

Mr. McNaughton mentioned numerous other banks in the state that furnish similar service to local people. The First National Bank at Albion, Ill., recently installed radio equipment to receive grain and live stock reports. At Carthage, Ill., the cashier of the Dime Savings Bank said that the farmers were hungry for more news. Inoculated with the radio speed bug, they wanted the news even faster. They were particularly interested in the opening and closing quotations. More than 250 places throughout the state where market news is received were listed for use. Many of these were the homes of individual persons, but business houses in towns that have installed public service, banks and grain elevators easily took the lead.

In Missouri, Illinois, Nebraska, Ohio and Iowa I visited more than two score banks which maintained a daily radio news service for the convenience of their customers. They included farmers' banks, trust companies, and savings banks. R. D. Bower, assistant treasurer of the Caldwell County Trust Company at Kingston, Mo., stated that it is the "best service we have ever had of getting prices. I hardly know how we could get along without it. The majority of the banks are using this just the same as we are." The cashier of the Farmers' Bank at Stephens, Mo., said the service was especially valuable as "we did not have access to any means of receiving the markets other than by newspapers, and newspaper markets are always a day late when they reachthe rural districts."

This use of radio in country banks

is serious business. In the city the radio may be used largely for entertainment, but in the rural places the use centers around the reception of political, social and business news. In many communities it has become the habit of certain groups to congregate wherever the reports are received at the hours fixed for the reception of the different kinds of information. First may come the live stock men to hear what happened at Chicago, Kansas City, Omaha, and the other big live stock markets that morning. Then the folks interested in overnight political and social developments all over the world. Follow then the grain people who want to know the opening prices on the various boards of trade. The general stock market quotations draw many listeners.

Everywhere it is the same story. At first the radio in rural communities was regarded as a novelty, but it is now becoming more and more an indispensable utility.

"When rural mail delivery was first established, most farmers were suspicious of it," one farmer told me. "They thought it was some new political propaganda. But now they depend on the system very much. It has been the same way with radio. The price of first-class radio sets is the only thing that holds them back. They're waiting for prices to go lower. Meantime they are making use of the services established in town in the banks and stores."

A movement is now being considered by state and Federal authorities for a nation-wide campaign to develop radio in rural territories on a really large scale. It is proposed to have the 2,000 or more county agricultural agents throughout the country to give visual demonstrations of radio to farmers, and to establish so-called radio reception centers all over the counties they cover. The aim is to place at least 500,000 radio receiving sets in farm homes. A feature of the campaign will be the giving of radio demonstrations at the state and county fairs. Such demonstrations on a single fair circuit last Summer were viewed by more than 4,000,000 people. An effort is to be made also to induce an increasing number of banks and stores to establish public receiving stations where farmers and others interested may come and get the latest commercial news.

Radio Reports as Well as Predicts Weather

U. S. Weather Bureau Has Used Radio Since 1905 and Is Expanding Its Wireless Network Continually

PROBABLY few people realize that the work of the U. S. Weather Bureau is dependent on prompt receipt of weather reports from observers over as wide an area as possible. It is from the comparison and charting of conditions that forecasts are made, the charts revealing the location of storm centers, and experience indicating their probable direction of movement. Radio telegraphy for years has played an increasingly important part in the communication systems upon which the Weather Bureau depends; in fact, the January, 1923, issue of the "Monthly Weather Review," published by the Bureau and issued in April, devotes nine pages to a "History of Radio in Relation to the Work of the Weather Bureau."

According to this article, "The first radiogram received by the Weather Bureau containing a weather observation taken on a ship in the Atlantic was from the S. S. *New York,* on December 3, 1905, in latitude 40° N., longitude 60° W. It was the result of arrangements made with the Marconi Telegraph Co. to receive at its station at Siasconset, on Nantucket Island, messages containing weather reports from passenger vessels plying between New York and European ports that were equipped with wireless apparatus. Few reports were received from ships in 1905 and 1906, but sufficient to indicate the great value of and necessity for such observations in forecast work. . . .

"Daily or twice daily observations now are secured by telegraph and cable from about 240 stations in the United States and Canada (210 in the United States and 30 in Canada), from 17 places in Mexico, 20 points in the West Indies, 12 Alaskan stations, and 22 European cities. These are supplemented by reports obtained wholly or in part by radio from 16 places in the West Indies and Central America; 5 in Alaska; from Honolulu, Guam, and Midway Island, in the Pacific; the Philippines, China, Japan in the Far East, and from 36 places in Europe and the Arctic regions, including the Azores, Greenland, Iceland, Spitzbergen, and Jan Mayen. . . .

"On July 15, 1913, the broadcasting of daily weather bulletins was begun from the naval radio station at Arlington, Va., and Key West, Fla. The bulletins were broadcast at 10 p. m. and in two parts. The first part consisted of code letters and figures showing barometric pressures, wind direction and force at 8 p. m., 75th meridian time, at 8 places on the Atlantic and Gulf coasts and at Bermuda. The second part contained special forecasts of winds along the north, middle, and south Atlantic and the Gulf coasts a hundred miles or so offshore. Storm and hurricane warnings were included whenever issued. . . .

"The first systematic radiophone broadcasts of forecasts were made from the station operated by the University of Wisconsin beginning with January 3, 1921. Prior to that date and since October 1, 1916, broadcasts had been made therefrom by radiotelegraph. The next radiophone forecast distribution service was inaugurated on April 26, 1921, by the St. Louis (Mo.) University. This was the first station to disseminate river forecasts by this means.

"On July 1, 1921, 12 radiophone stations in 7 States were broadcasting weather information, daily forecasts, river forecasts, crop information, cold-wave, frost, and other warnings. Since that time the work has been rapidly extended, and at the present time 140 radiotelephone stations in 39 States are engaged."

French Artists Demand Pay

AFTER several months of co-operation with the broadcasting stations in the Eiffel Tower and in the suburbs of Paris, certain French musicians have decided that no longer will they permit their concerts to be broadcast without payment. The Paris Orchestra, for instance, now refuses flatly to allow its concerts to be broadcast, and the Union of Dramatic and Lyric Artists and the Syndicate of Musicians have both instructed their singers and instrumentalists not to allow the broadcasters to transmit their efforts. Part of the difficulty is understood to have been occasioned by the fact that various restaurants and dance halls in Paris have discharged their musicians and instead have installed radio receivers. Just how the situation will end no one knows, but since the French government grants subsidies to the Comédie-Française, it is to be presumed that at least the artists thus subsidized will be more or less freely available for French broadcasting.

Time Signals Tell Where You Are

How Surveyors Use Arlington Time in Laying Out Boundary Lines—Automatic Recorder Developed for Use by U. S. Coast and Geodetic Survey

By S. R. Winters

THE determination of longitude and latitude by radio sounds technical and abstruse yet it affects every man who owns land, for all surveys are based on such data alone. The position of any point or points on the earth's surface can be accurately indicated only by reference to the lines of longitude and latitude, which are determined by observation of the exact time at which any one of several stars, or even the sun, cross the meridian or exact central line of the sky.

It is easy enough to use a surveyor's transit for observing the star; the error, if any, occurs in the chronometer that marks the time. Hence the importance of securing absolutely accurate time when in the field for surveying purposes, and hence the great value of the radio time signals to property owners.

Automatic apparatus for not only receiving these signals but recording them on paper has been developed, and recently was tried out in the vicinity of Wisconsin Rapids, Wis., where it automatically recorded time signals sent from the Naval Observatory in Washington, D. C. The Coast and Geodetic Survey of the United States Department of Commerce contemplates widespread application of this ingenious mechanism in recording time signals, and may even use it in the determination of differences of longitude in Alaska.

The new wireless instrument was designed and built by Dr. E. A. Eckhardt and Dr. J. C. Karcher of the Bureau of Standards, United States Department of Commerce, and before it was transferred to the Coast and Geodetic Survey, radio-telegraph signals from Lyons, France, 3,800 miles away, were automatically copied on a sheet of paper wound around a cylinder. Before being turned over to the service of the surveying branch of the Federal Government, the apparatus remained at the Naval Observatory for one month. Here, the lag in recording radio-telegraph time signals was determined.

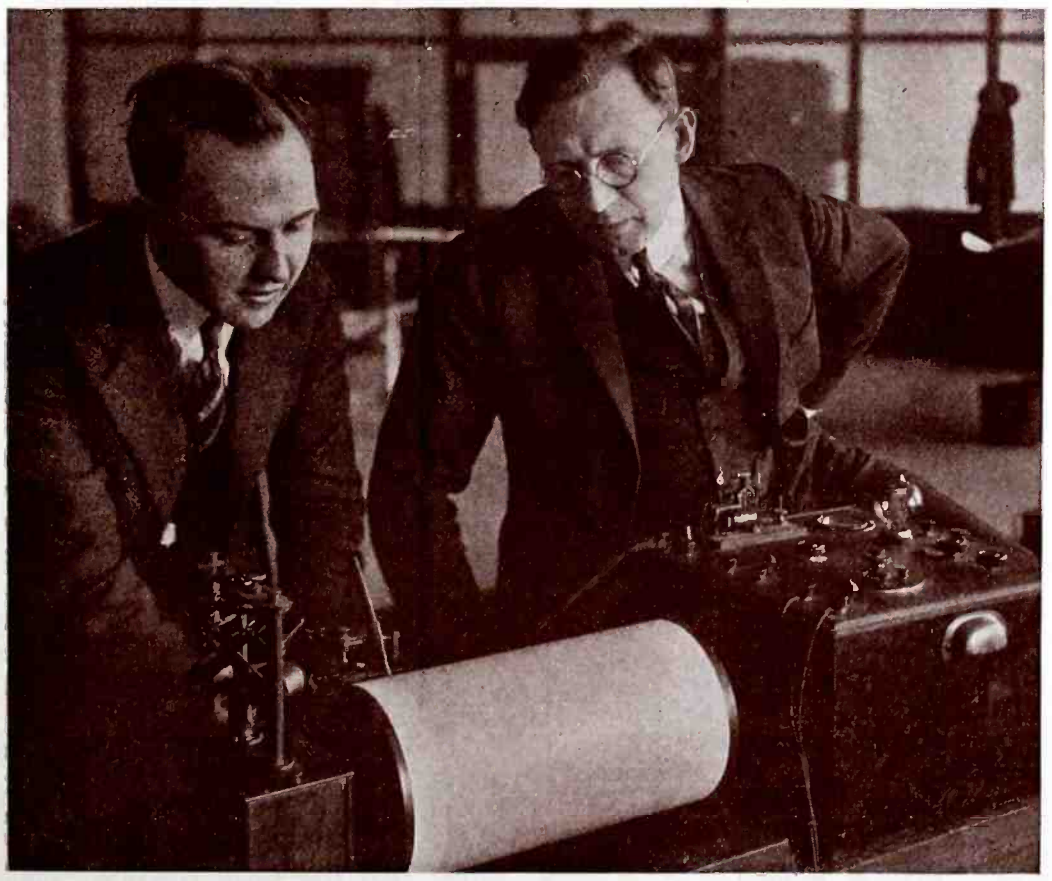
This retardation represents the interval of time between the tick of the master clock buried under the Naval Observatory and its record on the chronograph or time-measuring instrument used by the surveying crew afield. The time signal first passes through the telegraph relays at the Naval Observatory, going by land-line telegraph to Annapolis or Radio, Virginia, to the gang relays at this wireless station of the United States Navy Department. Thence the electric impulse passes through the receiving antenna, and out through the transmitting antenna, relays, and pen magnets to the pen record of the chronograph sheet. Hence, an allowance for the time taken by the electrical impulse in going through this complicated circuit must be applied to all longitude determinations made by radio telegraph. This correction, once determined, remains constant.

From the Naval Observatory, the surveying crew of the Coast and Geodetic Survey, under the direction of Lieutenant Fred E. Joekel, proceeded to Marshfield, Wis., in which state the first field tests were made. The initial experiment was carried out in the neighborhood of Wisconsin Rapids, and the party in charge of the expedition reported to the Washington office of the Coast and Geodetic Survey, "The results obtained were very satisfactory."

The time signals received from the Naval Observatory, via the wireless transmitting station at Arlington, and copied by this automatic radio recorder for use in conjunction with longitudinal determinations, were employed also in obtaining the rates of error of the gravity chronometers or time-measuring devices. Subsequently, latitude observations were made at Wisconsin Rapids, as well as at Owen, a point between Wisconsin Rapids and the next longitude station. Two three-quarter-ton motor trucks are used in transporting the surveying crew, wireless receiving apparatus, and surveying instruments. Where it is only necessary to make longitudinal observations, the automatic wireless recorder and auxiliary equipment can be installed in a very brief period of time. However, in the event that longitude, latitude and gravity reckonings are to be made, one and one-half days are required to set up the apparatus. This novel method of determining the differences in longitude and latitude is also being applied to surveys in Kansas, as a result of the success of the instrument in Wisconsin.

The radio receiving set used is a single-tube regenerative tuner, with some special adaptations that make

(*Continued on page 39*)



Making the time signals write themselves down—the new automatic radio time recorder with its designers, Dr. J. C. Karcher and Dr. E. A. Eckhardt, of the U. S. Bureau of Standards


Philip Gordon

Radio's Relation to Classical Music

Philip Gordon

Interviewed by Edwin Hall

WHAT is radio's relation to classical music? Is it merely an adjunct to the concert platform? Or has it a new sphere all its own? That is a question that has puzzled many broadcasting program managers, who have wondered whether to concentrate on jazz and the lighter type of music, or whether perhaps a little "highbrow stuff" now and then should be included for the benefit of a very few in the listening audience.

Philip Gordon thinks that the radio broadcasting station has a definite duty to both classical music and to the audience. It has the double duty of presenting that music carefully and understandingly, so that it will be enjoyed by those who already love it, and be appreciated by those who may be hearing it for the first time.

It was out of this conviction that Mr. Gordon's Monday evening lectures on Musical Appreciation grew. Started first as an experiment, to gratify his desire to try the idea out, the Monday evening talks from WOR have grown to be a fixture. "Every once in a while," said Mr. Gordon, "I decide that it takes a great deal of my time, and that I shall stop. Then I get a letter that shows me how much these talks mean to someone, and I continue."

He is a busy man. He is head of the music department of the South Side High School in Newark, N. J., and teaches a great deal outside of school hours. There are many other things that he could do with the time he has been giving to the radio audiences, yet they have been so appreciative, and have shown so well that they are getting new insights into music through his talks that he has continued them far beyond his original idea.

He began with two talks on "How Music Is Composed," in which Mr. Gordon endeavored to show some of the difficulties that a composer had to meet, and some of the possibilities. He illustrated every point carefully by playing standard compositions, or some of his own, on the piano.

That is one reason why these talks have meant so much; they are not dry-as-dust lectures, but real, vibrant ideas translated into both words and music.

The two explanations of musical composition made an instant hit. They were followed by several explanations of "The Instruments of the Orchestra," a natural outgrowth of the first talks.

Letters continued to flow to Mr. Gordon, so he decided to speak about the various composers who wrote for orchestra. He gave a series of talks on Beethoven, with copious illustrations from his works. Listeners said that they were charmed, and that they had never realized that classical music could be so beautiful.

The Beethoven series finished, Mr. Gordon proceeded to Wagner. That meant the next step, into opera. And so the radio audience heard him explain the more popular of Wagner's operas. At present, this series is still under way.

Now what does this mean? Here is a young and busy musician who yet takes time to talk to the radio audience once a week about the most important and significant musicians and their works, and does so not because of any vanity or pride, but because the radio audience has shown that they want his work.

"Half my letters come from small towns," he says, "and the others from big cities like New York and Newark and Philadelphia. That shows, I think, that the small town is proportionately more interested in the classics than the city. Radio has a great

When you said tonight that you were going to talk about the composer whom you consider greatest, I hoped you would name Beethoven; and when you did my heart leaped with joy, for I feel that he rises like a lone mountain peak above them all.

Your choice of the second movement of the seventh symphony was happy. This great movement produces always a profound effect upon me and, as usual, my tears flowed freely as your fingers reproduced its magic notes.

Ever new and ever fresh to me, Beethoven's music has made my life richer and better for nearly half a century. EDWARD BLAKENEY, Troy, N. Y.

Have listened to your most interesting lectures (over my radio) on "Musicians and Their Works," and intended writing to you before this, to thank you, and to tell you how much I enjoy them. Some years ago, while residing in Brooklyn, I had the privilege of hearing Walter Damrosch lecture on "Modern Musicians and Their Compositions," in a course of lectures and concerts given under the auspices of the Brooklyn Institute of Arts and Science. Music is the greatest part of my life, and oh, how I have revelled in it since the radio came into my life. I am a daily listener, and every day I realize more and more what a wonder it is—a very miracle. So full of endless possibilities for service to our fellow men if we only have the desire to give out our very selves. We have much to be thankful for, when so much is fully given—sent into our very powers. MRS. AGNES H. LITCHFIELD, Columbus, O.

opportunity to give these people an understanding of fine music, which they can make their own and carry with them for the rest of their lives. If I, in my small way, can help some of my listeners to such an understanding, I am only too glad to do it."

Mr. Gordon is a modest young man of considerable talent, as those know who hear him. His composition "June," which he has played over the radio, he thinks not good enough to warrant publishing, yet he has had innumerable requests for it.

It is with special pleasure that we have listened to your radio talks. Adelaide's greatest regret in graduating from South Side was giving up the Music Appreciation. She said last week that she missed your playing more than anything else, and they have no wireless outfit in Montclair Normal, so that they cannot listen in.

It is a great satisfaction to us to learn of some of the work, and I am taking this opportunity to thank you for what you did for her and for the great pleasure you are giving us. MRS. VAN N. POLHEMUS, East Orange, N. J.

I was listening on the radio, and I had the chance to hear you speak. I come from Panama, Central America, and I had taken piano lessons for quite a while. My teacher, Mr. Daniels, told me about Beethoven and Bach and many other composers. He told me that Beethoven when young (although not very young) became deaf and he said that he played all the symphonies. When I heard you play, I thought you played wonderful.

I will write and tell my piano teacher that I heard the seventh symphony by Beethoven played. From a girl 12 years old. FRANCES MARTIN, Newark, N. J.

When pressed as to the enjoyment he gets out of broadcasting he will confess that "there is a certain pleasure, I suppose, in developing the subject as I go along." He speaks extemporaneously, without notes, having prepared the talk beforehand by study. "There is nobody in the studio with me except the announcer," he reports, "and so it's just like talking to myself." But the real reason why he broadcasts is the fact that the audience has definitely shown him that he is giving them a better understanding of the great classics of music.

UPSTAIRS

They gather about the loud speaker to enjoy the music broadcast from stations far and near

The Radio Equipped Apartment

NEWARK, N. J., has been claiming the distinction of having the first radio-equipped apartment house; whether the claim is justified or not, certainly the Western Electric Co. ought to know when it says that this is the first time its public address system has been so used. A radio receiving set is operated in the pent house on the roof, and connected to the address system, which has outlets in every apartment.

The building thus fitted is the Ritz Apartments, 299 Clinton avenue, and in any of the 72 suites the radio programs can be enjoyed by simply slipping in a plug to connect a headset or loud speaker.

F. B. Kopff, the superintendent of the building, says the popularity of this innovation in apartment house service is evidenced by the fact that but comparatively little elevator service is required in the evenings; the greater number of the Ritz tenants prefer to stay home and listen-in.

The operator in the radio room on the Ritz roof must needs combine diplomacy with ability when he selects and picks up from the air a program that will suit the preferences of all the people in the seventy-two apartments. But thus far he has been so successful in his selection that even a loud speaker could not make the complaints audible, for there have been none. However, should such a contingency ever occur, it will be readily taken care of by installing an additional radio receiving set, permitting simultaneous reception of two programs.

The equipment now used consists of a radio receiving set and a high-power amplifier. There are four vacuum tubes in the receiver, affording two stages of radio frequency, detector and a single stage of audio frequency amplification. The complete set can be operated on dry batteries.

Because of the set's sensitiveness and selectivity every city in the Union which has a 500-watt broadcasting station has been heard by the families living in the Ritz apartments.

By means of a specially designed input coil, the radio receiver is connected to a Western Electric amplifier, in which power tubes provide three stages of audio frequency amplification, the last stage being push and pull.

Radio signals from the receiver are amplified and thence wired to all apartments, each of which is equipped with a headset of high impedance type and with a special receptacle, so arranged that no matter whether a few or all seventy-two headsets be used, the quality and volume will be in no wise impaired.

The possibility that apartment houses which provide radio service may become as tumultuous as the Tower of Babel thus is easily averted. By using headsets there can be no bedlam, and each lessee is given clear reception of broadcast numbers.

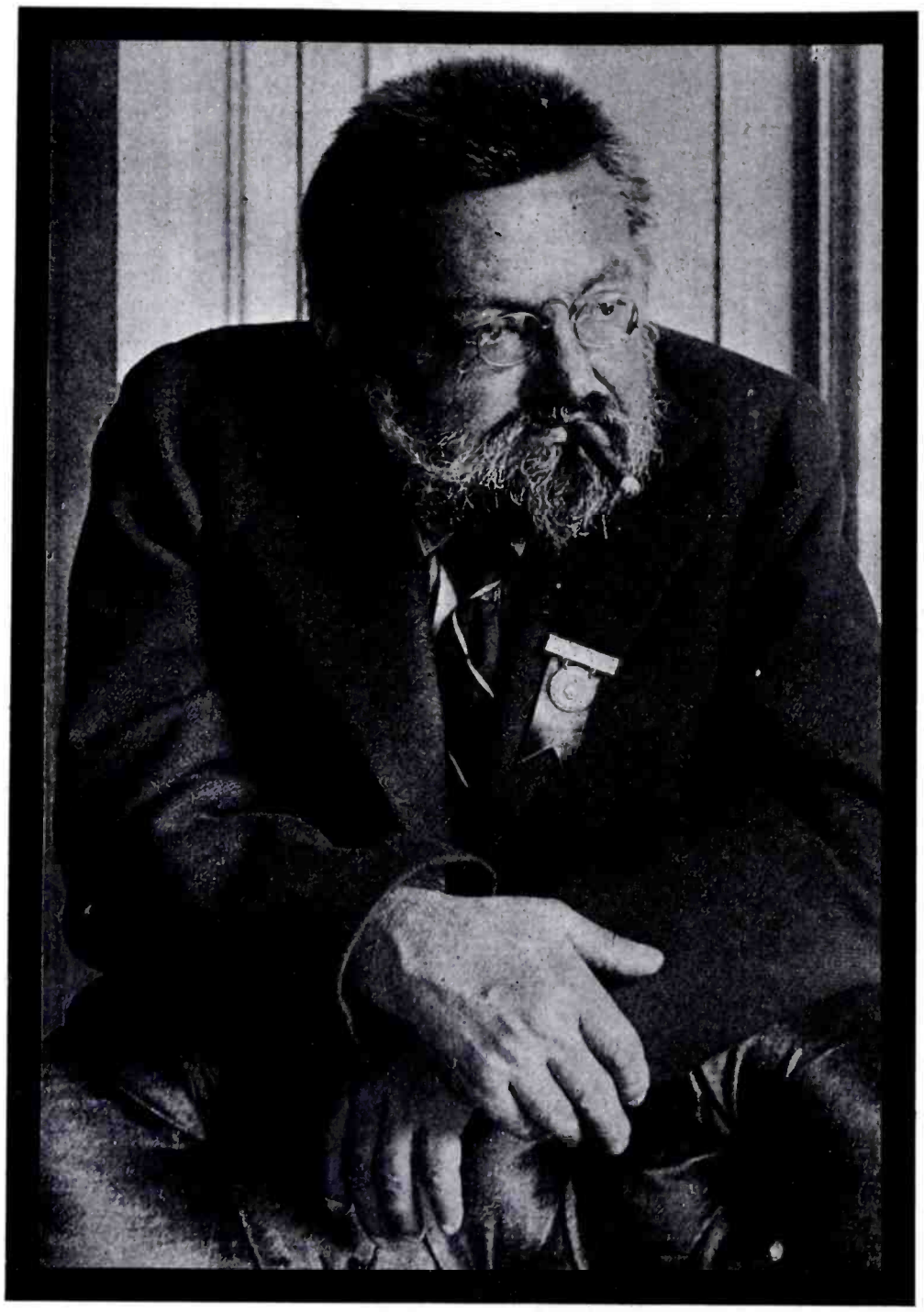
Superintendent Kopff believes in the practical application of the old adage: "All work and no play makes Jack a dull boy." He finds that the workers in the big boiler room of the Ritz perform their tasks with much more zest after intermissions or "recesses for radio." Accordingly, at intervals the workers in the cellar are given the opportunity to listen to what the chap on the roof picks up from the ether. And usually the effect is enlivening.

DOWNSTAIRS

They interrupt their labors to dance and step to that jazzy saxophone melody coming over the air

Charles Proteus Steinmetz

Electrical Wizard



THE scientific world was shocked on October 26 by the announcement of the death of the electrical genius who has contributed so generously to the development of electrical science. Returning to his home in Schenectady after a trip to the Pacific Coast which over-taxed his strength, the scientist was forced to a sick-bed from which it was hoped he would be able to make an early recovery and return to labors which he loved. But the weak heart which he had never permitted to handicap his splendid mental powers suddenly stopped its beat.

The career of Charles Steinmetz is an inspiration to every earnest worker, and presents one of the beautiful romances of the technical world. He was born in Breslau, Germany, on April 9, 1865, and received a good education in the universities of Breslau and Berlin. Astronomy was his early choice of study but he later turned to chemistry and electrical engineering. At an early age mathematics presented much difficulty to this boy who was later to be known as one of the scientific giants and accomplished mathematicians of the world. In later years the story is told of him that upon an occasion when he was called upon to solve a problem involving complicated computation and found no table of logarithms at hand, he made his own logarithm table—no small feat.

He developed early a predilection for advanced political thought and so found himself rapidly becoming *persona non grata* with the government authorities. He was compelled to forego his university degree and take refuge in Austria and later in Switzerland, where he continued his studies in the Polytechnicium of Zurich. Here he became acquainted with a young American student who persuaded Steinmetz to come to America.

Steinmetz arrived in this country in 1889, at quite the right period to enter into a profession which was then making a promising beginning. He was 24 years of age, handicapped by an inadequate knowledge of the English language and also by illness, which resulted in his detention at Ellis Island until his American student friend was able to procure his release.

His first position was in the drafting room of Rudolph Eickemeyer, an inventor and pioneer in the production of electrical apparatus. Here, at Yonkers, he was employed at a salary of $2.00 a day. But he rapidly attracted notice by his work on electric motors and generators and his articles contributed to scientific papers. He was a clear, logical thinker and possessed the knack of setting forth his thought in lucid, forceful writing, which later in life was to stand the acid test of such involved subjects as Einstein's Theory of Relativity.

Dr. Steinmetz later was taken into the employ of the General Electric Company where he organized a Consulting Engineering Department. He developed a laboratory at Schenectady worthy of his genius, in which he and his assistants could have all possible facilities in the prosecution of the investigations which he carried on with tireless enthusiasm.

He has latterly been a leader in the effort to obtain and control super-voltage. His experiments in this field culminated last year in the demonstration of a startlingly realistic, miniature thunderstorm with all the natural manifestations faithfully reproduced, in which the wizard played with lightning bolts of more than 1,000,000 volts.

The electrical genius who has for long been our acknowledged leader in scientific America is remarkable not only for the wonderful work which makes him unique; but also for his broad and intensely human devotion to the interests of mankind. Far from holding himself aloof from human interests because of the demands which science made upon his time and energy, he was always an interested observer of the trend of social and political institutions, and he held several useful public offices. The profession of electrical engineering loses a leader in the death, at the age of 58, of Dr. Steinmetz, and the country loses a priceless citizen.

Educational Facilities Extended by Radio

Columbia About to Try Radio in Extending Its Correspondence School

By Edwin Hall

ANY universal thought-carrying medium like radio quite naturally offers plenty of opportunity for speculation regarding its educational features. Education, reduced to its fundamentals, is nothing but a matter of communication. A professor teaches mathematics by communication with his students.

We shall soon be giving knowledge the wings of Mercury. The reason for this belief is founded on fact and experimentation. The writer refers to purely academic education; not what would be received by the masses in the natural course of broadcasting. The experiments in radio education are not numerous, but they have been convincing. The most significant was the one conducted by the New York Board of Education during the month of April, 1923. At that time a class in accounting at the Harron High School was given instructions from the mouth of the loud speaker that was connected by radio to the broadcast station of the Radio Corporation of America. The class assembled in the usual way and the instructor took his place at the microphone several miles distant. Of course, the instruction was entirely verbal and the class could not have been conducted regularly in this way without the use of the all-important blackboard.

A more significant and practical experiment is about to be tried at Columbia University, and to Columbia, far famed for its modern methods of instruction, will come the distinction of being the first institution of learning to try a new method that may eventually make every home a little red schoolhouse or veritable university. For several years Columbia has been distributing home instruction courses for those who have neither time nor money to spend for education. The mails are used in sending out typical correspondence school instruction sheets, and the student's progress is left entirely to his own resources. When there is a keen desire to learn, the correspondence schools are eminently successful, but there are many students who lack the persistency to carry on, due partly to lack of inspiration and sometimes to lack of understanding. Although the courses are prepared as simply as possible, there are always those who fail to comprehend and consequently they fall by the wayside when they reach that portion of their study where their progress is labored.

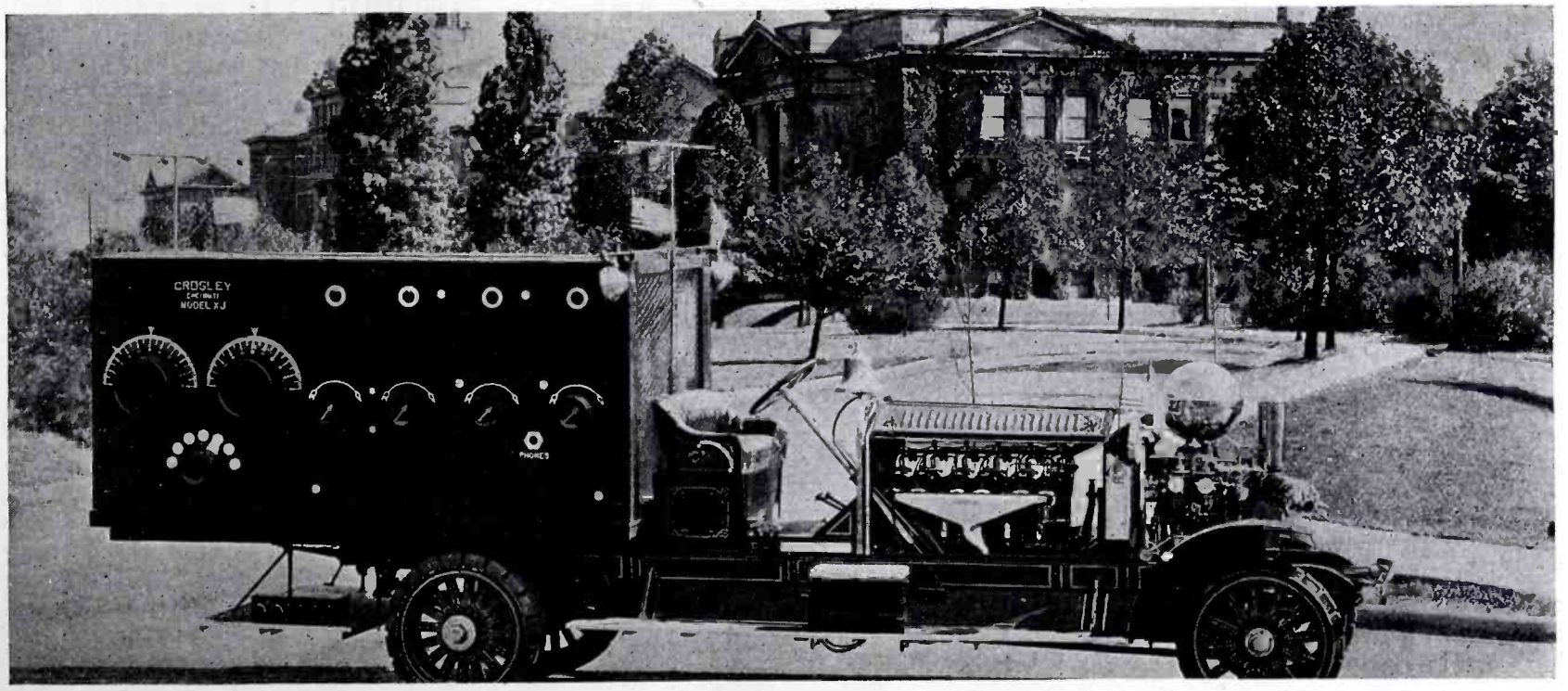
Columbia proposes to supplement its home study courses with lectures by radio and in these lectures the student, if he is within range of the broadcasting station that will be used for this purpose, will be able to have the real live voice of a professor at his side just as though he were attending school. If he is taking a course in journalism, he can hear weekly or semi-weekly the voice of his instructor giving directions regarding the lesson or general instruction on vital points. Even the teaching of such a difficult subject as mathematics could be greatly accelerated by treatment of this kind, and its value to a struggling student could not be over-estimated. Every course of instruction, regardless of its nature, would become easier with the aid that radio could offer.

Columbia's experiment may lead to developments that may make the ether one vast university. The effort will be watched and studied by educators the world over.

Considering the possible importance of radio to our educational system, it would seem to be high time that our educators called a national conference for the purpose of establishing radio's place in education. That it will develop into a powerful educational force is positive. As to the course it will take we are still uncertain, but the implements are in our hands and it would seem that we have nothing to do but learn how to apply them.

In further consideration of this, let us take up the matter of naturalization. We have hundreds of thousands of people in the United States who neither hold naturalization papers nor speak the English language. It is true that the more ambitious of these foreigners go to the evening lectures at the local schools, but at best this is only a small percentage of those who would be benefited by such instruction. A foreign laborer who puts in a hard ten-hour day is not usually in the mood to leave his comfortable chair and home during the evening. The young fellows may, but it takes real effort on the part of the middle-aged man.

It would be a comparatively simple matter to teach such an individual the rudiments of naturalization as well as



This gigantic receiving set replaced a marching band in a Cincinnati parade. WLW broadcast the band music picked up on this set

the fundamentals of the English language by radio. It would seem that our Federal, state or municipal governments should be perfectly willing to co-operate in a matter that is of such vital importance to the welfare of the community and the nation at large. It would be entirely feasible for municipal governments to loan out receivers for this purpose or sell them at cost to those who wished to use them. The responsibility would not be great, since a crystal receiver could be used in the average case. Probably in a city of 200,000 there might be 2,000 foreigners who could not speak English fluently, or perhaps not at all. Let us say that a broadcast receiver was available to fifty per cent. of this number. If a municipality took it upon itself to supply the remainder with crystal sets on loan it need represent only an investment of approximately five thousand dollars. Such an equipment would be a permanent fixture in the city's welfare equipment. It could be used over and over again and in the course of a few years it could be made to be responsible for any service that would triple or even quadruple the number of applicants for naturalization papers. It would allow our communities to assimilate their foreign element with unheard-of rapidity and facility.

There are so many things that radio can do to be of immediate assistance in educational work that one does not know where to begin in outlining them. It does not require much imagination to see where radio broadcasting could render a great and lasting service to our colleges and universities. The lecture is the basis of modern instruction in the higher schools of learning, and the lectures do not all come from the professors of the particular college in which the course is being given.

Every professor is anxious to call in experts to lecture on special subjects that will be of benefit to his students. For instance, in a course in electrical engineering, a wide-awake professor would be more than glad to invite numerous experts and specialists to replace him on his lecture platform during certain parts of the course. For instance, when the subject of thermo-electricity is reached, any professor would be more than glad to have his students listen to a lecture on this subject by such an eminent authority as E. C. Coblentz, of the Bureau of Standards. Mr. Coblentz has made a life study of this small but important branch of electrical phenomenon, consequently he knows a great deal more about it than the average professor.

Let us take a class of students struggling with the mathematics of alternating current. What a treat it would be for them to listen to Steinmetz, whose text books they are probably using. How nice it would be if a class in mining engineering could listen to John Hays Hammond, Sr., or a class in architecture to Cass Gilbert? Yet it is evident that these authorities who have succeded in combining the theory with the practical in the workaday world cannot stop their work and ride 500 miles to give a class of youngsters a lecture, no matter how much good it may do them. With an intelligently planned inter-collegiate or inter-university broadcasting system, there is no reason in the world why such men could not reach the hungry ears of hundreds of thousands of students.

If all of our educational forces were to co-operate in establishing such a system, untold benefit would result. Our professors could exchange classes with ease and the student body could listen to others outside of their own faculty. It would make the bonds between our institutions of learning tighter and co-relate our entire educational system at the same time tying it up with the workaday world—thereby supplying an influence that has been sadly lacking.

English Listeners Like Programs and Modulation of WGY

REPORTS of the reception in Europe of American broadcasting stations are already being received here following the return of cool weather and longer nights. Twenty-one English radio fans have written WGY, the General Electric Company broadcasting station reporting successful reception of the Schenectady station's program during the first week in September. The reception of WGY gave the English listeners the interesting opportunity of comparing the programs and quality of modulation of two continents.

W. E. Philpott of Rye Sussex, England, picked up WGY in the early morning of September 1. He writes, "Congratulations on the fine modulation. You were quite equal to Birmingham and Manchester."

Henry Myers of Low Fell, Durham, England, heard WGY and writes, "For consistent strength and clarity the concert came through much better than I get the London transmission."

J. Rhodes writing from Leeds, Yorkshire, England, said WGY was as "clear as Manchester 40 miles away."

The report of H. L. Holt of Manchester, England, is especially interesting inasmuch as he receeived WGY on an indoor aerial. He writes: "The apparatus I was using consists of an indoor aerial across the kiddies' bedroom and the ordinary detector and one stage of low frequency. The aerial is just a length of bell wire stretched backwards and forwards across the room in the form of a W and a V and then through the floor to the living room below the set. The tuner is just an ordinary single circuit regenerative one." Reception on a loud speaker strong enough to wake a person sleeping upstairs with bedroom door shut, is reported by T. Hall Felton of Grimsby, England. Mr. Felton was listening in with his father, Dr. E. H. Felton, who is vice-president of the Grimsby District Radio Society. He has a five-tube experimental set.

How Broadcasting Helps the Country Store

By O. M. Kile

A. C. HOEFNER runs a general store of New Melle, Missouri, He handles the usual general store merchandise and buys poultry and eggs from his farmer customers. This is how radio aids him; as told by himself:

"We are located in an inland town eight miles from a railroad, and only have mail service once a day. We used to be exactly 25 hours behind the market, since our market is set by the prices at St. Louis at 11:30 a. m., and printed in the evening papers which do not reach us until 1 p. m. the next day. Now we get the report by radio at 12:40, or one hour and twenty minutes after the market is set for the next twenty-four hours.

Tillers of the soil getting market quotations by radio

"With this service there is no chance for a repetition of what happened to us in the spring of 1921. One day that spring eggs dropped six cents a dozen. One of our customers who gets his mail by rural route from another point on the railroad, read this in his paper at 9 a. m. Knowing that our mail would not get in until 1 p. m. he rushed us 60 dozen eggs, thereby causing us a loss of $3.60 on a single customer.

"On the other hand we want to pay what produce is worth and now are often able to give our customers two or three cents a dozen more for eggs than they expect. We raise and lower our prices according to the radio quotations now.

"We have a flour mill here in town, also, and the manager always gets his market figures from me. He then buys his wheat, corn, and oats according to these reports."

C. A. Morton, of Morton & Co., a large St. Louis commission firm, who is in touch with merchants throughout that territory, summarizes the benefits of broadcasted market reports as follows:

"First, the margin of profit in the grain trade is based on the risk involved, and when the miller or grain dealer is in close touch with the markets and doesn't have to take the overnight risk, he will and actually does buy from the farmer on a narrower margin.

"Second, the farmer is as well posted as the miller or grain dealer, and he can insist on getting actual value for his products, whereas under the telephone or telegraph system, he was 24 hours or more behind the markets.

"There is another angle, not directly connected with the grain trade, that has come under our observation, but which is a parallel illustration of this latter point. Several times we have been in a grocery store or meat market and have heard some housewife 'call' the dealer because of the prices asked for eggs and poultry, quoting the market prices as broadcast by the St. Louis *Post-Dispatch*, station KSD. Business runs more amicably, and at least profitably enough, when everyone concerned knows the actual conditions."

In the Shack Abaft the Funnel

By Ortherus Gordon

"Under the spreading wires aloft,
The sea-going outfit stands,
Receivin' and sendin' on and off,
And agoin' to foreign lands."

DEAR LOFTY:

Now that you can copy eight words a minute and have already applied for a second grade amateur license, I suppose you are aching to run away to sea and pound a wicked nautical key. Don't do it! Stay at home where you can broadcast your call letters over the community without knocking your head on seagoing rafters, or ruining your innards with uncooked seaweed and raw tripe. Furthermore, as my last skipper was fond of quoting: "Don't hoist your mainsail 'til your blocks are greased!" and whatever advice you can dig out of that you are welcome to. What he meant was, don't even look at salt water until your glasses are smoked, your sea-legs bought and paid for, and you are sure everything is going to hold taut.

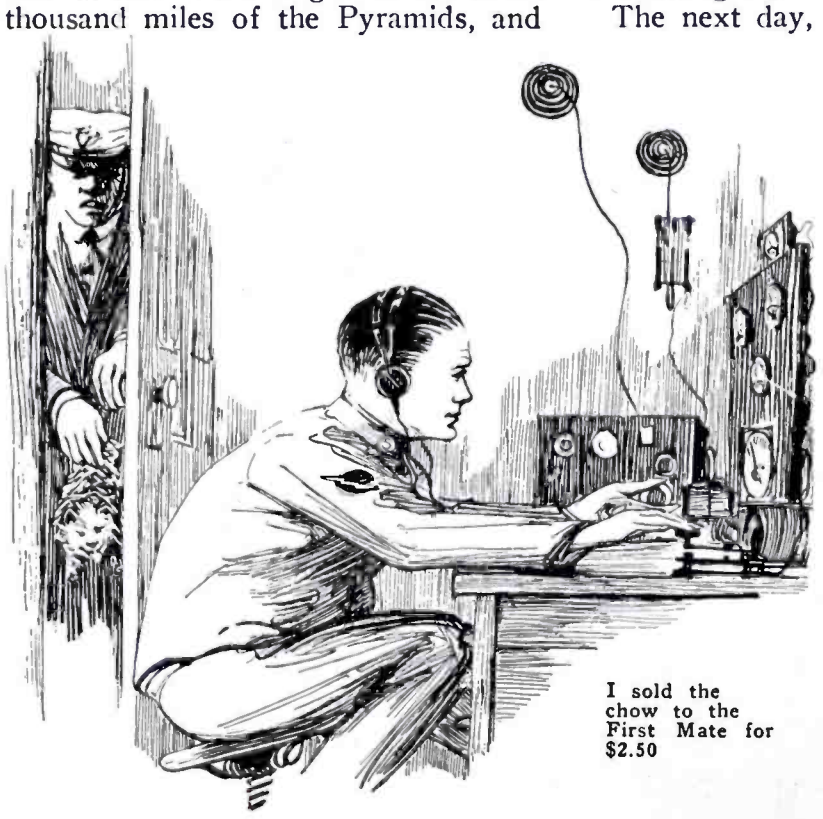
Take a sidewise glint at me, for example. I'm so salty now that I'll keep perfect for years after my death—but I wasn't always thus coated with brine. There was a time when I walked straight and wore my hats like other humans. You were in the crowd that morning I left home for Egypt and the Pyramids—at least that is where I thought I was going, in my innocence and bliss—with twenty words a minute stowed away under my skull. Well, to make a short story shorter, you know how quickly and cruelly I was disillusioned, how I never got within three thousand miles of the Pyramids, and how I was finally shunted off on a cattle boat to Europe. My self-respect dwindled from that day to this—and my ability correspondingly increased. I stuck to it, however, where many another would have gone home, with the result that now I occupy a room, a clothes-closet and a washstand all by myself, while two juniors live in half the cubic space right alongside of me. They hear the whirr of my electric fan and wish the bulkhead were as porous as it is thin.

Life at sea, Lofty old gin-pole, is not more than half bad. One gets around to see things and that means a whole lot, and after all the discomforts are paraded out and rehearsed the ultimate conclusion is that it is a lot of fun.

Take this last cruise, for example. You know all about my overland travels and troubles up to and including my triumphant entry into Seattle, and my joyous reception at the offices of the Hinge Steamship Company, the same with the motto "We are the Gate to the Orient" on its letterheads. I was assigned as Chief Operator on the ocean craft *Startinstop,* and after I had pinned my license on the pale green wall of the shack abaft the funnel, I reported to the Captain that the ship, as far as the dot and dash end of it was concerned, was ready to set out on her maiden voyage.

As a first attempt, the ensuing voyage was a fizzle. There wasn't a thing maidenly about anything that the *Startinstop* did, but we finally seeped into Shanghai.

The next day, the third operator—who had been there before — took me over to the local wireless huts and smoothed my entry into the radio circles of Shanghai. The two stations there are French and Chinese in nationality, but identical in their absurdity; the first with call letters that sound like seltzer water. FFZ, and the other with the back - handed call of XSG. Blows have been struck in the numberless arguments that have arisen over the equipment of these stations. Each asserts possession of the original set from the Ark, but from personal observation, I am sure that such instruments as they own were not only obsolete in Noah's time, but also forgotten. What these fellows have is really the old celestial outfit from the Garden of Eden, the same with which Adam and Eve listened in on heavenly concerts. Even with this remote look about them, the sets compare not unfavorably with some that were placed on the Shipping Board vessels during the war.



I sold the chow to the First Mate for $2.50

The receivers are panels five feet long and three feet high built into the wall of the building and anchored to the foundations thereof—and have an aspect that could not be softened by an earthquake. It is common belief that these sets can tune as close as thirty meters. That is erroneous, and I am glad to be able to qualify that belief by personal knowledge of the true facts. I myself listened in at FFZ one evening, and with the smallest change of inductance I tuned out a station on six hundred meters and brought in another on five thousand!

The transmitters are of no particular type—just mechanical monstrosities embracing all the known types of sending gear and a few of the unknown. To send, it is necessary to stand up and work a key as if you were drawing water from a well. The operators are to be congratulated on their ability to send out intelligible signals with such a key. When I hear them working now, I think of the poor cuss at the pump handle and refrain from employing profane language.

The very first commercial outfit I ever laid eyes on was far better than either collection of curiosities at Shanghai, and that is saying a good deal, for the shack and instruments aboard that cattle ship were half a shade this side of the limit.

I've often asked myself how I managed to get in the shack in which I handled my first ship messages. I must have closed the door as I sidled in for when I was composed enough to look around, I found myself with my back to it and facing the operating table at short range. Nothing about the room was spacious, the actual dimensions being six by six by just enough to crack me on the head when I stood up. On this ship, luckily, I had another room to go to when I wanted to straighten out my ears and rest my weary and battle-scarred head. The receiver—for that is what I finally decided it to be—was turned corner-

wise on the table with the headphones on a hook underneath. With all the courage I could command I pressed my fingers on the buzzer test button. I was thrilled through and through! It actually worked! That surprised me later, for it was the only thing that did—and even it went bad on a few needy occasions. The operating key I dared not press. I was afraid it would fall apart. It had as much side motion as it had up and down and the knob came off at the slightest provocation. The first contact I made with it a few days later made a noise like sputtering bacon and I promptly shut down for two hours. My change-over switch was a marvel in its line. To this day I have yet to see the switch that can break down as many circuits with a single throw and build up as many more with the same throw as that one. I touched it and moved it a trifle—and it fell into eight small pieces on the deck.

Crowding in on my right elbow as I leaned over the table was the operating panel. I despaired of ever finding out what all the meters, switches, fuses, circuit breakers and starter coils were for, but with the aid of a blueprint dug out from the underpart of a young stationary store in the drawers down the side of the table, I followed them all through from their start to their finish. There was a heavy coating of verdigris all over the instruments, and as it later developed, as many short circuits as long. Near the panel was the transmitting gear, rickety, decrepit and old-fashioned, with a mushy quenched spark gap as its most on the table. Everything I had been taught to look for in a sending set responded to a hasty roll call, from the imbecile jigger coil to the preposterous condenser, with its handle for changing the wave length sticking out unsupported into midair. We worked in three channels those days—450, 600 and 952. The only instrument that was neat and silent was the motor generator, and that was buried away in the engine room with a push button control on my table. All this, I thought, as I took in the whole dilapidated outfit with a single glance, is something that resembles nothing, but it is my wireless station. (You should have seen it—and heard it—a week later. That's how I earned my rep; such as it is!)

Underneath the table I discovered a sort of seat, which I immediately hauled out to sit on, but I had barely sat down when the door opened suddenly and nearly knocked me unconscious with a smart crack on the back of my head.

"If you are the new Sparks," bellowed a voice, "drag your carcass below and sign the articles."

That's all I was able to do—drag; and staggering under the weight of it, I went in the general direction of below and came upon a room full of ex-bartenders and sailors. The ex-bartenders were folding and ruffling imposing sets of papers and covering them with blotters while the sailors signed them. These were the ship's articles. I had never signed them before, and didn't know just what they were all about. Lately, being a little better informed, I know that when I sign on the dotted line, I agree not to eat more than my allotted ration of hard tack and rice, and to subsist on three United States Army Emergency Biscuits in case of shipwreck. But to get back to this trip in the *Startin-stop*—I decided in Shanghai to get a Chow dog and take him home with me. He was just a tiny thing, and he sure was cute. But, oh what a pest! Bad as he was though, the only person to really complain about him was the Second Mate, who was a dizzy goof in my opinion, so I didn't waste any time following out his sarcastic instructions or worrying about his threats. At the same time I was forced to follow the "Chow" critter around pretty closely to prevent what might easily assume the proportions of a personal insult to the dignified Second Mate.

The dog was taking too much time away from my slumber, and seeing a chance for a scoop in the way of general revenge, I sold him to the Third Mate for two dollars and a half, cleaning up four bits on the deal. As I expected, the Second Mate raised considerable smoke and the Third Mate retaliated in a fashion that almost brought the two to blows. To prevent further estrangement, the dog was given to the steward—who allowed the passengers to make a plaything of him. One dark night, he was left out on deck, and in the morning, the horrible story reached me that he had been washed overboard by the deck swabbing contingent of the Bosun's Mate.

Keep away from the sea, Lofty—you'll like it better. As for myself, I'm coming home and write a technical treatise on how impossible it is to transmit messages with an aerial that is so leaky that every time the Captain puts his mouth to a voice tube to telephone to the engine room he singes his whiskers and gets an electrical chin massage that stays with him from then on. There are a lot of funny things happen in the shack behind the funnel, and not among them are the words the Skipper uses when he comes back to the cabin after receiving such a startling reminder that there is such a thing as radio aboard the ship.

Yours for home and a solid ground,
VIC.

Church Bell Broadcasts Time Signals to Farmers

MANY stages of amplification and three different wave lengths are used to get Arlington time signals to the farmers in the vicinity of Medusa, Albany County, N. Y.

C. J. Waldron, a Medusa resident, lives next door to the church. He has added a few feet to the length of the bell rope and every noon, after tuning in WGY, the General Electric Company station at Schenectady, N. Y., he sits in his rocking chair with phones on head and bell rope in hand, waiting for the long Arlington note which marks twelve o'clock. At the long note he pulls the bell rope, and the bell, which is a big one, broadcasts the time signal miles around.

The signal passes through three different wavelengths — from Arlington on 2,500 meters, through WGY on 380 meters and the bell tone which has not been measured.

Time Signals Tell Where You Are

(*Continued from page* 31)

especially strong the response to the time signals, strong enough to operate a telegraph relay, which in turn governs the movement of the recording pen.

The recording unit does not differ essentially from that of other mechanical means for copying wireless messages in the absence of human ears. A sheet of paper is wound around a cylinder. The latter is rotated at a uniform speed by a clockwork, actuated somewhat like the grandfather clock, by falling weights. When off duty, the recording fountain pen traces a straight line, which for the sake of identification, is called the datum line. When receiving radio signals this pen leaves the datum line in accordance with the dots and dashes. This permanent record is readily deciphered by anyone who possesses a copy of the code chart. The services of a radio operator are dispensed with.

Other than serving the specific needs for which it was invented, namely, automatically recording radio time signals for making determinations in the differences of longitude, this apparatus is able to copy long-distance radiotelegraph communications from distant points. It is said to be the first automatic radio recorder that employs only one electron tube and yet is capable of receiving and recording radio-telegraph signals from Europe. It is portable, lending itself to carriage on an automobile, and can thus be employed by the Coast and Geodetic Survey in surveying expeditions to unfrequented and remote corners of the United States and its possessions.

Laughter on the Radio Wave

The Ship Operator

By Frank Chapman

Say, d'you know it's a deuce of a task
To answer the questions that passengers ask?
For a land lubber's questions out on the sea
Run through all the letters from A down to Z.

"Do you sail at night time?" they ask with
a smile.
"And say, when it rains, do you stop for a
while?
For you know, when it's raining (that is,
I should think)
It would run into the cellar and make the
ship sink.
And that bell there a-ringing; do you know,
it struck eight?
My Lord, how the time flies, who'd think
it so late?"

And then you explain, as you've done o'er
and o'er,
About the bell ringing, the time being four.
"Do you ever get seasick?" And you an-
swer with glee,
"I never get seasick, but sick of the sea."
"How far do you think we are off from the
shore?
Is it just a few miles, or is it some more?"
And you stand there and wonder how much
they will stand.
Then risk it at five thousand miles off the
land.

And should ever a lightship come into view
You've got to get busy and answer a few.
"Is that boat anchored there or tied to a
rock?
And why is it there and not at the dock?
And are there men on it there day after day?
How do they stand it, and what is their pay?

"Do the flying fish sing as they fly through
the air?
And do they have feathers like gulls flying
there?
Do you ever get homesick?" Now here's
where they sigh
With sympathy showing in each anxious eye.
And you say in a voice that the sea has
made rough
"Why, no, for you see, I'm not home long
enough."

Then they ask if you're married—you know
how it is.
If the passenger's fair and you're on to
your "biz."
Just what would you tell her, and she all alone
And three or four hundred miles from your
home?
Say, d'you know it's a deuce of a task
To answer the questions the passengers ask.

—*Baltimore Sun.*

NOWADAYS

By Percy Crosby

—*Brooklyn Eagle*

Observation

It used to be that a phonograph cabinet was merely a phonograph cabinet and nothing more. Nowadays it's hard to tell whether it's a phonograph cabinet, a radio, or a pipeless heater.—T. A. Sangan, Jr., in *N. Y. Globe.*

A Radio Romance

Lily's vacuum tubes were burning,
While my heart was wildly yearning
For a kiss!
Lil forgot me quite completely
As she tuned her set so neatly—
Frigid Miss!

Lily's hair, intoxicating,
Tantalizing, aggravating,
Brushed my cheek.
How I longed to kiss these tresses—
With my own lips' fond caresses
Hers to seek!

"No!" her answer was emphatic
As the crashing of the static—
What a din!
As I murmured: "Dear, take pity,"
Lily shouted: "Kansas City—
Tuned 'em in!"

As the signals came in clearer,
Lily's head kept coming nearer—
Glossy head of black—
Then she said: "Such oscillation
Justifies some osculation"—
Smack! Smack! Smack!

—Arthur L. Lippmann, in the N. Y. *Eve. Mail.*

Georgie: "When I got up this morning I found the detector tube all wet. What do you suppose caused that?"

Porgie: "Probably the grid leak."

Bow, wow, wow!
Little Super Tuner's set,
Whose set art thou?
Bow, wow, wow.

"Father is Scotch and takes the headphones off when the minister announces the offering," wrote eight year old Harold Midgley of Galt, Ontario, Canada, to one broadcasting station.

Mothers' Helper

Hint to distracted households, from a letter to a bed-timer: "I want to thank you for the pleasure you give my two younger children each evening, when we put on the phones and have *complete silence* for a half hour."

Wireless Wonders

Attendance at our meeting house
Was limited to one starved mouse;
Until the thought struck Deacon
Snow
To make us good by radio.

The folks they all turned out for
fair
To get religion from the air;
But Deacon must have crossed his
wire—
'Cause that dern box up in the choir

Yelled out, "Babe Ruth is now at
bat,
Dusted the plate off with his hat.
Strike one—the crowd in great sus-
Busted a homer to the fence."
pense;

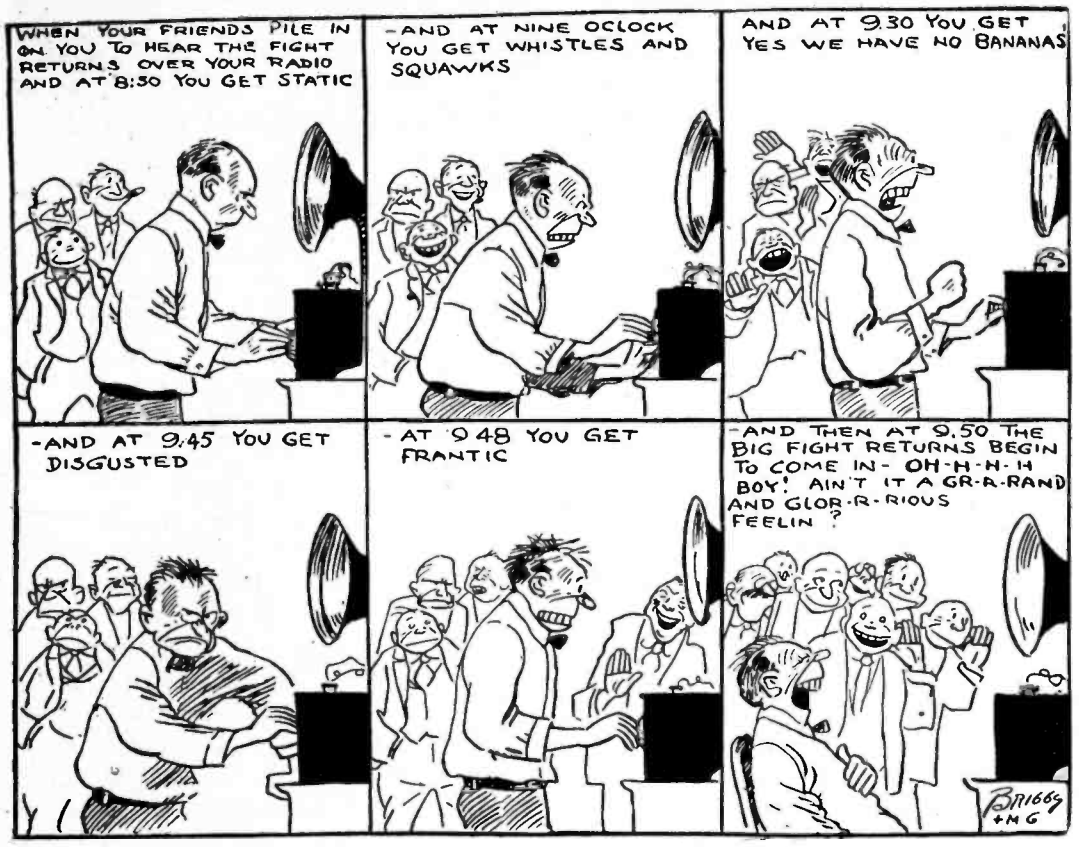
A fool kid whooped right out,
"Eeyow!"
And Deacon mopped a clammy
brow;
But our folks 'tend church as they
should,
Since science came to make us good.

—M. H. R., in Louisville *Courier-Journal.*

Wireless Wit in Cartoons

AIN'T IT A GRAND AND GLORIOUS FEELIN'?

By BRIGGS



—*N. Y. Tribune*

SAPPO

By SEGAR

—*N. Y. American*

DARK MOMENTS IN BRILLIANT LIVES

By KESSLER

—*N. Y. Evening Mail*

HOW TO TORTURE YOUR WIFE—By H. T. WEBSTER

—*N. Y. World*

WORLD WIDE WIRELESS

Radio Service Maintained Between U. S. and Japan

IN response to numerous inquiries received from the press and the public who have relatives, friends and business associates in Japan, Gen. J. G. Harbord, president of the Radio Corporation of America, announces that everything humanly possible is being done to maintain direct radio communication between the United States and Japan.

The communication between the Pacific group stations of the Radio Corporation system has been uninterrupted and in direct operation since the first news was received of the earthquake and fire which caused such havoc and destruction in Tokio, Yokohama and surrounding regions.

Dispatches have been received consistently from Japanese high-power radio plants, which consist of a transmitter at Haranomachi, and a receiver at Tomioka, which are respectively 178 and 155 miles north of Tokio. These stations were not damaged in any way and are in constant operation. The only interruption in communication with devastated regions was felt when the land line systems which link Tomioka with Tokio and Yokohama were destroyed. A substitute for these land lines is being attempted in the form of a fast courier system and other means that will expedite the exchange of messages between these two cities.

Realizing the urgency of the situation, the Japanese ambassador at Washington has just dispatched a radiogram to the Japanese superintendent of the Tomioka radio station, suggesting that steps be taken to provide means of communication between Tomioka radio station and the cities of Tokio and Yokohama, adding that the Radio Corporation is willing to meet the expense involved providing immediate connection is made with the Japanese cities mentioned.

A message just received from the corporation's San Francisco office states that the high-power radio station at Marshall, Cal., and Kahuka, Hawaiian Islands, are working direct with Tomioka, and that signals from Japanese stations are very clear and regular.

U. S. Government Radio Committee

THE United States committee of electrical and radio experts representing eight government departments having to do with radio and other electrical communications has been announced by the State Department. This committee, headed by Under-Secretary Phillips of the State Department, will meet at an early date to consider the plans and policies of the government on matters pertaining to international electrical communications.

The agenda prepared by the committee will become the basis for the United States' report to the fourth international conference when it is held in Paris. It is probable that the American delegates to that conference will be selected from the personnel of the committee. The international conference was to have been held this spring but was indefinitely postponed.

The following are the government department representatives:—

State, William Phillips, under secretary, chairman; treasury, Lieut. Zeusler, United States coast guard, and Constructor Walton, alternate; army, Maj.-Gen. George O. Squier, signal corps, and Maj. W. E. Prosser, alternate; post-office, Second-Asst.-Postmaster-General Paul Henderson; navy, Rear-Admiral W. R. Shoemaker and Commander D. C. Bingham, alternate; agriculture, W. A. Wheeler and E. B. Calvert, alternate; commerce, Solicitor S. B. Davis and P. E. D. Nagle, alternate; and United States Shipping Board, L. L. Lee, chief radio division.

The National Association of Radio Broadcasters in convention in New York City represented by Raymond Walker, C. H. Anderson, Frank W. Elliott, E. F. McDonald, Paul Klugh, W. S. Hedges, J. E. Jenkins, A. B. Cooper, John Shepard and Powell Crosby

Macmillan Greets N. Y. Show

EVEN though the polar ship *Bowdoin,* carrying Prof. Macmillan and his crew of explorers, are many hundreds of miles from New York, the men aboard ship have not lost interest in the development of radio in the United States. Saturday afternoon soon after the exposition was officially opened the following radiogram was received by the management of the show from Macmillan in winter quarters near Greenland. The message was relayed from the *Bowdoin* through the amateur station of Jack Barnesley, a Canadian operator:

"My compliments to the management and to the exhibitors. I want to congratulate all radio manufacturers in the United States for their excellent work in this great industry, which has made possible the elimination of the greatest hardships of the Arctic, namely, solitude. My sincerest compliments to you.

"DONALD B. MACMILLAN."

This is the first time a polar exploring ship has carried equipment by which the crew could be kept in touch with events in their home country.

Army Radio Service Pays

THE Army Radio net, valued at approximately $500,000, made a return to the Government of over ten per cent. during the past fiscal year, on paper. From June 30, 1922, to July 1, 1923, the traffic handled by the Signal Corps radio net would have cost the Government $66,375 at government rates via commercial wires. The actual cost of these operations was $13,840, which shows a paper saving of $52,535. Actually official messages are handled without cost, and the few private and commercial messages handled, where other radio service is not available, is charged for at slightly over commercial rates, the money being turned over to the Treasury of the United States.

During the fiscal year ended July, 120,968 official messages were handled by the Army's Message Center in the Munitions Building in Washington.

In the Army's radio net there are today thirteen main stations, 43 corps area stations and 12 air service or flying field stations, making 68 principal stations. In addition there are auxiliary stations which bring the number to 112 radio stations.

New Radio Beacons

A RADIO fog signal has been established by the Bureau of Lighthouses on the Nantucket Light Station, Nantucket Shoals, Mass. The signal characteristic consists of a group of four dashes every 30 seconds, silent 25 seconds, on 300-kilocycle frequency or 1,000-meter wavelength.

An automatic radio beacon has been established by the Canadian Government on the Heath Point Lightship off Heath Point, Gulf of St. Lawrence. The station will transmit on a wavelength of 1,000 meters with a spark frequency of 500. The characteristic of the station will be a series of groups of four dashes transmitted for a period of 60 seconds followed by a silent interval of four minutes. The elapsed time from the beginning of one group of dashes to the beginning of the next group will be four seconds. In foggy weather the automatic transmitter will be in operation on 1,000 meters continuously except when the operator is on watch. Requests for radio signals for direction-finding purposes should be made on 600 meters.

Radio Installed on Boston Fireboats

BOSTON has installed radio telephone and telegraph apparatus on its entire fleet of fireboats. Engines 31, 41 and 47 are now being equipped with the latest type tube telephone transmitters, so they can be in direct communication at all times with the fire headquarters on Bristol street, which is to be similarly equipped. Radio has thus found another means of furnishing a service heretofore unavailable to this class of fire-fighting apparatus.

The potential advantages of such communication can be readily realized at the present time, if an order is to be given to the commanders of the fireboats, it must be telephoned to some point near the changing location of the boat and relayed by messenger to its destination. This causes considerable delay and is a very inefficient means of communication.

Should a fire break out on the waterfront involving a large area, this method of communication would, no doubt, fail. Again, suppose the three fireboats were fighting a fire and another blaze should break out several miles away. This information could be instantly telephoned to the fireboat captains and one of the fleet could be dispatched to the scene of the new blaze. Radio will be an important factor in eliminating loss of time.

Foreign radio sets on exhibition at the N. Y. electrical show. At the left is a British Army short wave tuner, next an Italian Army short wave receiver, then a British power buzzer and amplifier, a combination French Army transmitter and receiver and next a long wave French Army receiver

Radio Helps Burning Ship

THE steel freighter, *Diana Dollar,* in serious difficulties in Banderas Bay, Lower California, 650 miles south of Los Angeles harbor, broadcast the need for "assistance at once," because of a "fire and explosion in number 6 hold."

It was later learned from the *Cacique,* Pacific mail liner, that the latter vessel was going at full speed to Banderas Bay from a point 75 miles distant.

Before the *Cacique* reached the burning freighter, apparently she went back to her course, as she had learned the steamer *Coahuila* and the transport *Argonne,* the former only 50 miles distant, were both rushing to the *Diana Dollar's* aid.

Giant Antenna at Koko Head

A NEW radio antenna system, six and a half miles long, with the object of protecting messages from interference and to maintain them in absolute secrecy, has just been installed by the Radio Corporation of America at Koko Head.

The antennas are strung in a direct mathematical line with the company's station near San Francisco and will receive signals on a wavelength of approximately 12,000 meters.

Radio Tests in Grand Canyon Successful

THE Geological Survey party carrying a radio set on a trip through the Grand Canyon of the Colorado, has arrived safely at Bright Angel trail. Notwithstanding the predictions of experts that it would be impossible to receive radio messages while in the bottom of Grand Canyon, Colonel Birdseye reports that he was in daily receipt of messages broadcast from Los Angeles, Salt Lake and Chicago.

Radio Set Installed in Sing Sing

A RADIO set has been installed in the death house of Sing Sing prison, New York. The idea was suggested by the prison electrician and supported by the Salvation Army. The outfit was presented to the death house by David Sarnoff, general manager of the Radio Corporation of America.

Radio in McCall, Idaho

RESIDENTS of McCall, Idaho, are among the most enthusiastic boosters in America. The town is four days from a railroad and receive mail but once every six weeks. Radio is depended upon almost exclusively for contact with the outside world.

Denver to Have Powerful Broadcasting Station

DENVER, COLORADO, has been selected as the site of the third powerful radio broadcasting station of the group to be operated by the General Electric Company, according to an announcement made recently by Martin P. Rice, director of broadcasting for that company. Work on the new station will be started as soon as the company's new broadcasting station at Oakland, California, is finished, probably in December.

The Denver station will complete the General Electric chain of broadcasting stations so far planned. WGY, at Schenectady, has been in operation for the past 18 months; Oakland, the second station, is the first to be housed in a structure erected exclusively for broadcasting equipment.

Both the Oakland and Denver stations will be modeled after WGY, so far as equipment is concerned. They will have the same power and transmitting radius as WGY which has been heard on a single transmission in every state in the Union, in England, Hawaii and countries of South America.

Radio Beacons for Airplanes

THE Army's new radio beacon system for guiding airplanes across the country is now under development, the first unit having been put into service recently at Fairfield, O.

The new aerial radio beacon is the result of experiments conducted at the radio laboratory of the Signal Corps under the direction of Capt. W. H. Murphy, of the Army, during the past months. A model directional radio transmitter was tried out at the laboratory and found operative and was later used in practical tests at McCook Field, Dayton, Ohio, up to distances of about 40 miles. Experiments with both single and crossed loops were employed, the best results being obtained with the latter.

The apparatus to be installed at these stations will be 5-KW transmitters which will send out successive signals of a distinct type every five seconds, separated directionally by 30 degrees. That is, taking the station as a center and the exact north bearing as 0 of 360 degrees, a significant code signal, such as two dashes, is transmitted. This signal would only be audible at maximum strength for each dash on the line directly north or south of the station. Rotating clock-wise or toward the right, the station would follow the initial signal by transmitting every five seconds another distinctive signal of two dots; each successive signal indicating an angular distance of 30 degrees.

Fixed ground beacons of this type are favored for air service work against the development of special direction finding equipment on aircraft, in order to keep all special equipment on the ground, and use only standard radio equipment for communication and navigation on aircraft, saving space and weight. The system is different from light-house radio beacons in that succeeding equal strength signals rotate at the rate of one revolution per minute, whereas the light-house sends them in all directions at once.

Radio Entertainment for the Arctic Trade Posts

THOUGH icebound and in darkness through the long winter months of the North Pole, trading posts in the Arctic zone will not be entirely isolated from civilization and life. According to plans made by the Hudson Bay Company, lonely posts will be provided with radio receiving sets so as to secure entertainment at any time. Two northbound ships, the S. S. *Bayeskimo* and the S. S. *Nascopie*, are carrying Westinghouse radio receiving sets to six of the posts above the Arctic Circle.

In order to determine whether or not these posts will be able to hear the concerts from the United States next winter, the ships are listening in on their way North to the broadcasts as they steam to the frigid zone. The Westinghouse station WBZ in Springfield, Mass., gave a special concert at 11 p. m., and radiograms received from the steamship *Bayeskimo* state that the music has been heard with great success.

There are hundreds of posts spread throughout Canada and North America, from above the Arctic Circle into James Bay. The ships have left these trading posts and the factors will have their sets for next winter. Although the reports received so far from the ships are very encouraging, complete information on the results obtained will be announced upon their return.

Vindication of the Loud Speaker

JUDGE Fleischmann of Ridgefield Park, N. J., decided recently that the radio loud speaker is not a nuisance. Years ago the courts ruled that the phonograph wasn't either, so it follows logically, then, that the radio has now a clear course before it, at least in Judge Fleischmann's jurisdiction.

The particular radio set in this instance is the property of Audley Walsh of 17 Overpeck avenue, Ridgefield Park. Walsh's radio outfit was equipped with a loud speaker and it was his wont to entertain the neighborhood. As many as a hundred persons were accustomed to stand and sit in the vacant lot across from the Walsh home and listen to the music and speech. An even larger crowd listened to the Marine Band concerts and the returns from the Polo Grounds the night that Dempsey put Firpo to sleep.

Everybody seemed pleased except Louis Vander Pyl, 22 Overpeck avenue, who said that the radio was a nuisance. Vander Pyl retaliated with a phonograph which he set out on his front porch and played at nights. One night it blared for eight hours, emitting the Sextette from "Lucia" 178 times until the neighborhood entertained thoughts of murder. But even an entire night of "Lucia" did not discourage Walsh, who kept on entertaining the crowd with his loud speaking radio set until Vander Pyl appealed, without success, to the Board of Health, and later to Judge Fleischmann whom he asked to silence the Walsh radio as a nuisance.

Donald Waesche, a lawyer was retained by Walsh. Mr. Vander Pyl, although not a barrister, appeared as counsel for himself. Mr. Waesche's victory was complete. The court ruled that no nuisance was discernible and that the case was closed.

KDKA and KYW Broadcast Movements of ZR-1

WHEN the giant navy dirigible ZR-1 nosed her way out of a bank of clouds within sight of her home hangar at Lakehurst, N. J., on the morning of October 3rd, she had completed a record trip to St. Louis and return. The ship covered approximately 2,200 miles during forty-six hours actually in the air.

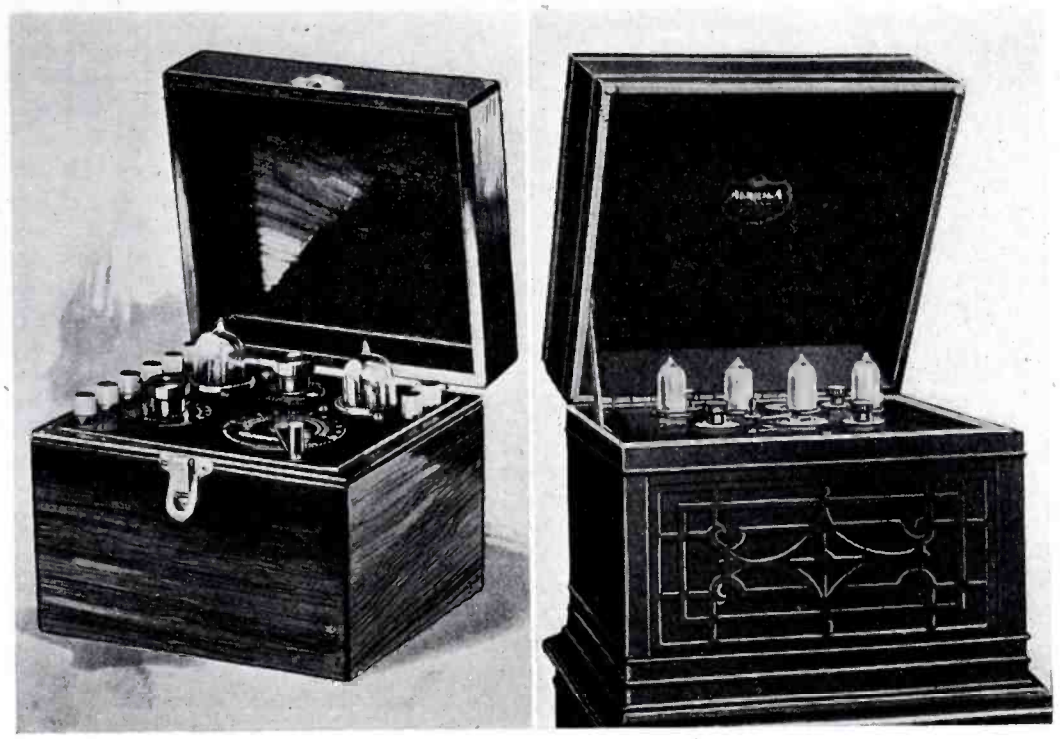
When the flight started from Lakehurst, N. J., station KDKA of the Westinghouse Electric & Manufacturing Company, located at East Pittsburgh, kept in touch with its progress. Arrangements had been made with correspondents in the different cities over which the dirigible passed to report by radio its movements. After the ZR-1 left St. Louis, Westinghouse Station KYW at Chicago followed its movements and gave a report over radio from its station every fifteen minutes.

Radio fans were advised approximately about the time when it would pass in their vicinity and were asked to keep in touch with KYW and let the announcer know as soon as they sighted the dirigible. This request was met with numerous phone calls and telegrams from many points along its route enabling thousands to keep in touch with its movements so that they could watch the flight.

The Hyper-Regenerative Receiver

By Arthur Van Dyke

THE purpose of this article is to describe a new adaptation of the regenerative principle for radio receivers, and since it is in accord with the best modern practice to name a new circuit attractively, the name, "Hyper - Regenerator" has been chosen for the circuit herein described. Mr. E. E. Bucher first suggested this arrangement to the author.



Two standard receiving sets that are suitable for use in the hyper-regenerative hook-up

This receiver has some very desirable characteristics, which may be summed up in the statement that it has all the advantages of both single-circuit and two-circuit regenerative receivers, and none of the reception limitations of either. This article will show why this is true. To restate the above startling claim, it can be said that the "hyper-regenerator" is as sensitive and as easy to operate as the single circuit receiver, and has more selectivity than any two-circuit receiver now in common use.

The single circuit regenerative receiver has two advantages, namely:

1. Simplicity of operation.
2. Greater sensitiveness than the usual two-circuit regenerative receiver.

The two-circuit receiver has two chief advantages, namely:

1. Greater selectivity than the single-circuit on large outdoor antennas.
2. Greater freedom from interference induced in the antenna by electric power machinery, such as elevator motors.

Simplicity of operation is had in the single-circuit receiver because there is only one circuit to tune to the desired signals. The two-circuit receiver is more difficult to operate because both of its two circuits must be in tune simultaneously before signals are heard, and there is no practical way of setting the two circuits independently of each other. The picking up of signals on this type of receiver is not easy, even for the expert operator who is familiar with each sound symptom. The two circuits make a combination much like that of a safe. The operation would be enormously simplified if there were some way that the two circuits could be tuned independently of each other as single circuits—then be put together and remain correctly adjusted. This is accomplished in the "hyper-regenerator." This, as well as the other features mentioned previously, will be explained later.

The most simple form of the new circuit is shown diagrammatically in figure 1.

The apparatus enclosed in the dash line square No. 1 is any good single circuit regenerative receiver. It has a regenerative adjustment or tickler, and a headset T_1. Signals are obtained in the usual manner in these headset telephones. The apparatus in square No. 2 is another single-circuit receiver, which may be exactly like the first one. This set is not connected to an antenna, however, but is short-circuited upon itself, that is, its antenna and ground binding posts, are simply connected together—later, an improved method for doing this will be described. The second receiver is placed beside the first one—if they are not enclosed in metal cases. The best position for it can be found by trial. A second headset T_2 is connected to the second receiver as shown or two jacks and a single headset may be used, in which case the headset can be worn continually and plugged into either circuit as desired. If jacks are used, the one in the first circuit must short circuit when the headset is removed, in order to close the plate circuit of the tube when the headset is out.

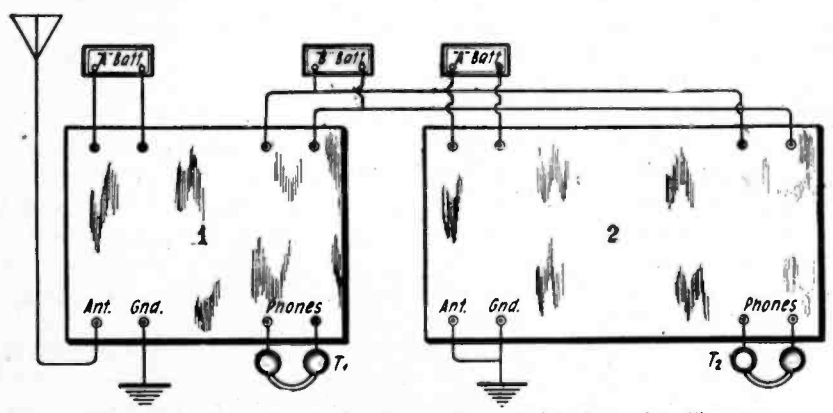


Figure 1—Two single-circuit receivers hooked-up for "hyper-regenerative" operation

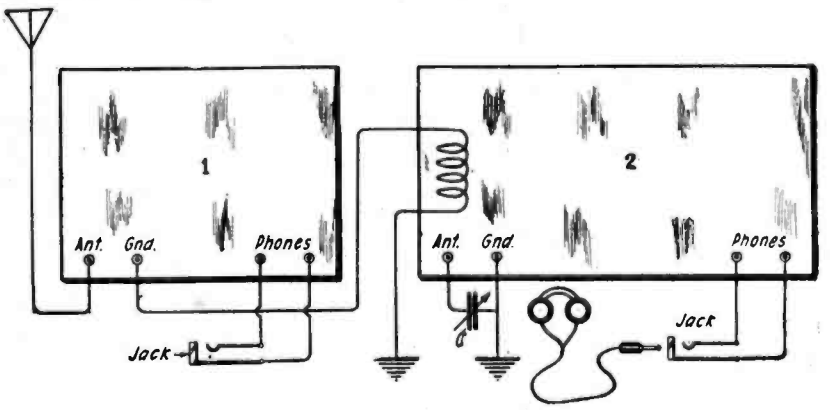


Figure 2—Two single-circuit receivers coupled to secure extreme selectivity in tuning

The two receiving sets then form a receiver with two circuits which, if operated in any one of several possible ways, has the performance and operational advantages stated at the beginning of this description.

Of course, if it is desired to use a loud speaker, an audio amplifier and loud speaker may be connected in place of the headset T_2 and the headset left connected at T_1. Later a method will be described, which does not require the use of a headset in either circuit, which is probably desirable in broadcast reception, whereas the one using headsets is preferable for telegraph communication, either amateur or commercial.

As described above, the necessary coupling between the two circuits is obtained by placing the two receivers near each other. Two tuners, such as the Radio Corporation Radiola Senior, or RA tuner, or one of each, may be placed side by side with good results. In this case, in order to vary the coupling it is necessary to move one of the sets relatively to the other. In some cases this is not convenient, and a more easily adjustable means of coupling is desirable. Variable coupling may be had by separating the two receivers by a distance of one or two feet, and providing a coil of a few (two or three) turns, which is connected as shown in figure 2. The coil can be placed inside or outside the receiver cabinet, but must be near the receiver inductance.

Figure 2 may be considered the ideal form of this receiver for reception of telegraph or telephone communication using headsets. The method of operation is to plug the headset into the first tube circuit and manip-

ulate the single-circuit receiver which is on the antenna, in the usual way. The set is then very sensitive for picking up signals. If interference is experienced, and it is desired to change to two circuits, turn on the second tube, increase its tickler coupling until the tube oscillates, and vary the wavelength control of the second set until beat notes are heard in the headset of the first set. This occurs when the secondary receiver is in tune with the primary receiver. Then decrease the tickler coupling until the receiver stops oscillating. Then move headset plug from the primary receiver, and plug into the secondary receiver. The signals will be heard immediately, and only small finishing tuning adjustments are then necessary. The coupling can be loosened to extremely loose values, far less than with the ordinary two-circuit receiver, and this increases the selectivity. Very often sufficient coupling is obtained with the two receivers—primary and secondary—placed several feet apart.

Attention is called to another detail in figure 2, namely the condenser marked "C." This is used across the antenna and ground terminals of the second receiver instead of short-circuiting them as was done in figure 1, to replace the antenna which is not used on this set. If the two sets used are identical, and one is connected to an antenna and the other is short-circuited, as in figure 1, then the tuning points on the two dials for any received signals will be widely different. Maximum convenience of operation will be had if both dials are set the same or nearly the same when in tune to the desired signals. This is accomplished by the condenser mentioned. If this is made a variable condenser, it can be adjusted until its capacity just equals that of the antenna. Then both receivers will tune at the same point on their wavelength dials. If a variable condenser is not available, a fixed condenser of the proper value will give good results. The value required is usually—to match the average antenna—300 micro-microfarads or 0.0003 microfarad. It should be noted that in the secondary receiver circuit, the condenser "C," figure 2, must be used, if the receiver is of a type which does not have a series condenser provided in its antenna circuit. All well designed receivers have this condenser, however, and it is provided in most of the modern single circuit sets.

The form of this arrangement preferred for broadcast reception may now be described. This method of arrangement is made somewhat different by the fact that an audio amplifier is necessary on one receiver —to be used as the secondary—but not on the other. The scheme is shown in figure 3. Here we may combine two receivers such as the Radiola Senior and Radiola Grand, or their equivalents. One has a suitable audio amplifier and loud speaker, and the other may have a headset, or have its "telephone" binding posts short-circuited.

In addition to the two receivers the only parts required are two single-pole double-throw switches, and a variable air condenser of 0.0005 mfd. capacity maximum. A double-pole double-throw switch to replace the two switches shown should not be used as the wiring to the switch in that case will introduce too much coupling between the circuits. Two switches must be used, connected as shown, and separated, each being near its receiver. The wiring from the second receiver to the switch and condenser must be as short and simple as possible and kept away from primary circuit parts and wires.

In figure 3 the coupling between circuits is obtained between the receivers themselves, no coupling coil being shown. It is often desirable to use a coupling coil, however, as in figure 2, in order to vary the coupling easily. The same batteries can be used for the two receivers, although with WD-11 tube sets, it is better to use separate filament batteries.

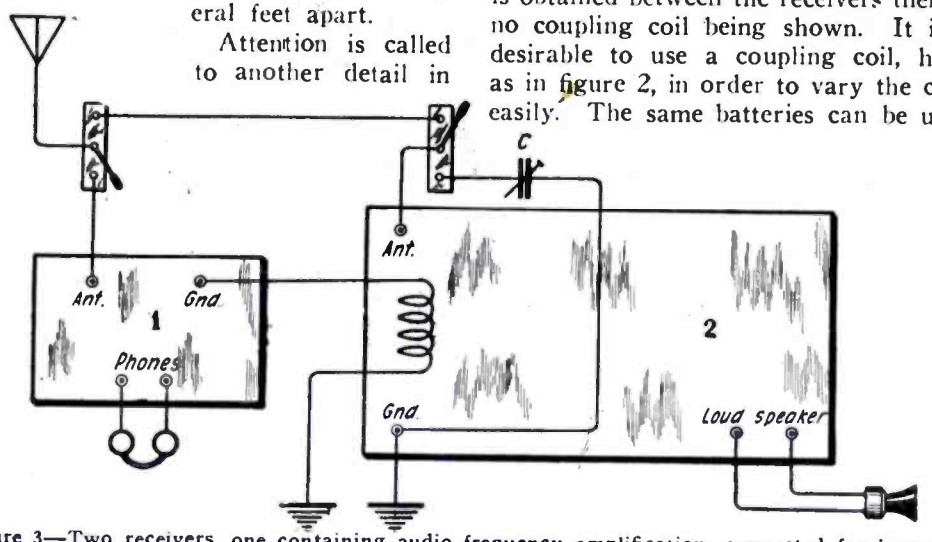


Figure 3—Two receivers, one containing audio frequency amplification, connected for improved broadcast reception

The mode of operation of this arrangement is as follows: For picking up signals and for usual operation when severe interference is not present, the simple single-circuit connection may be used. For this the two switches are thrown up. This puts the antenna on the secondary receiver which has the audio amplifier and loud speaker, and which is then operated in the usual manner, as a single-circuit regenerative receiver. When it is desired to obtain greater selectivity, the switches are thrown down. Then the tube of the first receiver is lighted and its control—wavelength and regeneration—adjusted, and also the condenser "C" adjusted until signals are heard and tuned in. Also at this time the tickler of the secondary receiver must be reduced usually because the resistance of the secondary circuit is less than that of the antenna circuit so that less regeneration is required. Note that condenser "C" is to be varied in the secondary tuning circuit, and not the wavelength control of the receiver. This is to be done the first time a signal is tuned in after connecting up the apparatus as shown, and is unnecessary thereafter. It will be seen that if a signal is tuned in with the switches up, in which condition the secondary receiver is connected to the antenna, and then the switches are put down and condenser "C" varied until signals are again in tune, condenser "C," having replaced the antenna, must be exactly qual to it. After this is done once, it need not be done again, condenser "C" may be left locked in position, and all later tuning of signals is even more simple. The process then is: Put switches up and tune in signals on the secondary receiver. To change to two-circuit operation, put switches down, decrease secondary receiver tickler coupling somewhat—if it was up pretty well before—and adjust the primary receiver wavelength and tickler controls.

There are several methods of operation, other than the one described, and some of them may appeal to certain readers more than the one described. It is not desirable to describe all these methods in this article. It should be possible for each experimenter to study out the method he likes best. The fundamental theory of the arrangement should be kept in mind. It is a two-circuit receiver, differing from the ordinary two-circuit type in the important respect that both circuits are regenerative, instead of only one, as in the ordinary two-circuit regenerative receiver. Since the effect of regeneration is to reduce the effective resistance of a circuit, when both circuits are made regenerative both circuits have, and therefore the whole system has, very low resistance. The ordinary two-circuit regenerative receiver reduces the resistance of the secondary by regeneration, but not that of the primary to any extent. Since the sharpness of tuning, the selectivity, in ordinary two-circuit receivers, depends very largely upon the resistance of the system, being greater as the resistance is less, it is increased materially by use of this arrangement. Use of looser coupling than customary with two-circuit receivers is also possible and this adds to the selectivity.

Looser coupling also adds to the nicety of operation in several ways. For example, with such loose coupling, tuning of either primary or secondary does not affect the other, and there is no mutual dependence, due to reaction, as in the ordinary receiver. This is especially valuable in C. W. telegraph reception where pitch of beat note is not affected by primary circuit adjustment. The "hyper" connection can be used as an ordinary two-circuit receiver, of course, by not lighting the tube of the first receiver. The set is then equivalent to an ordinary two-circuit receiver, and the enormous improvement in the hyper arrangement is obvious as soon as the tube is turned on and its tickler adjusted. Another way of looking at this arrangement is that the tube in the first receiver is a stage of radio frequency amplification. But since it is tunable, it is a very efficient radio amplifier stage, and is about equal to two stages of broad transformer coupled radio amplification.

The arrangement which has been described has the same sensitiveness, or slightly greater, perhaps, as the single circuit receiver. Greater sensitiveness can be obtained by more complicated connections of two receivers than are used in the arrangement shown here, but it is believed that this arrangement is the best, because of its simplicity, and ease of operation accompanied by selectivity of very high degree. The selectivity of this method is, in fact, the greatest that it is possible to obtain by methods dependent upon resonant tuning, and the excellent results obtained by its use will satisfy even very exacting experimenters and broadcast listeners.

Some Notes on Receiving Antenna Resistance

By Samuel C. Miller

THERE has been quite a bit of confusion in the mind of the amateur in regard to the factors which cause and make up the resistance of an antenna system. Due to the amateur's lack of knowledge as to these factors, he will go into unnecessary expense in the construction of the antenna system without obtaining any benefit whatever. This holds true even for those who have had a good electrical training because it is not realized that the phenomenon of high frequency or radio frequency is different than that obtained in a simple direct current, or 60-cycle alternating current, circuit.

In a direct current circuit, if two factors are known, then the third can be easily obtained by simple calculation. For instance, in figure 1, there is shown a dry cell connected across a lamp and coil in series. An ammeter is also placed in the circuit to read the current. The dry cell has a terminal voltage of 1.5 volts, the lamp a resistance of 1.0 ohm and the coil a resistance of 0.5 ohm. The current flowing in the circuit can therefore be found because the voltage and resistance are known. Using the formula $I = \frac{E}{R + R_1}$ where E is the voltage of the cell, R the resistance of the lamp and R_1 the resistance of the coil $I = \frac{1.5}{1 + .5} = 1$ ampere. This can be checked by the ammeter in the circuit.

A 60-cycle alternating current circuit is shown in figure 2. It consists of 110-volt supply across a 10-ohm lamp and a coil which has a wire resistance of 5 ohms and an inductance of 0.1 henry. The current flowing in the circuit as indicated by an A. C. ammeter can be solved by using the formula $I = \frac{E}{\sqrt{R^2 + X^2}}$ where E is the voltage, R is the ohmic resistance of the lamp and coil and X the reactance of the coil. The reactance is found from the formula $X = 2\pi fL$ where f is the frequency and L the inductance. Therefore $X = 6.28 \times 60 \times .1 = 37.6$ ohms. With the reactance = 37.6 ohms and the resistance = 15 ohms therefore $I = \frac{110}{\sqrt{15^2 + 37.6^2}} = 2.7$ amp.

To those unfamiliar with alternating current or direct current theory, it is my point not to give a lesson in the subject of solving problems, but to show that in direct current and low frequency alternating current circuits, it is comparatively simple to solve a problem to find a factor when the other factors are known. This can be accomplished with formulae readily available. However, in radio circuits, which deal with high frequency alternating currents and especially in that branch consisting of the antenna system, only very indefinite general laws are available and the calculation of each antenna system must be made separately. For instance, there are two antenna systems each having the constants as shown in figure 3; that is, each system has a 100-foot horizontal wire of the same diameter wire and identical 50-foot lead-ins. One antenna is located 25 feet above an apartment house while the other antenna is located 25 feet above grassy ground. On measuring the resistance of each it will be found that the resistance of the system located on the apartment house will be much higher, in fact, two to three times that of the antenna system located above the grassy ground. This seems surprising because they are identical in construction, even to the size of wire. If direct current or low frequency alternating current theory was applied, the two would give equal resistance results. But in dealing with radio frequency new factors enter which are more important than the ohmic resistance of the wire.

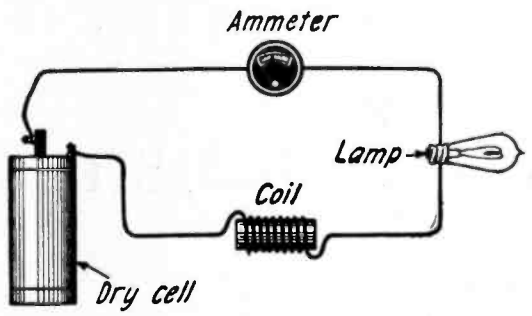


Figure 1

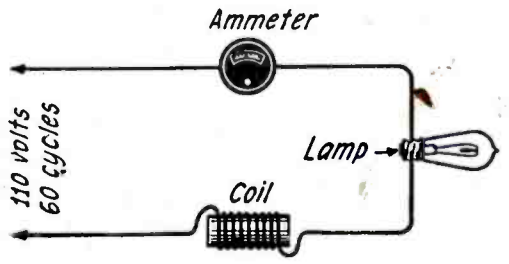


Figure 2

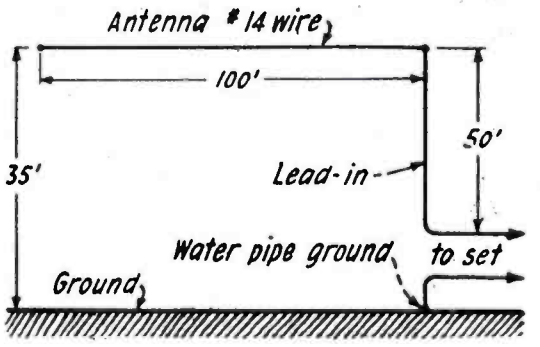


Figure 3

Methods of determining resistance in various circuits

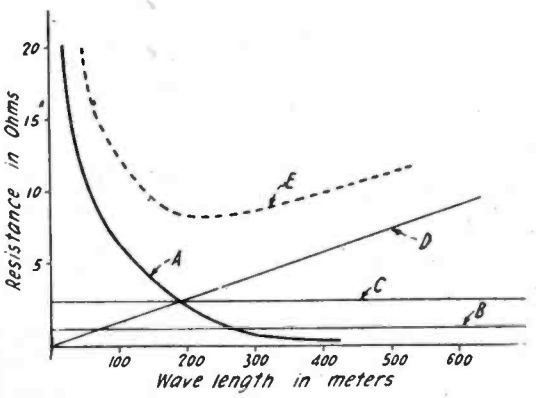


Figure 4—Graphs showing wavelength and resistance

As in a transmitting antenna system, a receiving antenna system can be said to dissipate the power absorbed by it, in four ways: first, radiation resistance; second, ohmic resistance of the wires; third, ground resistance; fourth, dielectric resistance.

The first of these, radiation resistance, represents the only useful agent, as upon it depends the amount of power that is actually impressed on the receiving circuit. This is represented in figure 4 by curve A. Figure 4 is a chart where the resistance is indicated on the ordinates and the wavelength by the abscissa.

The next source of dissipation of power is that due to the ohmic resistance and includes the losses in the antenna and lead-in wires. Because of the eddy current and skin effects due to the high frequencies in the wire, the resistance will vary with wavelength, but as the losses caused are small, the ohmic resistance can be taken as constant, irrespective of wavelength. It is therefore represented by a straight line "B" in figure 4.

The ground resistance is also an ohmic resistance and depends on the location of the station. Stations near water and good moist or grassy grounds will have a lower ground resistance than stations located on sandy or rocky ground. The straight line "C" in figure 4 is shown as a resistance which is constant irrespective of wavelength.

The dielectric resistance is caused by a dissipation of power through dielectric absorption. This is due to the fact that the antenna capacity is an imperfect condenser and therefore losses occur in the medium between the antenna wire and lead-in as one side and the ground and other masses such as buildings, iron pipes, etc., as the other side of the condenser. It is in this dielectric resistance where most of the losses occur in the average antenna systems and which constitutes most of the resistance, making the other factors, ohmic and ground resistance small as compared to it. The dielectric resistance is indicated by curve "D." For example, it has been found that the dielectric losses due to an antenna lead-in running parallel for a short distance to a grounded iron pipe caused a great increase of resistance in the antenna system. As any increase of antenna resistance means decrease in signal strength, it can be seen that it is important to keep down the resistance due to dielectric losses.

Going back to the comparison made earlier

of two identical antenna systems, one placed over a grassy ground and the other over a building, the reason becomes apparent why the antenna system over the apartment house will have a higher resistance than the one over a grassy ground. The ohmic and ground resistance in each case is the same, but the dielectric losses in the concrete and iron of the apartment house will be very much higher than the losses occurring in the air between the antenna and grassy ground. The resistances in the apartment house antenna will be divided approximately as follows: Ohmic resistance = 1 ohm; ground resistance = 2 ohms; dielectric resistance = 25 ohms; a total of 28 ohms, which is average for such an installation. On the other hand, the antenna over grassy ground will have approximately 3 ohms for ohmic and ground resistances and only 6 ohms for dielectric resistance, giving a total of 9 ohms which is representative of this type of installation.

Many suggestions have been submitted at various times for decreasing receiving antenna resistance by using heavier antenna wire or twisting many wires into a cable. If the antenna system were to be used for transmitting or for reception on the higher wavelengths, considerable gain would be obtained by careful choice of wire and form of flat top. But for reception on the shorter wavelengths, any decrease obtained in the ohmic resistance of the antenna is so negligible compared to the existing dielectric resistance that the extra expense involved is actually a waste of money.

In general, when constructing an antenna system for reception on short wavelengths the ideal is one consisting of a single wire 100 feet long and 25 feet or more above a grassy ground. Such a system has approximately a fundamental wavelength of 200 meters, a capacity of .0005 mfd. and a resistance of 10 ohms.

Certain precautions, however, should be observed in the construction of the antenna system in order to keep the dielectric losses, and therefore the resistance, as low as possible.

First—Keep the antenna and lead-in wires as far as possible away from buildings and grounded metallic conductors such as iron drain pipes, fire escapes, iron chimneys, etc.

Second—Be sure the ground lead is solidly connected to the ground, whether it be the radiator, water pipe or any other metal going into the earth. The best thing is to solder this connection, keeping in mind that solder will not hold if there is any grease or dirt on the point of contact. Be sure and scrape off any paint or foreign material before making this connection.

Third—Whenever possible stretch the antenna over a grassy ground and avoid bringing it close to buildings or trees. When connecting the antenna to a tree, bring the wire to a distance of about 8 or 10 feet from the tree and then insulate and guy the rest of the way to the tree. This should be carefully observed especially when using bare copper wire. If the antenna wire is brought in among the branches, a large loss will occur, particularly in rainy or damp weather.

A Method of Continuous Wave Transmission on 100 Meters

By F. W. Dunmore
Associate Physicist, Bureau of Standards

AT the request of the Chief of the Air Service, the Bureau of Standards undertook an investigation on a method of continuous wave transmission at 100 meters. The operation of electron tube transmitting sets working at longer wavelengths than 150 meters has been carefully studied by many radio experimenters, but methods of transmission at 100 meters and the nature of such transmission over any considerable distance has not been much investigated up to the present time. It is the object of this report to describe the method developed, the details of the circuits used, and the results of some of the tests made over distances up to 300 miles.

Type of Antenna

As a coil antenna is an effective radiator when the ratio of wavelength to coil dimensions is not large, and since a coil antenna is a somewhat directive radiator, an antenna somewhat on this order was developed. It is a combination of the capacity type and the coil type of antenna. The power is coupled in at the center of the lower horizontal section of the antenna. The antenna consists of a number of wires in parallel in the form of a rectangle with a gap in it. The antenna thus includes substantially a single-turn inductance coil and a condenser. The condenser is formed by covering the two wooden spreaders with copper foil. The glass rods between the two spreaders are efficient insulators. The parallel wires composing the antenna are 23 No. 20 B. & S. gauge bare copper wires connected in parallel and spaced three inches apart. Light wooden spreaders are placed about every 4 feet in order to keep the wires separated. The size of the antenna is 18 feet high and 40 feet long. The above combination, with the three-turn secondary coil connected in series, forms a circuit with a wavelength of 105 meters.

The circuit used was somewhat similar to the Meissner circuit. Western Electric type G 50-watt tubes were used, four of these being operated in parallel. With this combination about 6 amperes at 105 meters were obtained in the antenna. The tubes were found to operate more satisfactorily with 32,000 ohms shunted by a 0.002 microfarad condenser connected in the grid circuits. A similar condenser shunted by a 50-ohm resistance, in the high voltage supply circuit, helped to stabilize the operation of the tubes. For operation at 105 meters, it was found that the primary or plate coil "B," should consist of two turns of heavy copper strip 2 inches wide. This coil, shunted by a 0.002 microfarad mica transmitting condenser, gave the required wavelength of 105 meters.

For the grid coil a 14-turn helix was used. A tap at 5½ turns from the center gave best operation. The coupling between this coil and the plate coil was rather critical.

To transfer the power to the antenna, a secondary coupling coil was used. This coil consisted of three turns of brass strip, 1 inch wide. This coil was connected in series with the antenna.

For interrupting the continuous wave, for I. C. W. work, a chopper was used. This chopper was connected in series with the lead from the filament circuit to the radio-frequency circuit.

Results Obtained

Numerous tests have been made with this type of short wave transmitting set. Mr. Frank Conrad, of the Westinghouse Electric and Manufacturing Co., has kindly co-operated with us in making these tests by arranging to have an operator listen at his station, 8XK, in East Pittsburgh, Pa.

To date five tests have been made with the above station. The first two tests were made at night. Signals were reported as received at East Pittsburgh with an audibility of approximately 1,000 on a detector and one stage of audio amplification. An interesting fact in connection with these tests was that there was practically no fading. The above tests were also heard at Boston, Mass. Two-way communication was maintained with the 8XK station on both tests.

The evening tests were so satisfactory it was decided to investigate the daylight transmission effects. Continuous tests were therefore made on two occasions starting at 12 o'clock noon and running into the evening up to 10 p. m., in order to compare the relative signal strength of day and night transmission. It was expected that at such short wavelengths the received signal strength would be much less during daylight than at night.

The results of the first daylight-darkness tests were as follows: The signal strength at 8XK was reported to be about 100 audibility both during the day and evening. A detector and one stage of audio-amplification was used for reception. The fact that the signal strength was the same during the day as in the evening is a very interesting one as, at short wavelengths especially, it has been held that the absorption would be much greater during the daytime than at night. No conclusions can be drawn upon this point until a number of tests have been made. The weather was rainy at the transmitting end and cloudy at the receiving end on the day of the first tests. Another interesting point which was noted was the lack of fading. Further tests are needed to confirm the results with respect to this unexpected condition.

(*Continued on page* 59)

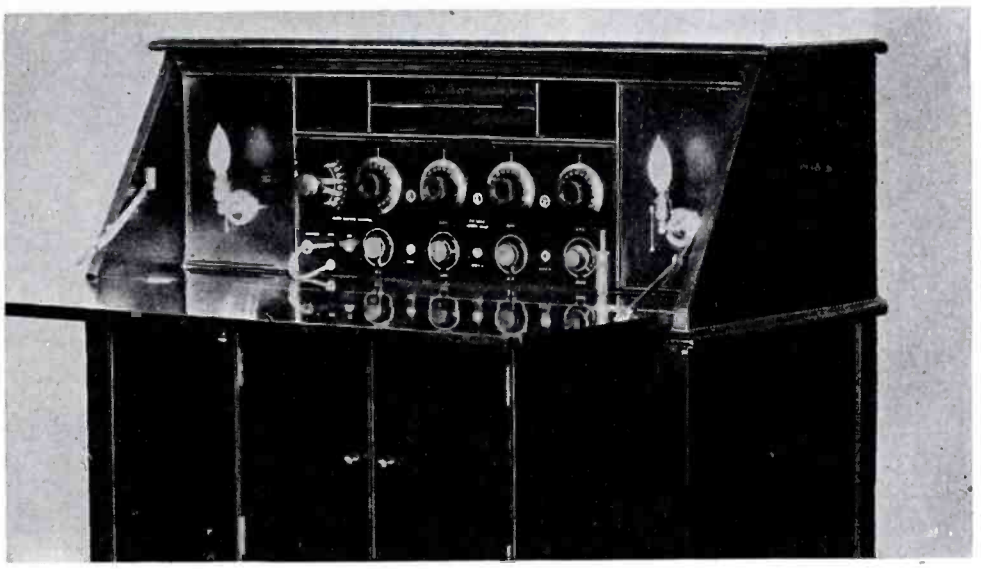
Tuned Radio Frequency Amplification

A Reactance Capacity Coupled Circuit Remodeled to Suit Present Broadcast Reception Suitable for Use With a Loud Speaker on Distance as Well as Local Reception

By Leon W. Bishop, 1XP

RADIO frequency amplification has been the subject of much discussion for ten years, but it is only in the last few years that we have been able to get good results on the shorter wave bands.

Fully 90 per cent. of the radio frequency circuits employ transformers of fixed ratios for a given wave band and in some instances use iron to broaden the range. No matter what method is used to broaden the band with a fixed ratio transformer, there is still one band that is favored while the efficiency drops off rapidly on either side.



A tuned radio frequency amplifying receiving set designed by the author

There is no need of a double circuit tuner when several stages of tuned radio frequency are used and where a slight amount of regeneration is present. In figure 1 let the dotted line represent a given wavelength and point A the tuning point of the single circuit. If the first tube is tuned to this exact point, regeneration will occur, but a place on either side of A will be found

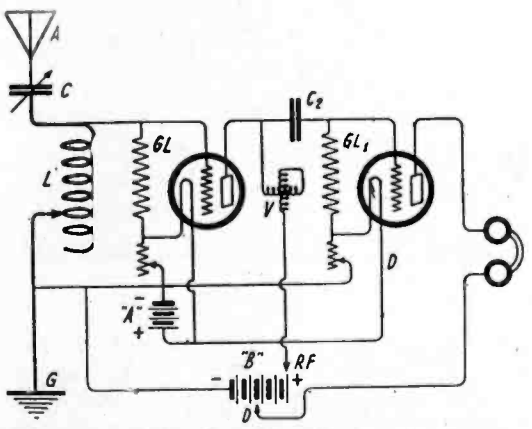


Figure 1—One stage of radio frequency and detector circuit

where no regeneration occurs and the amplification is normal. The point C represents the tuning peak of the second tube and it may be seen that the relative positions of B and C may be reversed so as to minimize interference from local sources. The third stage is shown by D and is not critical of tuning, due to the great amount of amplification delivered to it by the first two stages, however a wide range of selectivity may be obtained by using this stage in connection with the second.

Figure 2 shows one tuned stage of radio frequency and detector. The variable condenser C is .0005 mfd. (23 plates). The tuning inductance L consists of 60 turns of No. 22 wire wound on a four-inch tube and tapped every 10 turns. V is a variometer and should be free from shellac on the windings. The success of this circuit depends upon the grid leaks and for that reason it is best to use a variable grid leak. The first grid leak GL is about one megohm, and the second or detector grid leak GL_1 is about one-half megohm. The grid condenser C_2 is of the mica type and .0005 mfd.

The high vacuum type of tube is best for the radio frequency circuits, while the standard type of detector tube is best adapted for the detector circuit. The B battery for the first radio frequency tube should be from 45 or 67½ volts, and the detector voltage should be that amount recommended by the manufacturer for the particular tube used.

The grid leaks should be adjusted to the point where only a small path of regeneration occurs when tuning the variometer. A variometer may be used in the plate circuit of the detector tube with increased amplification, but also increased tuning troubles.

Figure 3 shows three tuned stages and detector. The aerial circuit is the same as that described in figure 2. The fixed condenser C_1 of .001 mfd. is of the mica type. The grid leaks on the first and second tubes should be capable of adjustment as low as 10,000 ohms. A 300 or 400-ohm potentiometer P is connected across the A battery and the negative B battery returned to it. A separate tap is provided for the first stage of radio frequency while the second two stages are connected to the same point on the positive B battery. As much B battery as possible should be used on the radio frequency tubes up to about 90 volts. The proper amount is determined by trial.

The phones should be shunted with a .002 mfd. condenser, to prevent capacity feed back.

For those interested in power amplification, figure 4 shows three stages of radio frequency and two stages of audio frequency amplification. The radio frequency part of the circuit is the same as that shown in figure 3. The fixed condenser C_3 is .002 mfd., the point X to be connected to the negative side of the filament and not to the negative side of the A battery.

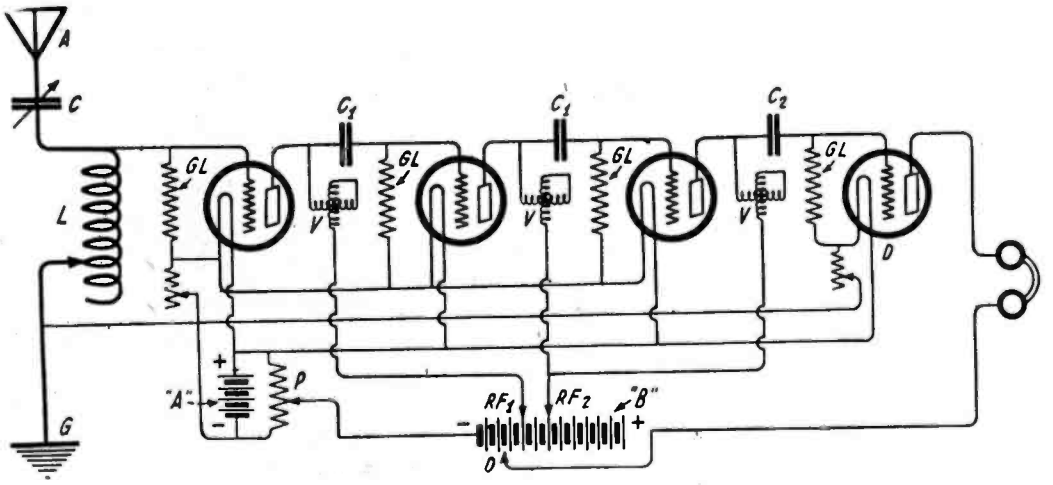


Figure 3—Circuit diagram of a 3-stage radio frequency and detector set

Figure 5 shows an outline of the panel, which is 22 x 8 inches, for those wishing to follow the design.

The results obtained with this circuit depends upon two points, first, the adjustment of the grid leaks, and second, your knowledge of tuning.

Radiotron 201-A tubes are the best for all of the amplifiers, and may be used for the detector, but the old standard detector tube UV-200 with proper plate voltage, seems to give the best results. When distance reception is the object, the voltage on the plate of the first radio frequency tube should be lowered, but when volume is desired this should be increased.

The dials should be set to correspond with the variometers. That is, the dial should be at zero when the variometer is at minimum, as readings obtained on various stations have a meaning and the same station will always appear at a given point providing the values of the grid leaks have not been changed in the meantime.

When the circuit is first used regeneration will run wild, but this can be controlled by decreasing the grid leaks. The leak on the second tube is most critical and is always the lowest, sometimes in the order of 10,000 ohms. As the leaks are decreased tuning becomes broader, but it is advisable to have a path of regeneration on the first variometer. When regeneration enters into this circuit it comes on with a bang and all signals stop. The greatest signal strength is obtained on either one side or the other of the regenerative point and close to it.

Once a rough setting of the grid leaks are obtained the third variometer dial can be set at 75 and the second dial at 40, tuning the first variometer and aerial condenser to a given signal, using both hands in the operation. The tuning may be finished up by a final setting of the second and third variometers.

The most active part of the first variometer dial is the first eighth of the dial, the second variometer the middle half and the third is active over the last half. This is the normal condition, but many variations may be tried that are more selective.

While various points of regeneration may be found, it must be remembered that this type of regenerative set will not produce interference with other receivers in the neighborhood.

This circuit is taken from the old British practice of reactance capacity coupling and remodeled to suit our present broadcasting reception. The circuit is designed for use with a loud speaker on distance reception as well as local. Stations 1,500 to 2,000 miles away may be reproduced in the loud speaker with wonderful volume and no distortion. Indoor types of aerials may be used with success and also loops for local work. This set greatly reduces interference from local stations as well as static.

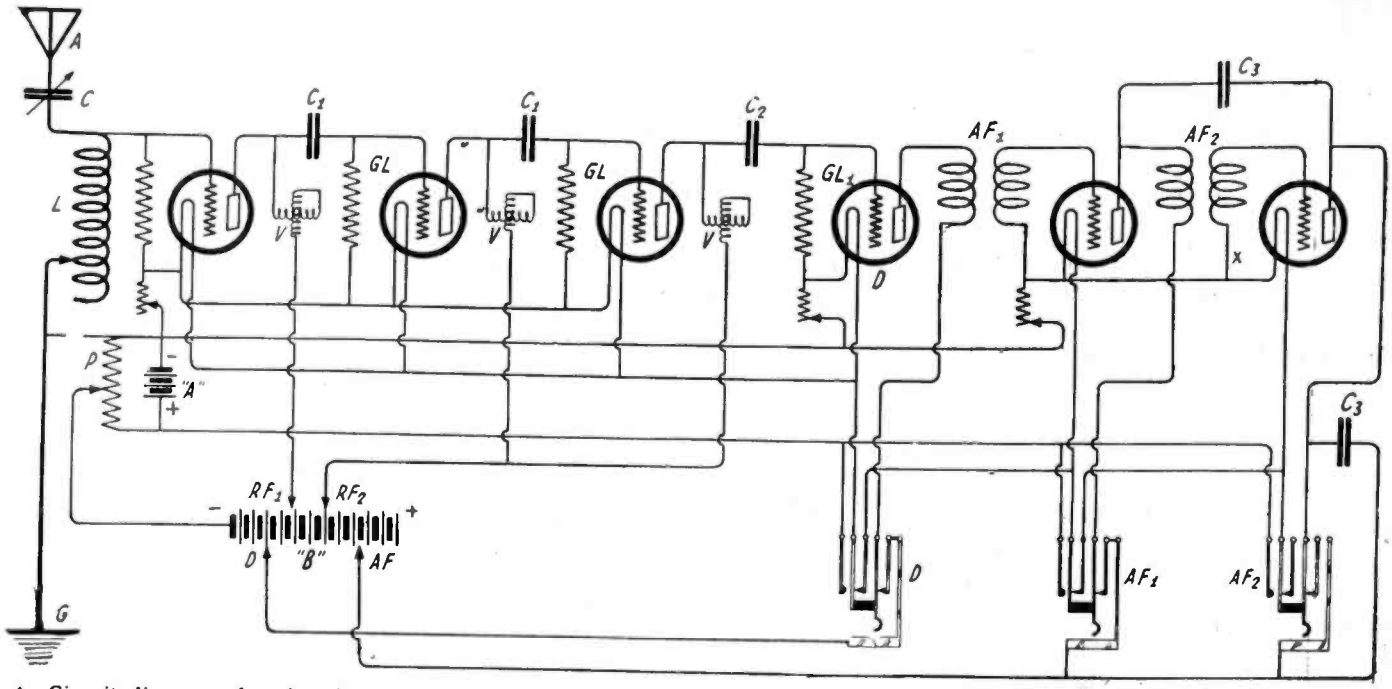


Figure 4—Circuit diagram of a six-tube set having 3 stages of tuned radio frequency, detector and 2 stages of audio frequency amplification

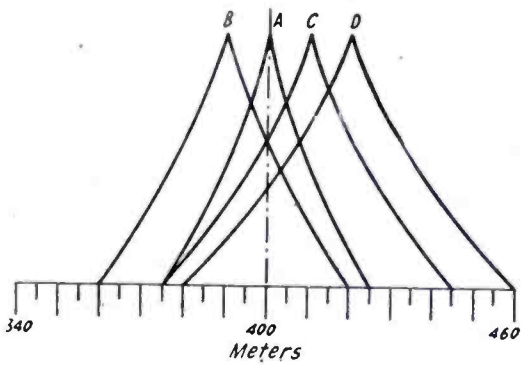


Figure 1—Tuning graphs

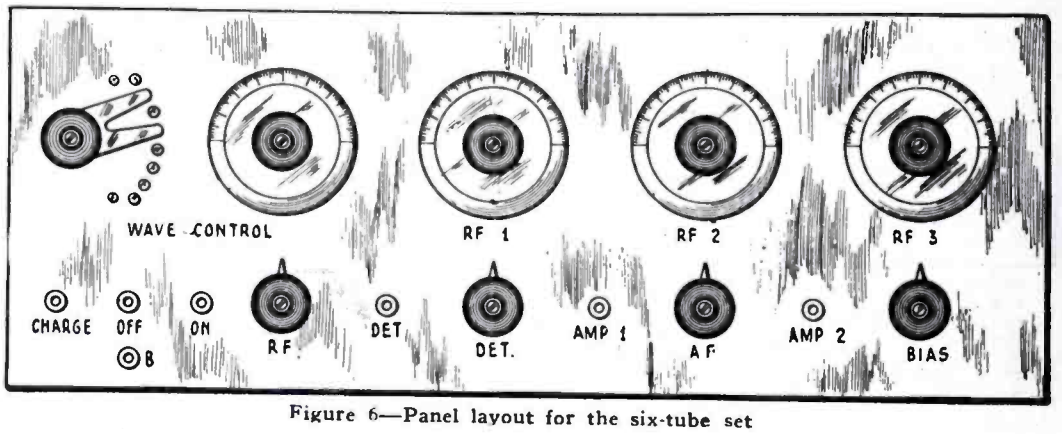


Figure 6—Panel layout for the six-tube set

Key to Diagrams—A, aerial; A, A battery; AF, audio frequency; B, B battery; C, .0005 variable condenser; C_1, .001 fixed condenser; C_2, .0005 fixed condenser; C_3, .002 fixed condenser; D, detector; G, ground; GL, grid leak; GL_1, detector grid leak; L, tuning coil; P, potentiometer bias; RF, radio frequency; V, variometer.

Civil Service Examination for Telegraph Operators

THE United States Civil Service Commission announces an open competitive examination for telegraph operator to fill vacancies in the Bureau of Agricultural Economics, Department of Agriculture, at an entrance salary of $1,400 a year, plus the increase of $20 a month granted by Congress, and vacancies in positions requiring similar qualifications.

Applicants must have had at least two years' experience as telegraph operator, such experience to have been acquired with any of the large commercial telegraph companies, with any of the large press associations, in the general relay offices of any large railroad, or with any private concern operating a leased-wire service, such as newspapers, brokers, packing houses, etc.

Competitors will not be required to report for examination at any place, but will be rated on their education, training, and experience, on a scale of 100, such ratings being based upon competitors' sworn statements in their applications and upon corroborative evidence. All applications must be in by December 28.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil-service examiners at the post office or custom house in any city.

Six More Stations for United Fruit Co.

Powerful 20 K. W. Radiotron Transmitting Sets to Be Installed in Central America and the United States to Perfect a Communication System Between the Americas

SIX vacuum tube radio transmitters, to be the most powerful stations of this type on the American continent, and first to make use of the General Electric 20-kilowatt Radiotron, are being installed by the United Fruit Company and the Tropical Radio Telegraph Company at points in Central America and the United States for the purpose of completing the links of an adequate communications system between the Americas. These transmitters will be located at: New Orleans, La.; Miami, Fla.; Puerto Barrios, Guatemala; Tegucigalpa, Honduras; Managua, Nicaragua, and Almirante, Panama.

The Tropical Radio Company operates the stations at New Orleans, Miami, Tegucigalpa and Managua, while the stations at Puerto Barrios and Almirante are operated by the United Fruit Company.

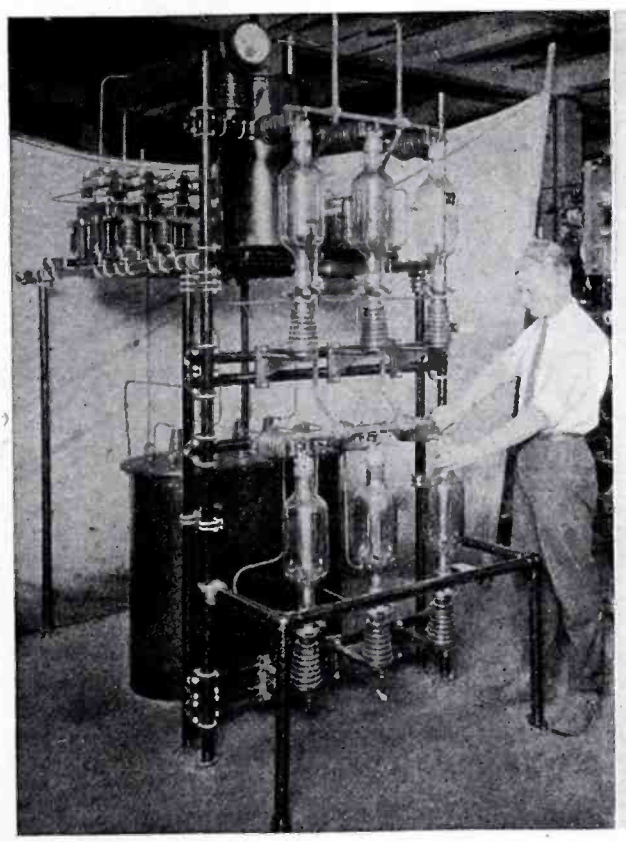
The first of these six sets has just been completed at the Schenectady works of the General Electric Company and will be shipped within a few days to the Tegucigalpa station. The other five are scheduled to be completed and shipped at the rate of one a month. About two months will be required to install each set and it is therefore expected that all six will be in operation by the middle of next year.

The United Fruit Company established the first radio stations in Central America and was the first to establish commercial radio communication between Central America and the United States in 1904. The operation of these stations convinced the directors of the United Fruit Company that radio was practical and valuable in a business which handled such a highly perishable product as the banana. So the year following, or 1906, stations were opened at Bluefields and Rama, Nicaragua. All these stations. because of the lack of land communications, handled, in addition to the company's business, a large share of the telegraph business of the general public between these places and the United States and Europe. Other stations have followed since then until now, with the six new tube transmitter stations, there will be a total of nineteen, comprising the United Fruit Company's radio system. All stations of the United Fruit Company's system, including all their ships of the "Great White Fleet," are to be equipped with tube transmitters of a similar type.

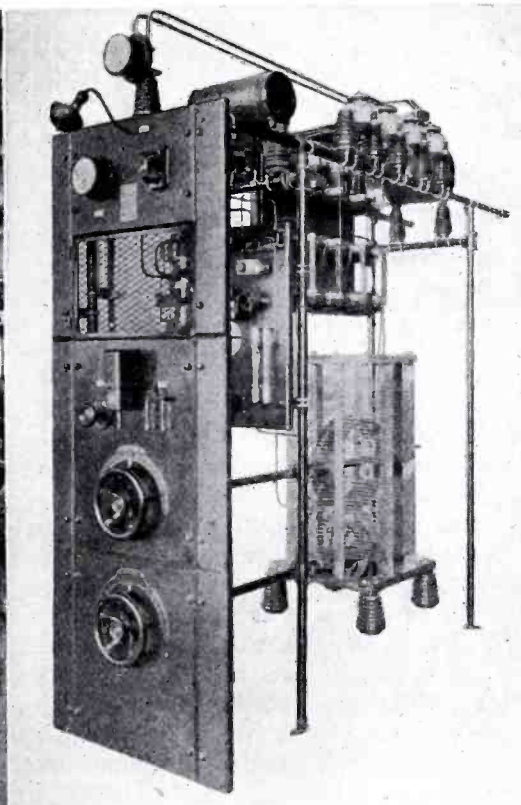
The United Fruit Company has spent more than $3,000,000 in the development of its radio system and upon the completion of new stations under construction its investment in radio will probably exceed $4,000,000. Since 1911, the radio activities of the company in all its branches have been under the immediate direction of George S. Davis, who is general manager of their radio telegraph department. He is also president and a director of the Wireless Specialty Apparatus Company, general manager of the Tropical Radio Telegraph Company and a director of the Radio Corporation of America.

In the operation of these transmitters, in some cases where stations are located in remote places, the primary power is generated at the station by gas or oil engine driven alternators supplying 220 volts. In other stations the power is obtained from the distribution system of local power companies. This power first goes to the service panel where complete apparatus for control, protection and metering is installed. Then it goes to the rectifier, which consists of a bank of transformers and six, twelve and one-half kilowatt kenotrons. Here the voltage is stepped up and rectified, to become 15,000 volts direct current. This high voltage is then used for plate power on the pliotron oscillators.

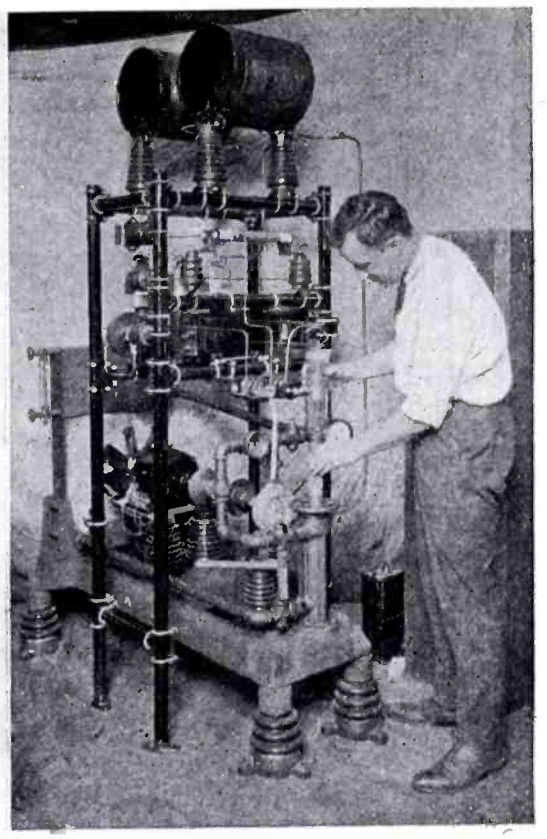
The frequency is controlled by means of a master oscillator employing a one-kilowatt pliotron. The master oscillator provides a lower power radio frequency supply, which is then amplified to twenty kilowatts of power by means of one of the new water-cooled twenty-kilowatt tubes. The amplified power is passed through a tank circuit which eliminates harmonics and is then fed into the multiple tuned antenna. Keying is accomplished by means of a relay on the master oscillator unit. This relay may be controlled from any desired distance and is adapted to keying speeds up to sixty words per minute.



Kenotron rectifier unit of the 20 K. W. transmitting set



The master oscillator for use with 20 K. W. transmitting equipment



20 K. W. water cooled tube unit

Minerals That Are Used As Crystal Detectors

By Dr. E. Bade

THE electrical properties of certain minerals and crystals, which permit a high frequency current to flow more freely in one direction than in another, have made the crystal detector receiving set universally popular, especially near a broadcasting station. A fragment of such a mineral, adapted for this work, rectifies the high frequency radio waves, and it is this unilateral conductivity, with its one direction current, which actuates the phones, in other words, it changes the radio-frequency waves into audio-frequency waves.

In order for the mineral to do this, it must possess certain properties. In operation it must resemble a valve which permits a flow when there is pressure in back of it, but it must shut off this flow, when the pressure is released, that is, it must prevent a return flow. This is accomplished by the internal structure of the crystal detector.

The most common of such minerals which have this inherent "valve-like" property, are the sulphur compounds of the heavier metals of lead, copper, iron, and molybdenum. The sulphide of lead is about the most sensitive crystal, as it rectifies the radio-frequency currents much more thoroughly than any other mineral, although some of the new synthetic crystals are quite good for this purpose.

Galena, the sulphide of lead, is the peer of all crystal detectors. Usually only a fragment of the mineral is taken, the fracture of the break cleaves into three different planes which are at right angles to each other. This cubic cleavage, as it is called, is demanded by its structure, for, it is composed of an almost infinite number of minute particles which have a regular arrangement and relation to each other. These tiny, minute particles have, in the course of time, gradually been brought together, and, like a structure, which has been built up block by block, so the crystal has formed and increased in size by its own individual "blocks."

Not every piece of galena is sensitive to radio reception, one face or the other being valueless for this purpose. By turning the mineral around, a sensitive spot may be found. If this does not help, simply splitting off a thin sheet on one side will usually lead to the desired result. Never throw a crystal away simply because a sensitive spot cannot be found. Take a sharp pointed knife and split off a fragment uncovering a fresh and untarnished cleavage surface. Nine times out of ten this will produce the desired effect. A piece less than 1/16 of an inch gives far better results, at times, than a thicker, chunkier piece, although this is not always true. A piece of galena must be tested before it can be said that it is sensitive.

Galena not only finds a restricted use in radio reception, but it is of far greater importance as an ore for lead, sheet lead as well as pipes, etc., being made from it. One third of the annual production of lead is used in making paints and is permanently lost. But strange to say this important metal is not so much mined for its content of lead, as for the silver which is associated with it, the lead being only an incidental product of manufacture.

Another sulphide used for radio but of little commercial importance, is that of iron, the pyrite as well as the marcasite. The former are cubic while the latter are spear-shaped. Both are but slightly sensitive.

The sulphides of copper are sometimes used for detectors in radio reception. Chalcopyrite and bornite, both important ores for copper, are comparatively rare in crystal form. These two types of minerals have been successfully used for rectifying high frequency currents of radio waves.

A sulphur compound of molybdenum, molybdenite also has the property of unilateral conductivity and can therefore be used as a detector. This lead-gray mineral, metallic in appearance, is seldom found in large quantities, and is quite difficult to obtain. It is one of the more important ores for this element which finds its greatest use in the hardening of steel, as a fireproofing material, and as a coloring matter for rubber and leather.

The oxide of zinc, zincite, primarily found in New Jersey, has been one of the

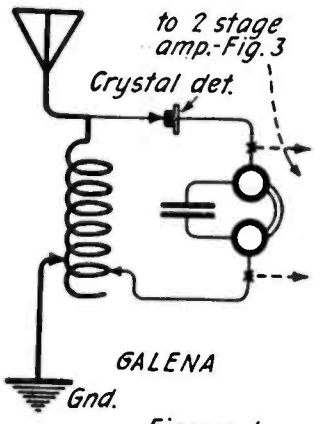


Figure 1

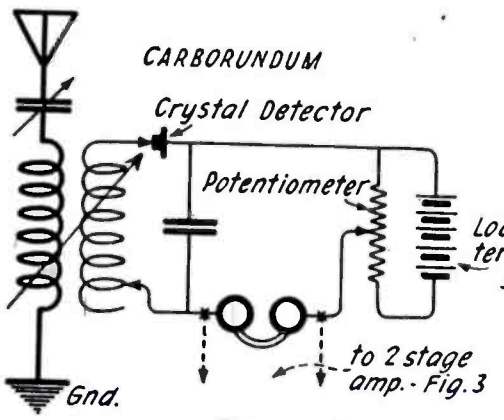


Figure 2

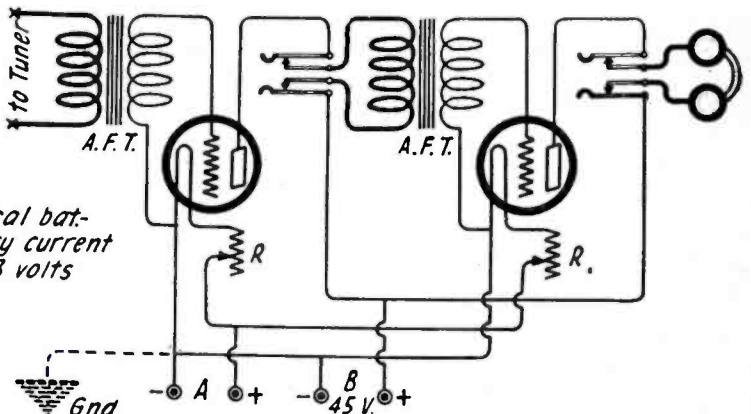


Figure 3

Receiving circuits using crystal detectors and two-step audio frequency amplifying unit


Marcasite


Carborundum


Galena


Silicon

more successful minerals used as a crystal detector. In fact, when a fragment of zincite, or a tiny crystal of it, is placed in contact with either chalcopyrite or bornite, the well known Perikon detector is produced. This combination is very successful, in fact some persons prefer this type to galena, the more universal detector. To make a detector of this type, take a larger fragment of the copper ore, embed it in a low melting alloy and place in the detector cup. Mount the tiny crystal of zincite in a similar way on the rod carrying the cat-whisker or mount it on a short piece of wire and attach this in place of the cat-whisker. The point of the tiny zincite crystal is then brought in contact with the copper mineral whereupon rectification will occur.

Another mineral having unilateral conductivity is cuprite, a copper oxide. It is the most abundant element and still it is never found free. By igniting a mixture of pure sand and magnesium in a clay crucible, amorphous silicon is obtained by the sudden reaction which occurs, the entire mass developing intense heat. When cooled, white magnesium oxide which is soluble in dilute acids and amorphous silicon which remains unattacked, is produced. The crystalized silicon is obtained by adding the silicon powder to molten zinc or aluminum. Here it dissolves, and on cooling, octahedrons or crystal leaves are formed. These can be obtained by dissolving the metal in acids whereupon the silicon remains. On a commercial scale it is prepared by heating a mixture of coke and sand in an electric furnace to a very high temperature. Carbon monoxide is given off and silicon remains as a silvery, metallic appearing substance highly crystalline and very brittle.

Crystals of carborundum, the silicide of carbon, also possesses the peculiar property of unilateral conductivity. It is prepared like silicon, the difference being that more coke is employed and the heating continued for a longer period. Silicon is the product first formed, but this silicon again reacts with the excess carbon present uniting with it. This is carborundum, and appears as beautiful purplish black crystals of extreme hardness. When this artificial crystal is employed as a detector for the rectification of high frequency currents, it is advisable to employ a small constant potential across the terminals. This will increase the sensitiveness of the compound.

Figure 1 is a simple crystal receiving apparatus using silicon, galena or synthetic crystal without a local battery current and figure 2 shows a similar type using carborundum or zincite bornite crystals which depend upon the combined effects of the receiving energy and a local battery current for effective reception. While code signals of a damped wave character can be received over considerable distance with a receiving apparatus of this kind, undamped or C. W. signals cannot be converted into audible sounds. Modulated or voice signals (broadcast) can be received from stations within a thirty-mile radius provided that head phones are used. For sufficient volume to operate a loud speaker with the types shown in figures 1 and 2 a two-stage audio frequency amplifier, figure 3, should be added. Comparing the receiving range of this apparatus with a vacuum tube detector, in place of the crystal it is found that the tube is superior in long distance reception. However, the crystal gives much clearer and undistorted signals.

Figures 4 and 5 show the crystal detector employed in the reflex circuit. Regardless of the crystal employed a local battery current is not supplied. The crystal here acts as the detector after the incoming current has passed through the radio frequency amplifier, but it has nothing to do with the volume of the detected and rectified signals. The audio frequency circuit figure 3, can be used effectively in circuits 4 and 5 in producing greater volume.

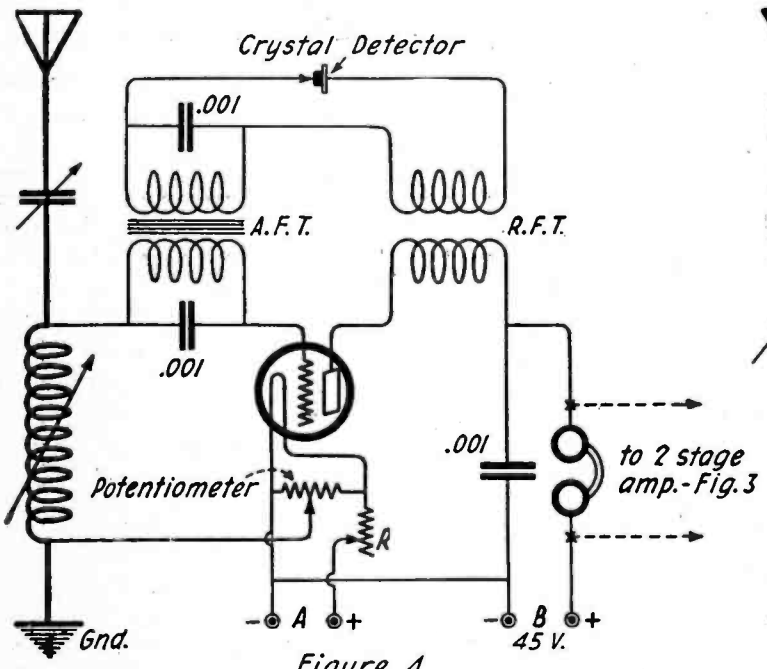


Figure 4

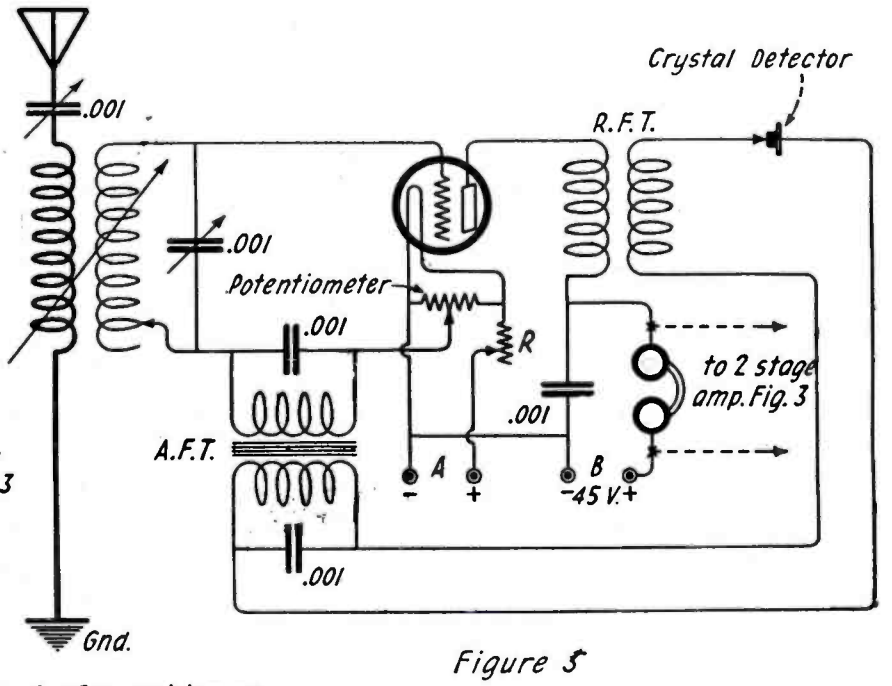


Figure 5

Circuit diagrams of reflex receiving sets

not especially valuable as a detector, but it is important as a copper ore.

A detector widely employed by the Marconi company, until recently is cerusite, a lead carbonate. It has been formed by the decomposition of galena by waters charged with carbon dioxide gas and as such it is found on top of galena itself. This mineral is of great importance as a source for lead.

Some of the rarer elements can also be used as rectifying detectors. One of little commercial value, but finding a restricted use as a detector is tellurium. This is a very rare mineral element producing small hexagonal crystals and are primarily found in Colorado and in Transylvania. Arsenic has also been used for this purpose, although the crystals, which occur free in nature, are comparatively rare.

The non-metallic boron is never found free in nature, but still it can be used to rectify high frequency currents. The element is prepared by heating the chloride of boron in an atmosphere of hydrogen to a very high temperature. The resulting pure boron is dark gray in color and almost as hard as a diamond. In this condition it can be used as a detector.

Crystallized silicon is another artificial rectifier of radio frequency waves. This element is considered second in importance to galena as a detector. Next to oxygen it is

The Deaf Hear With Radio Amplifiers

ACCORDING to a recent dispatch from London, a 77-year-old man, who has been deaf for thirty years, has heard once more through the use of radio receiving apparatus. Tests conducted at Marconi House, London, indicate that not only this man but a great many others, including some who have been deaf from birth, are able to perceive music when amplified to great volume by means of radio amplifiers.

Some of them actually hear the sounds, if any portion of their auditory nerve is active, no matter how deeply buried within the head it may be.

Others are only able to feel the rhythm of the vibrations. In other cases the success of these tests has strained the emotions of the engineers who have witnessed the joy of those who find themselves perceiving sounds for the first time in years, or even in their lifetime.

Experiments will be continued to develop this phase of radio so that it may be applied in a practical manner.

Characteristics of Airplane Antennas

By E. Bellini

(Translated from the Radio-Revue of Paris)

THE antenna that is customarily employed on airplanes consists of a cable some 40 meters (132 feet) long, provided with a weight at its end. This weight can be rolled up or unrolled according to the need, or even cut in case of danger. In full flight this antenna takes the form shown in figure 1. The ground, or more properly the counterpoise, consists of the metal in the airplane, such as the motors, guy wires, etc.

This antenna is very efficient, but it presents the defect of being strongly directional both in transmission and reception. Figure 2 shows a diagram of the energy radiated in different directions by such an antenna, the airplane being at a distance of about 10 kilometers (6 miles) and at a height of about 1,600 meters (5,280 feet). The maximum energy is radiated in a direction opposite to the free end of the antenna. In the case of figure 2 the maximum energy is 54 times greater than the minimum. This figure varies according to the angle of elevation of the airplane, the length of the antenna and the speed, as well as some other factors, but the ratio is always more or less high. In consequence if the airplane flies directly away from the receiving station on the ground, the two will be able to work by radio only during a relatively limited time.

The shape of the airplane antenna varies according to the speed, but always remains strongly inclined to the vertical and never by any chance approximates a horizontal position in normal flight. One can then easily see that an airplane antenna must have characteristics that are quite individual, compared with vertical antennas, loops or other aerials installed on the surface of the earth. The situation is not less complicated by the fact that an airplane can occupy all positions in space, and may even fly over the receiving station. Tests, long and delicate, have confirmed these conclusions.

Figure 3 shows the curve of volume of reception when the airplane flies at a constant height of 1,600 meters (5,280 feet) in a vertical plane passing through the receiving antenna. The received energy increases in exact proportion with the approach of the airplane to the receiving set, attains its maximum at a distance of about 1,500 meters (4,950 feet) before reaching a vertical position over the receiver, then diminishes very rapidly and becomes practically zero at a distance of about 200 meters (660 feet) before passing over the receiver. The volume then increases anew and attains a new maximum, inferior to the first one, about 500 meters (1,650 feet) after having passed over the receiving set. The volume then diminishes uniformly. If the airplane instead of flying exactly over the station on the ground passes by at one side, the maximum and minimum become less accentuated, but the general form of the curve remains the same.

An identical phenomenon is noted when one wishes to receive in an airplane transmissions from a station on the ground. The volume of reception for any location of the airplane in space varies according to the angle that the axis of the airplane forms with that of the ground station. Extremely delicate tests made with the aid of receiving apparatus employing galvanometers installed on board of an airplane have furnished a diagram of the received energy practically identical with that of the transmitted energy of figure 2. The received energy is at its maximum in the direction opposite to the free end of the antenna. The ratio of the maximum energy to the minimum energy is the same as was shown in receiving tests in the reversed direction. In a general way, when a receiving airplane flies over a transmitter on the ground, the received energy varies according to the manner observed and charted in figure 3.

The directional qualities of an airplane antenna are not sufficiently well defined to make them of service in radio compass work, except in a very rough way. These direc-

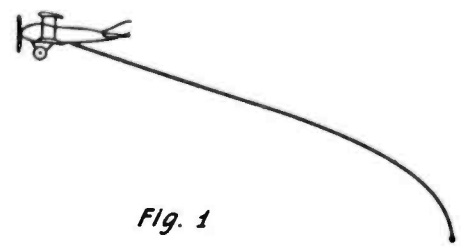


Fig. 1

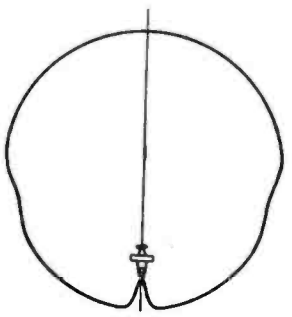


Fig. 2

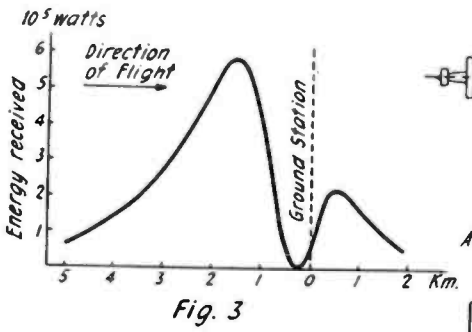


Fig. 3

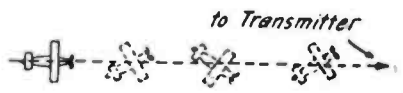


Fig. 12

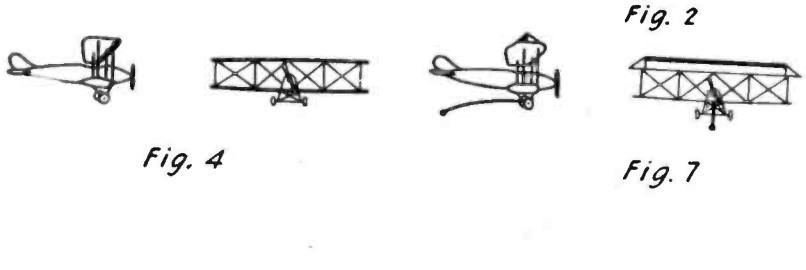


Fig. 4

Fig. 7

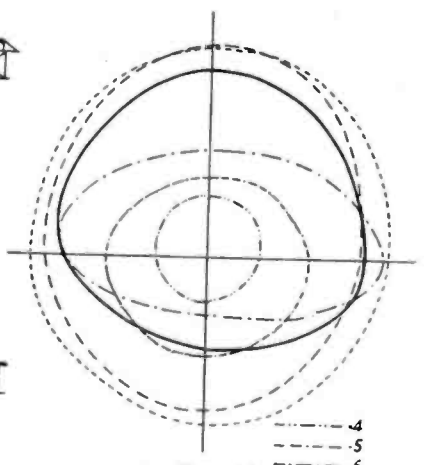


Fig. 10

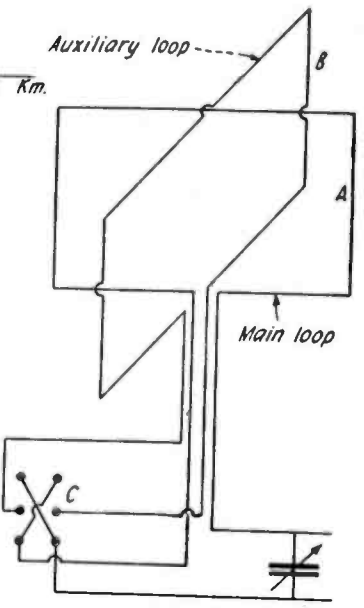


Fig. 13

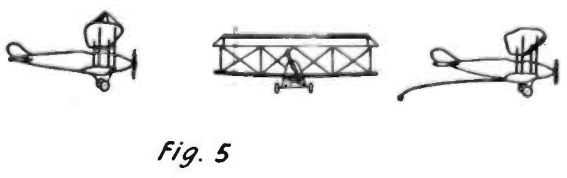


Fig. 5


Fig. 8


Fig. 6


Fig. 9

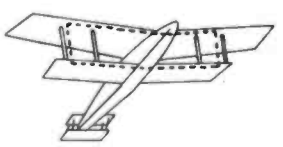


Fig. 11

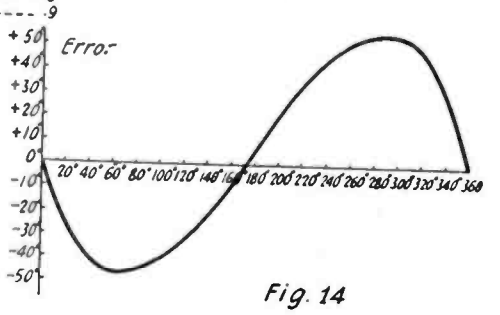


Fig. 14

Details and characteristics of antennas for airplanes

tional qualities therefore, may be considered to be a detriment rather than an advantage. For that reason and for others, efforts have been made to provide airplanes with non-directional antennas. More or less success has been realized in employing antennas whose general types are indicated in figures 4 to 9. Figure 10 shows the diagrams of the energy radiated by these different types. These exceedingly interesting tests were made in Germany.

The diagram shows that these particular antennas are not at all directional, or are very slightly so. The diagram also shows, on an arbitrary scale, the relative radiated energies. The trailing antenna of figures 6, 7, 8 and 9 are 7½ meters (23¼ feet) long and bears at its extremity a weight of 500 grammes (one pound). It is easy to see that the trailing antenna loses its directional properties if it is shortened and if its counterpoise extends at right angles to it and at a sufficient distance. Unfortunately, we do not possess data upon the ranges of these antennas, compared to that of the conventional trailing antenna of figure 1, and it is feared that the range realized is much too reduced. Only additional tests can give us this information.

Radio compass work on board an airplane, and also on the ground, in order to ascertain the direction of a machine, is of the greatest importance. It permits the pilot to recover his course in mist, cloud or storm, while to the men on the ground it affords the opportunity of aiding friendly aircraft and discovering the position of enemy flyers.

Radio compass work on board an airplane can be accomplished in four different ways. First, in placing on the airplane a single loop of as large size as possible, preferably following the leading edges of the upper and lower wings, and thus being at right angles to the trailing antenna, as shown in figure 11. This system permits the pilot to ascertain the direction of a transmitter by swinging from side to side in his course, as shown in figure 12. These maneuvers, however, may become complicated, and cause the loss of time and of distance, which is generally inadmissible. The system, however, has the advantage that its receiving range is great.

Second, in placing a single small loop inside the body of the plane, the loop pivoting around a vertical axis. This permits of direction finding without changing the course of the plane. Its range, however, is limited.

Third, using the Robinson system shown in figure 13, which consists of two perpendicular loops, A and B, one within the other, one turning around a vertical axis. The windings are in series with a series-parallel switch C providing parallel connection as well. When one of the loops is directional with the transmitter, changing the series-parallel switch produces no change in the received signal. The rotatable loop, known as the "main loop," (*cadre principal*) is directed toward the transmitter. The other loop, the "auxiliary," has two or three times more turns than the first. This system avoids, somewhat, confusion caused by external sounds for instead of listening for minimum signal volume, one tunes for the maximum, and reads the position by the aid of observing the equality of the signals in the two positions of the switch. However, from the point of view of range this system is no better than that using a single loop, and may even have a lesser ability in distance work.

Fourth, using the Bellini-Tosi system with its tuned antennas, one antenna is placed longitudinally in the plane, following the axis of the craft, while the other is transverse at right angles. It is not necessary that the two have the same shape, provided that they enclose the same surface. In fact, it is the custom to give the axial aerial a slightly smaller surface than that of the transverse one, in order to compensate for the errors produced by the metallic masses of the engine and its equipment. By experiment it is possible to compensate for this error. In the three preceding installations no such compensation is possible, and a correction table or curve is necessary.

However, other factors sometimes prevent the turning loop and the Bellini-Tosi systems from revealing the exact position of an airplane. If the plane flies directly toward or from the transmitter, the position indicated by the apparatus is exact, regardless of the distance and height of the plane. This, however, is the case only when the transmitter is located at the destination of the plane, or in a line passing through the aircraft and its landing field, which is not always the case. Also, when the airplane is far distant or very low upon the horizon, that is to say when its elevation is small, the radio compass work is quite exact, independently of the course of the plane. But in all other conditions, as when the plane is not in line with the transmitter, and is relatively high above it, errors are noted. The error increases with the elevation of the plane and with its position, attaining its maximum when the plane presents its side squarely to the transmitter. An error as great as 60 degrees has been noted.

Figure 14 shows the curve of this error, taken in a particular case. In this, the scale in degrees represents the angle between the axis of the plane and that of the ground station; O corresponds to the position of the plane flying directly toward the transmitter, 90 degrees, the plane presenting its right side, etc.

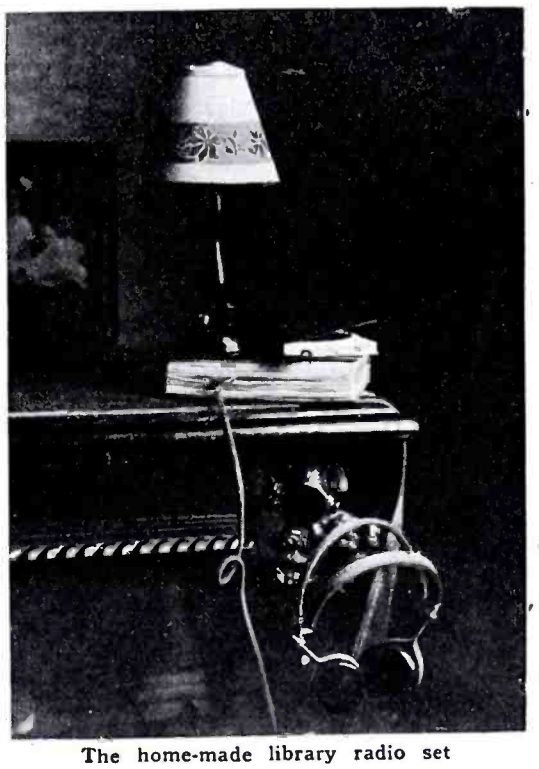
Methods have been tried for determining both the direction and the position of an airplane, but so far none of them have given positive results, and it can be said that we do not as yet possess a radiogoniometric method for locating planes. The systems we have been considering, it should be noted, have afforded only the direction of the horizontal projection of the direction of the plane, and not the actual position in the sky. However, the tests made with planes provided with antennas as shown in figures 4 to 9 have indicated results that are exact enough for practical purposes.

ALBERT C. EISELLE of Cleveland Heights, Ohio, has received 168 broadcasting stations in four countries: the United States, Canada, Cuba and Porto Rico. The following stations have been heard with two tubes:

KHJ	Los Angeles, Calif.	2,100 Miles
KGW	Portland, Oregon	2,100 Miles
KLZ	Denver, Colo.	1,250 Miles
KFAF	Denver, Colo.	1,250 Miles
KDYL	Salt Lake City, Utah	1,600 Miles
CFCN	Calgary, Alta., Canada	1,650 Miles
CJCG	Winnipeg, Man., Canada	1,000 Miles
PWX	Havana, Cuba	1,300 Miles
6KW	Tuinicu, Cuba	1,400 Miles
WCM	Austin, Texas	1,175 Miles
WFAA	Dallas, Texas	1,100 Miles
WBAP	Fort Worth, Texas	1,110 Miles
WOAI	San Antonio, Texas	1,250 Miles
WAAB	New Orleans, La.	1,000 Miles

A Home-Made Library Radio Set

THE structural details of the home-made radio telephone receiving outfit of Arthur B. Pierce of Washington, D. C., do not constitute the proverbial "open book." In reality, the apparatus, for the most part, is concealed between the covers of a book. Then, too, while the butcher, the baker, and the candlestick-maker may be interested in wireless telephony, this individual is probably the first person to utilize a candlestick as a harmonizing influence in the arrangement of wireless instruments in a library.



The home-made library radio set

Mr. Pierce calls it a "library radio set." Two books and a candlestick are the household units that serve to harmonize the radio telephone installation with the conventional equipment of a home library. One of the books, occupying a lower position on the library table, contains within its pages the four binding posts and wires essential to the operation of the wireless receiving set, with the exception of the tuning coils. The latter, of the spider-web type are concealed within the covers of a smaller book, and they are readily operated by merely opening and closing this book.

The crystal detector occupies a position at the base of the candlestick; the concealment of this sensitive mineral not being attempted, since to the casual observer it has the semblance of an electric switch. Moreover, when the candlestick is lighted, its illumination is reflected directly on the crystal.

This "library radio set" is in complete harmony with the furniture in the midst of which it is installed. The mahogany candlestick corresponds with the table and its shade with the wall-paper.

Wavelength versus Kilocycles

By Walter A. Cohen

THE Radio Conference at Washington recommended that the tuning adjustment of a broadcasting station be expressed as a frequency in kilocycles rather than as a wavelength in meters. The present texts and most articles until recently have used the wavelength terminology, so that some of the fans had difficulty in tying up meters with kilocycles. For the benefit of these, the present article is written.

The transmission of a broadcasting station is not limited to a single frequency or wavelength but for the proper transmission of speech or music, so called side band frequencies are necessary including in all, a band of about 10,000 cycles or 10 kilocycles. As the frequency varies inversely with the wavelength, the number of meters included by this 10,000 cycle band will vary with the wavelength upon which the station is operating. Thus, at 200 meters, a 5,000 cycle band either side of the fundamental would include wavelengths from 199.3 meters to 200.7, a band of only 1.4 meters, while at 600 meters, a 10,000 cycle band would include wavelengths from 594 to 606 meters, a band of 12 meters. Thus it is seen that the new method of expressing the frequency in kilocycles rather than the wavelength in meters is by far the easiest and by far the most comprehensive system to use. This is the basis of the new broadcasting schedule whereby the country is divided into districts and each station is separated in a given district from the next by at least 10,000 cycles, thus obviating interference and permitting simultaneous operation of stations.

Knowing the wavelength, it is quite easy to compute the frequency by means of the simple formula shown below:

$$n = \frac{v}{\lambda}$$

where n equals the frequency in cycles, λ the wavelength in meters and v the velocity of propagation of electromagnetic waves, 186,000 miles or 300,000,000 meters (almost) per second. Substituting in this formula for 200 meters, we arrive at the following results:

$$n = \frac{300{,}000{,}000}{200} = 1{,}500{,}000 \text{ cycles}$$

This is rather a large number to express and handle conveniently and so, for convenience, we divide v by 1,000, expressing it in kilometers instead of meters and our result n is then expressed in kilocycles, in the present case, 1,500 kilocycles, a much more convenient figure.

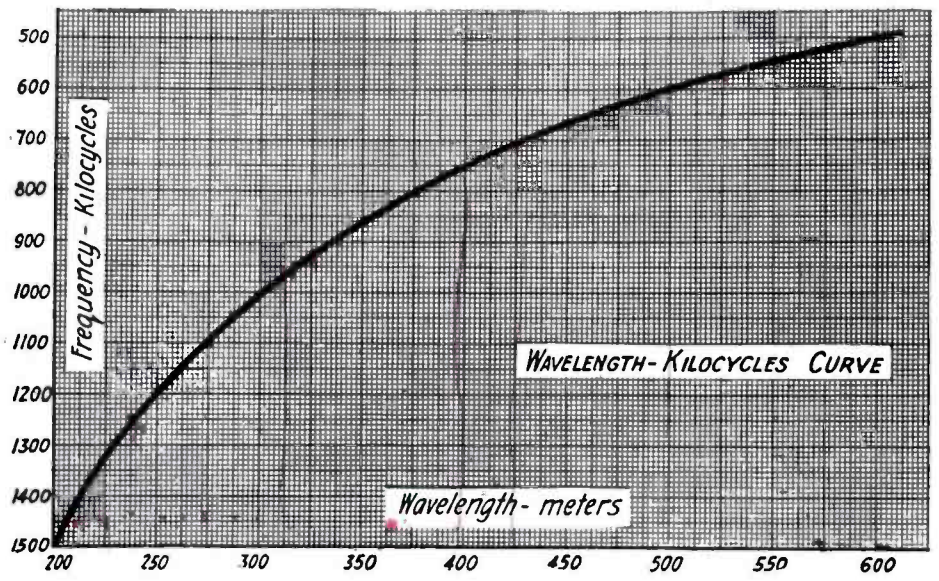
Conversely, knowing the frequency, we may obtain the wavelength by transposing the above formula and we then have:

$$\lambda = \frac{v}{n} = \frac{300{,}000}{1{,}500} = 200 \text{ meters}$$

However, to obviate the use of even this simple calculation, the appended curve will prove useful for ready reference. The ordinate or vertical column is expressed in kilocycles and the abscissae or horizontal column in meters. Thus knowing one value we may easily and quickly find the corresponding value. A practical example follows:

Suppose we wish to find the wavelength so that we may tune in a station listed in the broadcasting column of the newspapers as 833.3 kilocycles. We search in the left hand column of the curve for 833.3. Here we find 10 small divisions between each 100 kilocycles. Therefore each small division must represent 10 kilocycles. Thus we will find 833.3 three and three tenths spaces below 800. Having located this point, we follow to the right in a horizontal line until we intersect the curve. From this point we drop down perpendicularly to the bottom of the sheet where we will find the wavelength. Here, each small square represents 2½ meters, and as the point sought is four small spaces to the right of 350, the wavelength must be 350 plus 4 x 2½ or 360 meters.

Having the wavelength given, to find the number of kilocycles, we just reverse the process.



Graphic curve to determine wavelength in kilocycles or meters

My Martian Radio Signals

By Old Timer

RADIO has its perennials. Mysterious signals, presumably originating somewhere off in space, most likely on the planet Mars, constitute one of our best radio perennials. Every twelve months the mysterious Martian signals again come up for a column or two of newspaper space, a few statements from the leading scientists, a due share in everyday conversation, and the forefront of the stage of our imagination.

I happened to be working for a large radio company back in those early days. Down in the lower end of New York City, off to one side of the towering buildings of the financial district, my employers maintained a stock room and small assembly shop on the ground floor of a six-story loft building. In order that we might test radio receiving sets, we had a small four-wire antenna on the roof, with a long single-wire lead-in coming all the way down to the first floor by way of a chimney. I am free to confess that such odd moments as I could get away from less pleasant tasks, I put in testing receiving apparatus and listening to the dot-dash messages which then filled the air. There were the slow and cumbersome Continental Code messages and the light, rapid, staccato Morse Code messages. The Marconi stations and ships employed the former, while the American radio stations and ships employed the latter.

In the course of my experiments, I conceived the brilliant idea of making a super magnetic detector. That form of detector has long since passed out of existence so far as everyday radio is concerned. At any rate, lest you do not know what a magnetic detector is, I am going to explain it in a few words. The magnetic detector consists of a primary winding, connected with the antenna and ground, and a secondary winding connected with the telephone receivers. A pair of permanent magnets is arranged so that the two north poles and the two south

poles are close to the coils. Passing through the coils is a band of soft-iron wire, which moves through the coils and over two grooved pulleys by means of clockwork. The signals, flowing through the primary coil, induce a current in the secondary coil which flows through the receivers and produces audible sounds.

Now my super-magnetic detector made use of a five-kilowatt open-core transformer—a huge spark coil, in brief, since it was a Telefunken coil made just like a spark coil such as you would find in the well equipped physics laboratory. I had a simple means of agitating the soft-iron core so as to simulate the action of the moving band of iron wire of the real magnetic detector. The primary of the transformer was connected with the antenna and ground, through simple tuning apparatus, while the secondary was connected with a pair of head phones.

Much to my surprise, signals came through with thundering regularity. Sure enough, the signals were being received, but it did not require more than a few moments to decide that these were not the usual radio messages. Dashes predominated, with here and there a lonesome dot. It was more on the Continental code order, but still it was not Continental. What could it be?

Martian signals, of course! What else could it be? I called in the superintendent of the shop and he listened to the mysterious signals in perfect amazement. Then we sought one of our operators and had him listen to the mysterious signals. After ten minutes of concentration, during which he endeavored to decipher the mysterious signals, he decided that they must be signals from somewhere off in space. Here we were, face to face with an achievement which would startle the world.

Our manager, after listening to the signals for an hour or more, was convinced; but he gave instructions not to let a word of this great achievement get out until we could learn more about it.

A week went by, during which time I was assigned to the somewhat monotonous task of listening in to the Martian signals, hour by hour.

And then came the rude dénouement of the Martian signal episode. A lineman for a stock quotation ticker service came to our shop one morning and asked permission to get to our opening into the chimney. We granted his request. Pretty soon, he was hard at work pulling out several wires, which he tapped by means of those little clips provided with sharp spikes that can pierce the insulation and reach the copper conductor of any wire. He then connected a telegraph sounder with the tapped wires. To our astonishment, the sounder gave forth the very same sluggish dashes with the sprinkling of dots which we had been listening to all these weeks! The Martian signals which we had been receiving were nothing more or less than the impulses sent over the stock quotation ticker wires for operating the stock quotation tickers. Paralleling our lead-in wire, the ticker circuit wires were inducing fairly strong currents in our radio circuit. The huge induction coil served to transform the induced current into one quite suitable for the operation of the telephone receivers. Our Martian signals, therefore, were not radio signals to begin with, and they did not come from far off in space. They were quite earthbound, you may be sure.

Radio's Place in Communication Service

By Orrin E. Dunlap, Jr.

A QUESTION which has often been asked is whether or not radio will become a public utility more important than the telephone, telegraph, or cable. A glance at the history of communication as well as that of transportation shows that each new system has supplemented methods already in existence, affording and providing a greater range of facilities to meet new up-to-date conditions and to render more efficient public service.

Radio waves linked Japan with the rest of the world after seismic waves had caused catastrophe and destroyed all other means of communication. Cable relay stations were carried away, telephone exchanges swamped, inland telegraph and telephone lines destroyed and many operators killed. The earthquake spared the 660-foot tower of Japan's most powerful radio station, which answers to the call JAA. The Radio Corporation of America through its San Francisco and Honolulu stations maintained constant communication over the transpacific circuit in the ether lanes and showed how admirably radio could supplement other means of communication.

During the month of August, 1922, the Irish Irregulars took possession of seventeen cable lines linking Europe with the American continent causing accumulation of piles of messages. The great radio circuits, operated by the Radio Corporation of America, leading to England, one to Norway, one to Germany and another to France were soon handling the diverted traffic which was scheduled to travel beneath the Atlantic as cablegrams, but instead arrived in the United States at the speed of sunlight via the ether. Radio facilities, both transmitting and receiving proved adequate for the heavy traffic entrusted to it. Delays were kept down to a minimum and the Hertzian waves demonstrated their ability to supplement the cables.

When the subway and elevated lines were opened in the large cities of the country many were of the opinion that the surface cars would no longer be of use. But time has attested that the surface car is adapted for use where an elevated or subway line cannot be operated efficiently or economically. An incidental relation exists between the telephone, telegraph, cables and radio. As systems of communication each method aids the other, since their individual characteristics enable them to accomplish and overcome conditions adverse to any one method of communication. The telephone cannot reach everyone, neither can the telegraph, the cables or radio but with all four working together it is possible to reach any spot on the face of the earth by the telephone transmitter, microphone of radio or key of the telegraph. The steamship, the railroad, the airplane and automobile all supplement each other and so it will be with the telephone, telegraph, cable and radio.

The applications of commercial radio telegraphy and radio telephony is particularly adapted for mobile vehicles, such as trains and automobiles, ship to ship, and ship to shore, and between airplanes and airplanes to the ground. Radio is undoubtedly the first line of communication across large expanses of water and deserts. As a medium for the dissemination of entertainment and news radio is also of great importance.

Two of the excellent features of radio not possessed by either the telephone, telegraph or cable are its great speed of 186,000 miles a second, a velocity which carries a radiogram around the earth seven and one-half times in the twinkle of an eye; in less time than a telephone receiver can be lifted from the hook to attract the attention of the operator. The second salient feature in radio is its ability to reach instantaneously an audience numbering into the millions. Already, Lord Gainsford, Chairman of the British Broadcasting Company, has stated that on the basis of one radiophone station adequately serving the whole area within a radius of thirty miles, eight stations in the British Isles will be capable of entertaining 30,000,000 people, approximately sixty-five per cent. of the population, even though crystal sets are employed for receiving. Six stations are now operating in England.

Broadcasting of the late President Harding's speeches showed radio extremely valuable as a medium to carry a vital message from the President to the people. It will be possible for a President to address Congress and at the same time talk to thousands of Americans in every State in the Union, at the same instant his voice resounds in the Capitol in Washington.

The feasibility of trans-oceanic and transcontinental radio telephony was clearly demonstrated last January in tests conducted between New York and England. Interesting and successful experiments have been performed between ships and shore. Such tests tend to portray a picture when in the future a person on board ship will be able to talk direct to his home in San Francisco, Chicago, New Orleans or New York. These events also serve to show how radio will supplement the telephone and thus render more extensive service throughout the world.

Conditions which developed from the war

were such that the manufacture of a cable would have involved a long delay in supplying service between Los Angeles, California and Avalon, on Catalina Island. Radio provided an interconnecting link for three years. If a person in Boston or any other city in the United States wished to talk with a person in Avalon, the long distance call was made in the usual way through the Los Angeles exchange of the telephone system. The voice from Boston continued over the wires from Los Angeles to the radio station at Long Beach and from that point it leaped thirty-one and a half miles of water to the radio receiving station at Pebbly Beach, where the voice was plucked from the air and put back on the regular telephone wires which lead to Avalon, without the slightest intimation to the parties talking that radio played a part in the circuit. This celebrated "talk bridge" was discontinued during the past Summer and replaced by two submarine cables. It was a case of the ether supplementing the cables.

Although radio has encountered more obstacles in radiophone service on moving trains than it has on board ship, it is safe to say that the day will come before many years pass when an individual can successfully talk from an express train speeding between New York and Chicago, to his home in any city or town in the United States or to a friend on a vessel far out on the Atlantic or Pacific.

The best applications of commercial radio telephone are over large stretches of water; in moving vehicles; in some forms of broadcasting where it is desired to direct the same communication simultaneously to a large number of persons and in remote places where it is impractical to stretch wires for telegraph or telephone. It should be remembered that radio telephony is limited in scope by natural conditions, but the same is true of the telephone and telegraph. Each system of communication is endowed with advantages not possessed by the others, but all cooperating and working together they supplement and make possible a wider and more efficient communication system; radio with its tall steel towers silhouetted against the sky, the telephone and telegraph forming a web of copper over the land and the cable secluded in the depths of the sea.

Six Antennas and Six Transmitters for Simultaneous Operation at One Radio Station

By S. R. Winters

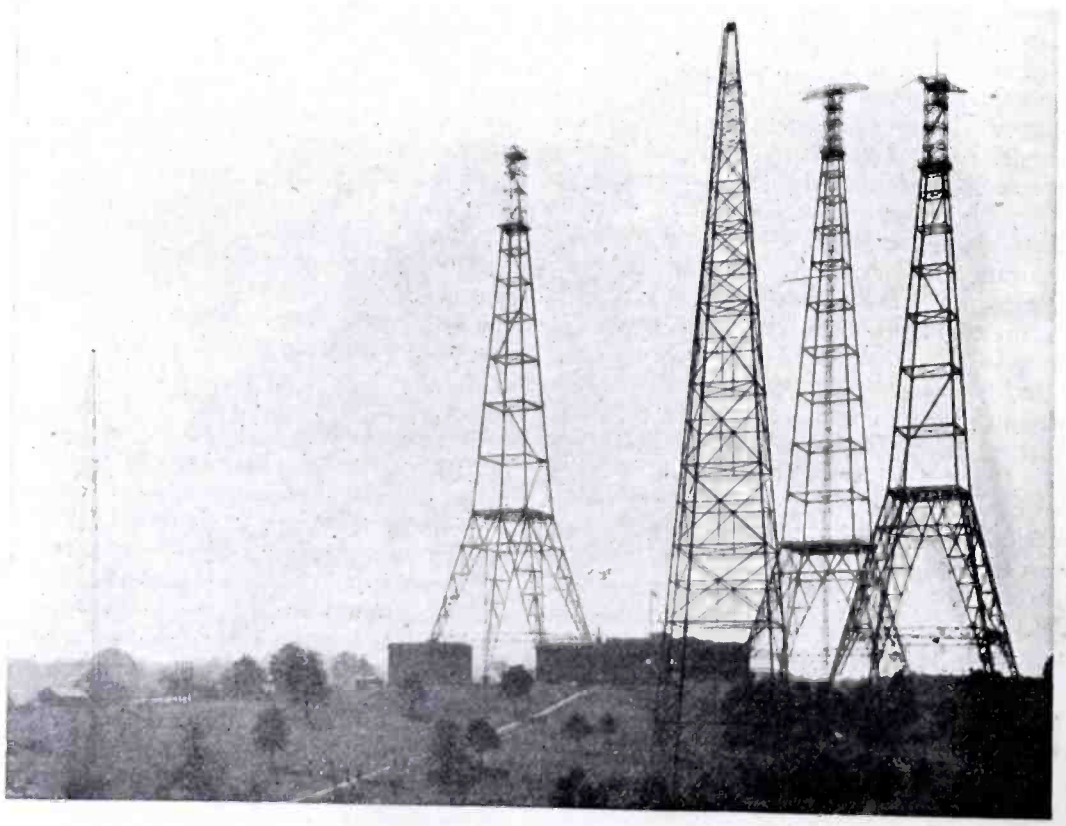
THE antenna system of NAA—the radio telegraph and telephone transmitting station of the United States Navy Department, located at Radio, Virginia—has no counterpart in the world. The heavy traffic, as well as the variety, handled at this point has necessitated the erection of two auxiliary masts and a third addition is being contemplated. Thus, all told, six antennas, operating in conjunction with an equal number of transmitters, may be used simultaneously at one sending station when this multiple system of transmission is completed.

The multiplicity of this antenna system may be appreciated when it is considered that the use of two antennas at any one transmitting station is the ordinary limit. The traffic imposed upon NAA has demanded the installation of a many-sided system for the radiation of electric energy. The traffic of the Signal Corps of the War Department, the dispatch of communications from the United States Navy Department, the transmission of communications for the benefit of aircraft, and a broadcasting service involving the dissemination of information from practically every department of the Federal Government, are negotiated through this 24-hour, continuously operated, wireless telegraph and telephone station.

The burdens of NAA, as heavy as they are, hardly equal the diversity of its service. From the sending of a "hog flash"—market quotations on swine—to a diagnosis of neuralgia and the broadcasting of a presidential message, the offerings emanating from Radio, Virginia, eclipse the proverbial "57" varieties. The transmission of time signals, reports on weather conditions, broadcasts on the subject of geology, labor, child welfare, education, and life-saving on our coasts, are among the diversity of themes treated by this broadcasting station. Of its programs much has been written, earning for NAA the title of "Most Serviceable Government Radio Station in the World."

This article, therefore, is primarily concerned with its unique radiating system, anticipating that amateurs will be interested in this multiple antenna system. The three original masts or towers were built in 1913, this being the first unit in the chain of high-power stations subsequently erected by the United States Navy Department. One of these original masts is 600 feet high, and the other two are 450 feet tall. They are spaced 350 feet apart, and the top of the towers were designed to withstand a load of 10,000 pounds. Contrary to recent designs of towers, which contain three legs, the first ones built at Arlington or Radio are of the three-legged type and they include about three times as much steel as the towers installed within recent years.

The two auxiliary antennas recently included in the electric radiating system of NAA are comprised of masts 200 feet high, and the sixth tower, in contemplation, will likely duplicate the features of these recent antenna installations. The 200-foot towers recently added to this many-sided antenna system were formerly in use at the Washington Barracks and were purchased by the War Department for the needs of the Signal Corps when its traffic was assigned for transmission through NAA. The joint operation of this station by the Navy Department and War Department has obviated the expense that would have been incurred by the erection and maintenance of separate stations, a procedure once contemplated.



The towers and antenna system at station NAA, located at Radio, Va.

The complete antenna system at Radio, Virginia, the only place in the United States so designated, is allotted to specific services. The five antennas are described as "main," "aircraft," "army," "navy," "radiophone," and the sixth antenna has not been classified with respect to its duties. An equal number of transmitters will be in operation, at the same time if desired. One of these transmitting units is reserved for the broadcasting of radio-telephone communications, and the other five transmitters will be used for the transmission of radio-telegraph signals.

Strangely enough, NAA, with its six-fold capacity for the radiation of messages on electro-magnetic waves, is not provided with facilities for the reception of wireless signals. Moreover, both the Office of Communications of the Navy Department and the Signal Corps of the War Department handle their traffic from different buildings by remote control systems. That is to say, the Signal Corps, for instance, sends its messages to all parts of the United States from headquarters in the Munitions Building, four miles removed from Radio, Virginia.

Similarly, the Office of Communications of the Navy Department, which intelligence division is located on the second floor of the Navy Department Building, directs its naval traffic by means of remote control with such points as Key West, New Orleans, Boston, and San Juan. The effectiveness of this multiple radiating system—six antennas and as many transmitters—is such as to embrace a large area of the United States. By means of the radio-telephone transmitting outfit, recently installed, a presidential message or the speeches of other distinguished officials in Washington may be dispersed to the middle western states and southward as far as New Orleans. Under favorable atmospheric conditions, the audible range of NAA is within a radius of 1,500 miles of the National Capital.

The three main types of equipment for radiating electric energy are employed at Radio, namely, arc, spark, and tube transmitters. Weather forecasts are dispersed at 10 o'clock in the morning and at the same hour in the evening by means of an arc transmitter, using continuous waves of 5,950 meters. Weather reports are also sent daily and Sunday by use of the radio-telephone tube transmitter. Time signals from the Naval Observatory, weather reports, ship orders, and naval press news are transmitted regularly by means of a spark transmitter, operating on a wavelength of 2,650 meters. Market reports are disseminated by both radio telegraph and telephone, and the various broadcasts from the different Government departments are dispersed by the radio-telephone tube transmitter.

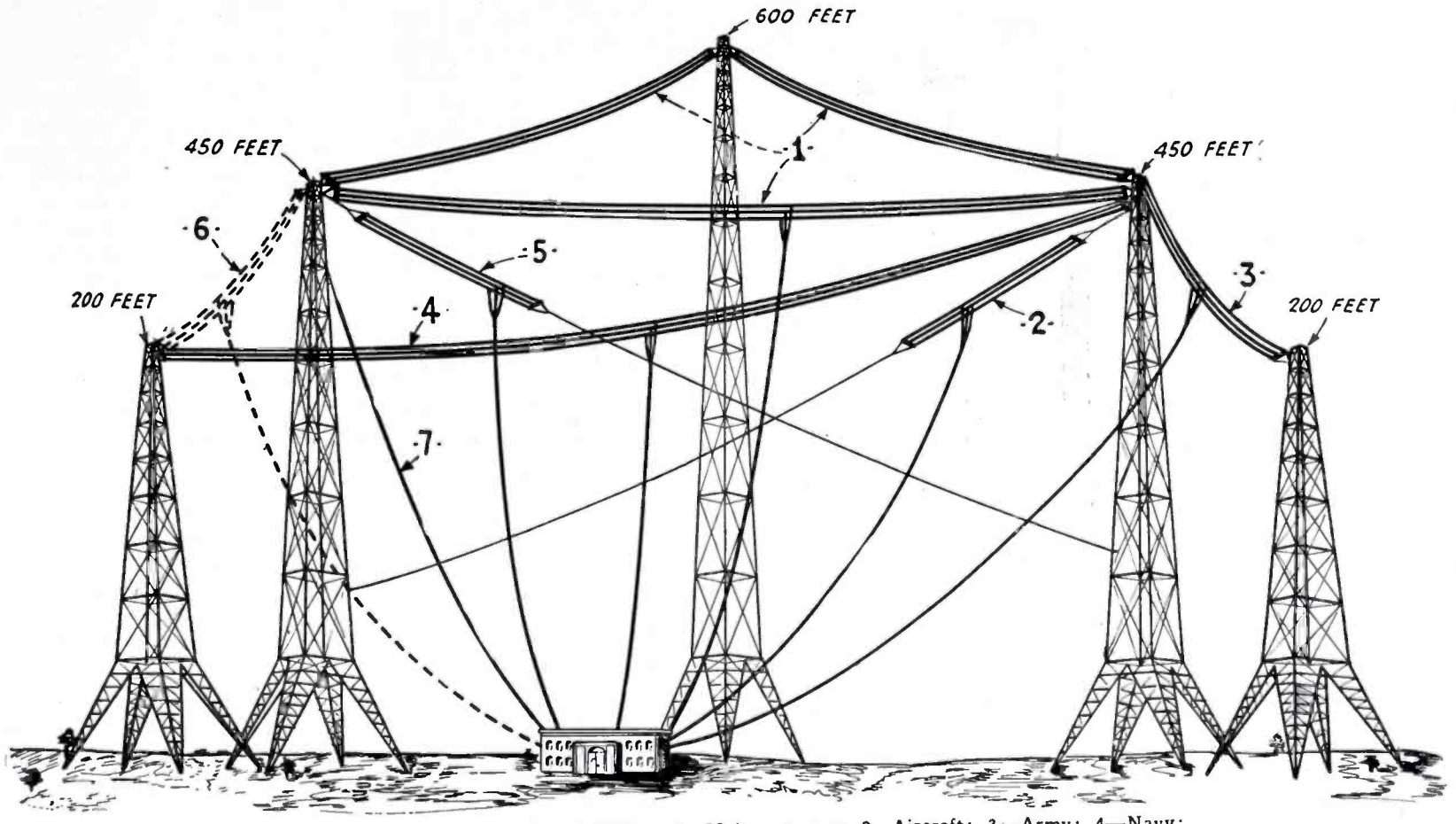


Diagram of antenna system at NAA. 1—Main antenna; 2—Aircraft; 3—Army; 4—Navy; 5—Radiophone; 6—Not classified; 7—Radiophone broadcasting

A Method of Continuous Wave Transmission on 100 Meters

(*Continued from page* 48)

The result of the second daylight-darkness tests with 8XK were as follows: The schedule was as before. During the early afternoon the signals came through rather poorly. The weather was cloudy at both ends. However, at 3:30 p. m., when the sun was shining brightly at the receiving end and it was cloudy at the transmitting end, the C. W. signals were heard with an audibility of 170. The I. C. W. was also heard. This signal strength was greater than at any time during the day of the previous tests and when it was cloudy all day.

Some fading was noted, especially at 8:15 p. m., when the usual night fading observed on the commercial wavelengths was experienced. During the evening the audibility averaged approximately 200 to 300. The I. C. W. averaged about 100. The measurements of audibilities are only approximate as considerable interference from power induction was experienced at the receiving end.

As a result of these tests it may be concluded that short-wave transmission at 105 meters, using the antenna and circuits described, is entirely practical over a distance of 300 miles. It would seem that for daylight transmission, especially, there are marked advantages in the use of such a system.

Interference from strays may also be greatly reduced since it is feasible to use a small coil antenna at the receiving end. Furthermore, strays or atmospheric disturbances are not as intense on wavelengths of 105 meters as on longer wavelengths.

While a sufficient number of tests have been made to draw the conclusions stated, the results indicate that short-wave transmission on 100 meters or still shorter wavelengths should be investigated further. It is expected that further experiments will be made and results reported to the Air Service.

Practical Demonstration of Radio Equipped Motor Repair Lorry

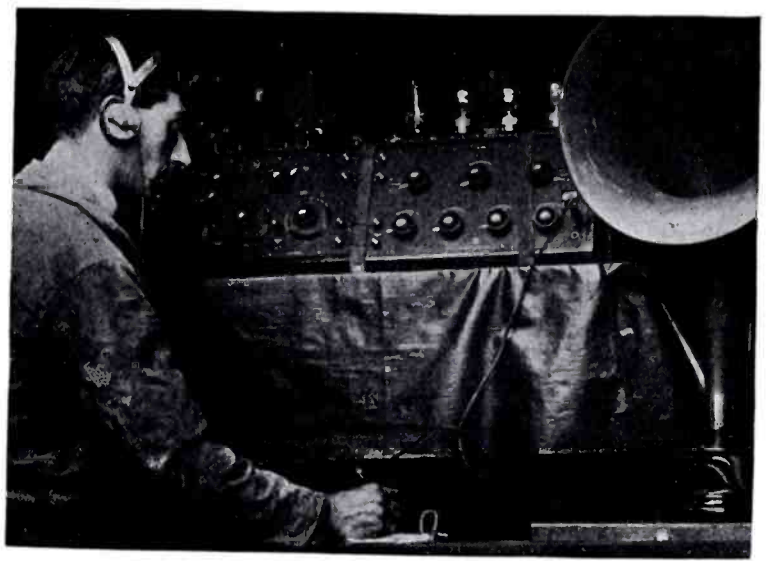
By J. S. Smith

RADIO telephony continues to present opportunities for enterprising methods of communication in unusual circumstances, and J. S. Woodhams of London, England, has utilized this method of communication in connection with a radio telephone installation between a motor repair vehicle on the open road and its headquarters.

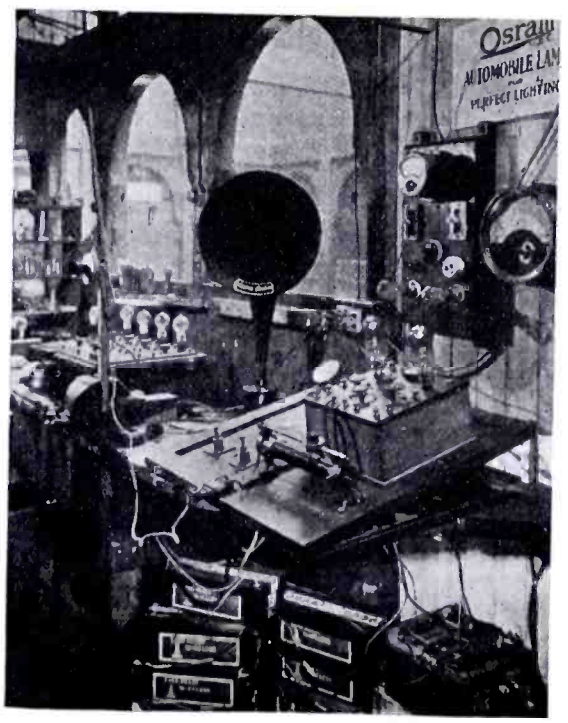
The motor repair lorry is equipped with a sensitive receiving apparatus, and the garage has its transmitting and receiving plant so that while the vehicle is away from headquarters its driver can still receive messages and instructions.

The test was arranged as follows: The repair van was sent out in answer to an imaginary summons from an owner-driver who had broken down at a pre-determined position and while the vehicle was away the garage was supposed to have received another request for assistance from a further automobile that was broken down in the vicinity of the first mishap. This is a very common situation and one where time and money can obviously be saved if a message can be received by the repair lorry in order to prevent it returning to the garage before going on the second job, thus making unnecessary the second journey.

The van left the garage and arrived at the scene of the first imaginary breakdown and the garage was requested to get in touch with the driver and instruct him to take care of the further breakdown about three miles further on. It is interesting to note that during the transmission of the radio telephonic communication it so happened that 2LO the London broadcasting station was carrying out some tests and the fact that the small power garage station was received three miles away in the van at a point only one and one-half miles from the powerful broadcasting station at 2LO furnished definite proof that notwithstanding such adverse conditions sufficient selectivity of tuning is possible to accomplish the desired results.



The receiving set in the lorry



The transmitting set at the garage

In order to avoid the necessity of maintaining a constant watch on the repair lorry an arrangement has been made whereby communication is established definitely every quarter of an hour, two synchronized watches being used for the purpose. This arrangement insures actual communication whether the van is attending a breakdown or in motion on the road. In the latter circumstances notwithstanding extraneous noises from the motion of the vehicle itself and neighboring traffic, no inconvenience in reception is experienced.

The repair lorry it should be mentioned is equipped with benches and tools so that adjustments and small repairs can be carried out on the scene of the breakdown. A crane is also fitted which is stowed away in the body when not in use and which serves to support the front end of a vehicle which has to be towed in for repairs.

The transmitting plant located at the garage near Piccadilly Circus, London, a spot familiar to American visitors, consists of a two-tube transmitter. The tubes employed are of the Marconi Osram type, one being utilized to produce the necessary power and the other being used to furnish modulation by the well known "choke control" method. The necessary high plate voltage is supplied by means of Ever-ready dry batteries in preference to the usual high voltage motor generator.

This method of obtaining a high potential is not adopted from the point of view of cost, but on account of their reliability and the fact that they require little or no attention and do not require the attention of a skilled operator. It should be mentioned at this point that the whole installation can be operated by a layman.

The dry batteries mentioned are found to

(*Continued on page 63*)

The lorry with the aerial raised

The aerial lowered, showing the adjustable aerial poles

Distortion in Audio Frequency Amplifiers

A Good Deal of Poor Quality Is Caused Through the Incorrect Use of Audio Frequency Amplifiers. This Article Deals Step by Step With Each Factor Which May Cause Distorted Signals

By S. O. Pearson, B.Sc.
(The Wireless World and Radio Review)

WHEN it is desired to amplify wireless signals or telephony sufficiently for reception on a loud speaking telephone, it is almost essential to employ one or more stages of audio frequency amplification after the rectifier. The kind of audio frequency amplifier most commonly used is the transformer-coupled type, on account of its relatively large amplification for a given number of thermionic valves. Instruments of this type must be very carefully designed if the received speech is to be free from distortion, and in this instalment the chief causes of distortion, and their effects, are discussed, suggestions being given in each case for the elimination of distortion as far as possible. For reasons given below it will be seen that the transformer-coupled audio amplifier can never be quite free from distortion, although with careful design very good results can be obtained.

It is quite commonly found that the results given by a set operating a loud speaker are not as clear as those given by a set operating head telephones only, where no audio frequency amplifier is used. For this reason it is often assumed that the loud speaker must be at fault, but this is not usually the case. The writer has found that with a carefully designed amplifier the results given by a loud speaker are even more pleasing to listen to than those of head telephones.

The chief causes of distortion in the transformer-coupled type of amplifier may be classified as follows:

(1) Operation too near either of the bends in the characteristic curve of a tube.
(2) Saturation of one or more of the tubes.
(3) Resonance effects in the transformer windings and circuits.
(4) Presence of high frequency oscillations in various parts of the circuits.
(5) Effect of the iron cored transformers.

These several causes are discussed in turn below, and, where possible, suggestions are given for their elimination.

Operation Too Near the Bends of the Characteristic Curve

This is one of the most common causes of distortion and is simply due to faulty adjustment. The vibrations which go to make up speech or music are of a very complex nature, and if oscillations of potential representing in wave form the vibrations of perfect speech are impressed on the grid of a valve, then, in order to get magnified speech without distortion on the output side of the tube, the wave-form of the oscillating component of the plate current must be an exact reproduction of that of the grid potential. This is only possible when the operating portion of the grid voltage-plate current curve is a perfect straight line. Now the valve characteristic curve is usually approximately a straight line over a limited range only, and therefore it is most important to see that the normal grid potential is adjusted to such a value that operation takes place over the straight portion of the curve. The correct grid potential is not fixed for any particular tube, but depends on the value of the plate potential. There is a separate static characteristic curve for each value of the plate potential, and a "family" of such characteristic curves is shown in figure 1 for various plate voltages and constant filament current. Varying the filament current simply has the effect of changing the positions of the upper bends of the curves without appreciably affecting the lower portions.

The simplest arrangement is obtained when such a plate voltage is employed that zero grid potential will allow the tube to functiton at or near the middle point of the straight portion of the characteristic curve,

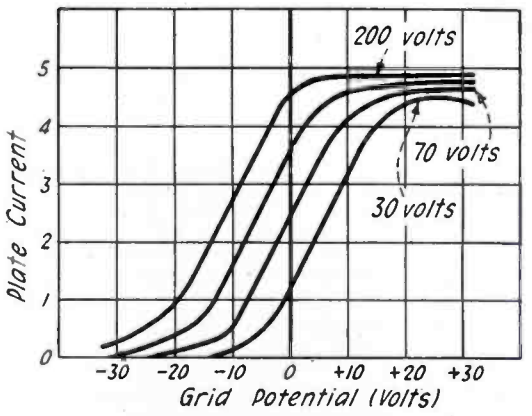


Figure 1.—A group of characteristic curves for various plate voltages and constant filament current

as in this case no grid battery is needed. This is the most usual arrangement, and the plate potentials recommended for various types of tubes by their respective makers are given on the assumptiton that the normal grid potential in each case, for purposes of amplification, is zero with respect to the negative end of the filament. Modern hard tubes which are manufactured in large quantities are fairly uniform, and in general it is quite sufficient to accept the manufacturers' figures. However, one occasionally comes across a tube with peculiar characteristics of its own, and therefore if facilities are available, it is advisable to determine the chief characteristics of all tubes in use.

The coupling between two tubes of an audio frequency amplifier constitutes an impedance connected in series with the plate of the first tube, the object being to obtain variations of potential differences across it proportional to the oscillations impressed on the grid of that tube but having been magnified. These magnified oscillations of potential are passed on to the grid of the second tube by transformer action. For satisfactory working the impedance of the inter-tube coupling at the lowest note frequency to be dealt with should be at least equal to the plate to filament resistance of the tube. An ordinary power transformer is designed to take as small a no-load current as possible without making the design too expensive, and the condititons in an inter-tube transformer are very similar; namely, that for a given amplitude of oscillating potential difference across the primary winding, the oscillating current shall be as small as possible. But in this case it is not the expense which decides the limit but the self capacity of the windings. This is discussed later.

When a very high resistance or a very high impedance is connected in the plate circuit the plate current does not vary, for a given impressed oscillation on the grid, as it would do without any impedance in the plate circuit. The anode impedance is actually placed in the circuit to prevent the current from varying, i. e., to act as a choke, and in so doing to produce an oscillating voltage across the resistance or impedance. Thus we do not get variations of plate current of the order suggested by the ordinary anode characteristic of the tube. This is due to the fact that the plate potential is no longer constant, being at every instant equal to the difference between the voltage of the B battery and the voltage across the primary of the transformer. However, the oscillations across the primary of the transformer will be a fairly exact copy of those impressed on the grid if the tube is operated on the straight portion of the ordinary D.C. characteristic using normal value of plate voltage, because the variation of plate current, for fixed grid potential, is nearly proportional to the variation of plate potential. This of course assumes that there is no distortion due to the iron of the transformer.

It is interesting to note what happens on connecting in the plate circuit a choke or transformer primary of infinitely great impedance, but whose resistance is sufficiently low to allow the D.C. component of the plate current to flow and thus maintain the average potential of the plate at the normal value. Under these conditions the plate current could contain no oscillating component at all, even though an oscillation is being impressed on the grid. But across the choke there will be an oscillating potential difference of such a value that the plate potential is varied in such a manner as to maintain the plate current constant. Under these conditions the tube gives its greatest possible amplification, and the ratio of the amplitude of the oscillation across the choke to that applied to the grid is equal to the amplification constant of the tube. These are really the ideal conditions of operation, but in practice it is impossible to wind a

choke or transformer with very large impedance on account of the self capacity of the windings. With an impedance, at a given frequency, equal to the internal resistance of the tube, the voltage amplification will be just half the amplification constant, but with a step-up transformer this may be multiplied by about three before being applied to the grid of the next tube.

The foregoing remarks have been added because it does not seem to be generally appreciated that the current oscillations in the plate circuit of a tube coupled to another as described above, are suppressed as far as possible, being virtually converted into voltage oscillations. Also, neglecting self-capacity, an inter tube transformer when in operation is really on no-load or open circuit, assuming that the grid of the second tube does not draw any current. Thus it will be seen that the very common statement that the impedance of the inter tube coupling must be equal to the internal impedance of the tube for best results, is rather misleading—the higher the impedance the better is the amplification. The same conditions apply as regards voltage amplification, to the transformer-coupled as to the resistance-coupled amplifier, and in figure 2 a curve is shown giving the relation between resistance or impedance in the plate circuit and the voltage amplification. With the transformer, of course, the impedance varies with the frequency, whereas for the ohmic resistance the impedance is practically constant for all frequencies.

The tube for which the curve of figure 2 was drawn had an amplification constant of about 7, its internal resistance being 27,000 ohms, and the curve shows that when the impedance in series with the plate is 27,000 ohms the voltage amplification is 3.5. Now since the impedance of a transformer varies in almost direct proportion to the frequency, it follows that the voltage amplification will be different for different frequencies, and the higher frequencies and harmonics will be amplified to a much greater extent than the lower ones. The effect of this is to give the speech a sharp piercing sound, and in the case of music the base notes are almost, if not entirely, swamped by the higher notes. This defect is usually overcome by shunting the primaries of the transformers with small condensers of the order of 0.002 mfd., so as to offer a lower impedance to the higher frequencies, these small capacities not materially affecting the impedance offered to the lower note frequencies. The effect is to give the speech or music a more mellow and pleasing tone.

Saturation of One or More of the Tubes

When the signals have been amplified up through successive stages to such an extent, and the amplitude of the oscillations applied to the grid of, say, the last tube, are so great that operation takes place right around both bends in the characteristic curve, that tube is said to be saturated. When this occurs, all the peaks of the waves are cut off or flattened out both top and bottom, and very bad distortion is the result. If the tube is only just saturated the trouble can usually be overcome by brightening the filament and using a higher plate potential on the last tube. This has the effect of considerably lengthening the straight portion of the characteristic curve. When a much higher plate voltage is employed it is usually necessary to apply a negative potential to the grid in order to work at the correct point of the new curve. When very loud results are required it becomes necessary to employ a larger tube of the type used for transmitting purposes and capable of giving out a considerable amount of power.

Resonance Effects

It was stated above that the windings of intertube transformers are never free from self capacity. This capacity and the added capacity across the primary mentioned above, in conjunction with the inductance of the windings of a transformer may constitute a tuned circuit, especially if the resistances of the windings are low. This is usually the case and should the natural frequency of resonance of the transformer lie within the range of audible frequencies received, "blasting" will take place whenever a note of that frequency occurs, this being one of the faults of cheap transformers wound with insufficient wire. It is usual to shunt the primaries of the intertube transformers for the reason given above, and this tends to bring the natural frequency down below the audible range. When a cheap transformer with too high a natural frequency is shunted by a condenser sufficiently large to bring the resonant frequency down below audibility, it is usually found that most of the higher harmonics of the speech wave pass through the condenser instead of through the transformer winding, with the result that the speech has a muffled sound. When buying an intertube transformer it always pays to get a good one.

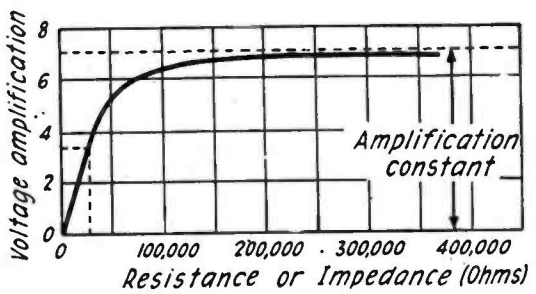


Figure 2.—Curve giving the relation between resistance or impedance in the plate circuit and the voltage amplification

Presence of Local Oscillations

Sometimes in low frequency amplifiers it is found that continuous oscillations are set up and maintained. Their frequency may lie within the audible range, in which case the set is said to "howl," a phenomenon with which most experimenters are familiar; but on the other hand the frequency of these local oscillations may be above the range of audibility, and will not be heard in the telephones when no speech is being received. Even when speech is being received the high frequency oscillations will not be actually heard, but they have a detrimental effect on the quality of the speech or music, this effect being rather difficult to explain in words. Those who have listened to speech received on an Armstrong super regenerative receiver will have some idea of the quality of the speech received. Apart from the high-pitched whistle there is a strange "edging" or "fuzziness" about the words.

Local oscillations of this nature are, of course, produced by stray coupling between the output and input sides of the amplifier and may be due to faulty laying out and spacing of the connections. The frequency of the oscillation will be at the natural frequency of some part of the circuit, and once having constructed an amplifier which exhibits these phenomena it is no easy matter to locate the trouble and eliminate it. This can only be done by trial, and the remedy usually lies in the reversing of one or more of the intertube transformer windings.

Low frequency oscillations or howling may take two forms, (a) ordinary free oscillations as above, and (b) the starting and stopping of high frequency oscillations in the detector circuit where the leaky grid-condenser method of rectification is used in conjunction with reaction. Howling is usually due to the latter cause, which is not really a fault in the audio frequency amplifier, but rather due to excessive reaction. When the set is made to oscillate a negative potential is accumulated on the grid of the detector and may reach such a high value that the oscillations cease. As soon as the grid has reached a voltage approaching the normal value again, the oscillations re-commence. This process is repeated several hundred times per second with the result that the set howls. When receiving telephony, of course, the set must never be made to oscillate, so that howling from the latter cause would be impossible.

Practical Demonstration of Radio Equipped Motor Repair Lorry

(*Continued from page 60*)

possess a long life when used for this purpose as the transmissions are necessarily brief. A further advantage is the elimination of ripple noises which are common to the use of a motor generator system. The total potential employed is about 1,000 volts and the batteries have been found to stand up very well to their work. The aerial current is carried to a single wire T aerial above the garage.

The receiving set employed on the van consists of a movable four-wire aerial mounted on top which is capable of being lowered by means of hand control by the driver when passing under bridges or trees.

The receiver incorporates four tubes, one radio frequency on the popular tuned anode system, a detector and two stages of audio frequency. The tuner itself utilizes honeycomb coils and a grid potentiometer to control oscillation.

Forty-five volts HT is required to the first and 60 volts to the other tubes. A Western Electric loud speaker is also included in the van installation.

The upkeep and operation costs of these sets is quite moderate and will be covered by the time and expense saved by the fact that the motor van can be kept constantly on the move from one job to another without returning to the garage.

It will be seen that this development opens up several possibilities, for in addition to a repair shop keeping in touch with a mobile van that is on the road it would be extremely useful if the vehicles employed by a parcel collecting and delivery agency could receive messages from headquarters while they were on the road.

BROADCASTING STATION DIRECTORY

(Revised to October 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.	286
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.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
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
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFAY	W. J. Virgin Milling Co....Central Point, Ore.	360
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, Oregon	229
KFFP	First Baptist Church.....Moberly, Mo.	275
KFFQ	Markscheffel 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 Hdw. Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGY	Gjelbaug's Radio Shop.....Baudette, Minn.	224
KFGZ	Emmanuel Missionary Co...Berrien Spgs., Mich.	268
KFHA	Colorado State Normal School..Gunnison, Colo.	360
KFHB	The Rialto Theatre.....Hood River, Oregon	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHI	Charles V. Dixon.....Wichita, Kans.	224
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
KFHY	R. S. McEwan.....Trinidad, Colo.	242
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip 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...Marshaltown, 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
KFJQ	Valley Radio Div. of Electric Construction Co., Grand Forks, N. D.	252
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.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Monominee, Mich.	248
KFLE	National Educational Service.....Denver, Colo.	268
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
WEV	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
WGF	The Register & Tribune.....Des Moines, Iowa	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. .....Schenectady, 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	Shotton 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 .....Chicago, Ill.	360
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. .....Canton, Ohio	360
WWI	Ford Motor Co. .....Dearborn, Mich.	273
WWJ	The Detroit News .....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WWZ	John Wanamaker .....New York, N. Y.	360
WAAB	Valdemar 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.	286
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
WAAP	Otto W. Taylor .....Wichita, Kans.	360
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.	360
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, Wisc.	234
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WAJV	Indian Pipe 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	246
WBAX	John H. Stenger, Jr. .....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co. .....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBC	Sterling Radio Equipment Co. .....Sterling, Ill.	229
WBBD	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 .....Houston, Tex.	360
WCAL	St. Olaf College .....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co. .....Baltimore, Md.	360

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
WDAO	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 and 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	Electrical Supply Co. .....Port Arthur, Tex.	360
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	School of Music, Rochester Univ., Rochester, N. Y.	360
WHAO	F. A. Hill .....Savannah, Ga.	360
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 Mfg. Co.....Newton, Ia.	360
WIAI	Heers Stores Co. .....Springfield, Mo.	252
WIAK	Journal Stockman Co. .....Omaha, Nebr.	278
WIAR	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
WIAY	Fox River Valley Radio Supply Co., Neenah, Wisc.	224
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	Kelley-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
WKAU	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.	360
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
WMAM	Beaumont Radio Equipment Co...Beaumont, Tex.	360
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
WOAB	Valley Radio .....Grand Forks, N. D.	280
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
WOAR	Henry P. Lundskow .....Kenosha, Wisc.	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	Averbach & 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
WRAS	Radio Supply Co. .....McLeansboro, Ill.	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
WSAU	Camp Marienfield .....Chesham, N. H.	229
WSAW	Curtice & McElwee .....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory .....Chicago, Ill.	268
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.	390
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
WWAC	Sanger Brothers .....Waco, Tex.	360
WWAD	Wright & Wright, Inc. .....Philadelphia, Pa.	360
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 Coroporation 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, Ontario	
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	

NEW APPLIANCES AND DEVICES

New Shamrock Variometer

THE Shamrock Mfg. Co. has put on the market a new variometer which has some new and improved features in variometer design.

A feature of the Shamrock variometer is the pig tail connections from the rotor to stator coil. This feature has been adopted to secure a connection that would eliminate noises and leakage.

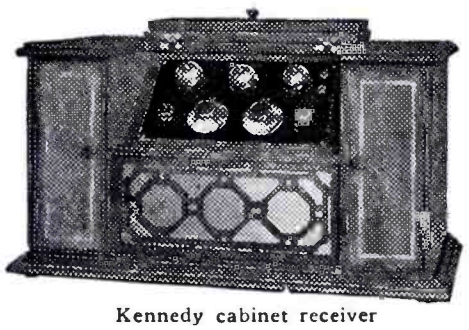
Shamrock variometer

Both rotor and stator leads have separate Fahnestock connections, permitting the use of the Shamrock as a straight variometer or a split variometer.

The floating stop arrangement employed in the Shamrock, insures a full 360° turn of the rotor within the stator, thus giving the maximum inductive efficiency. This variometer will tune up to 600 meters, which takes in all the new high broadcasting wavelengths.

Colin B. Kennedy Cabinet Receivers

THE Colin B. Kennedy Corporation has recently placed on the market a new line of cabinet receivers, known as the Kennedy Type 410 receiving units. These instruments are in mahogany with gold plated

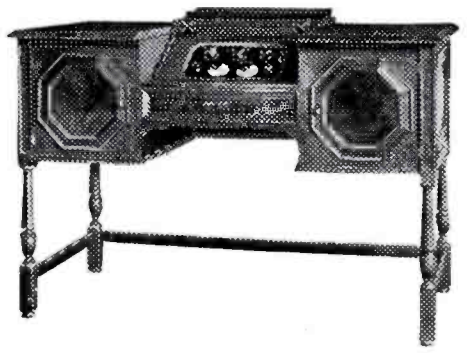


Kennedy cabinet receiver

dials and fittings, and are entirely self contained. Complete control of this new unit is accomplished by means of only two dials, one for tuning and the other for volume. The entire broadcasting range of wavelengths is covered.

These receivers may be used with any standard type of vacuum tube, dry cell batteries being contained in the cabinet and binding posts are provided on the rear for external six-volt battery connection if desired.

The new Kennedy loud speaker is also incorporated in each of these instruments. It has an adjustment for altering the tone chamber to suit the variety of broadcast being received.

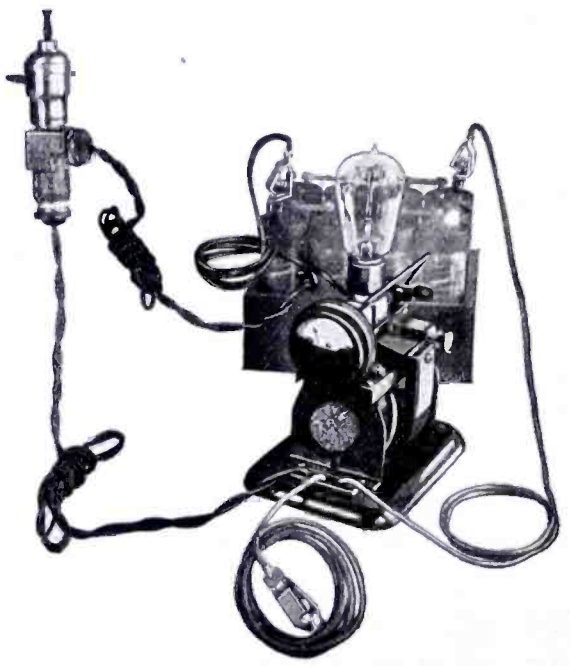


Kennedy Jacobean console model receiver

France F-F. Charging Attachment

THE France Manufacturing Company has put on the market the F-F Charging Attachment for "B" Storage Batteries, 24 to 96 Volts.

The attachment converts any F-F Battery Charger into an instrument that will charge any "B" Storage Battery of from 24 to 96 volts. The charging rate is varied by use of different sizes of ordinary lamps in accordance with instructions.



"B" Storage Battery Charger

No "A" battery is needed to make the F-F battery charger and attachment function. No changing of connections or alterations on the charger are required. There is nothing complicated about the attachment and it is claimed it will not get out of order.

Cutler-Hammer Filament Switch

THE Cutler-Hammer Mfg. Co. has placed on the market a new type of switch to control the filament current supply of receiving tubes. This new switch has been designed for use with tubes the filaments of which operate at low temperature. The switch has easily visible "on" and "off" positions. It has positive wiping contacts that

Filament switch

assure full battery voltage and cannot loosen and cause troublesome noises. The unit can be readily mounted on a panel by boring a single hole 13/16 inch in diameter.

Mesco Loud Speaker

THE loud speaker with the concert modulator is the description given to the new Manhattan loud speaker, made by

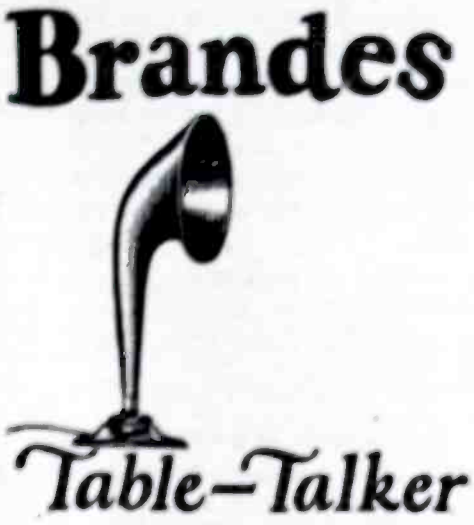
Mesco loud speaker

the Manhattan Electrical Supply Co., Inc. By means of this concert modulator, the instrument can be accommodated to all conditions and to every circuit, tube or battery with which it may be operated. No batteries are required for its use. The diaphragm is positively locked in the extra heavy lead-compound reproducing unit, precluding all vibration except in the diaphragm itself.

Brandes "Table-Talker"

FOR a long time, C. Brandes, Inc., have made only their Matched Tone Headsets, but they now announce a new piece of radio apparatus trademarked "Brandes Table-Talker," which is a loud speaker at a very reasonable price.

The new Brandes Table-Talker is finished in a beautiful neutral shade of deep brown with a crystalline finished horn and copper oxidized finish base. It harmonizes with the home furnishings. The base is felt-padded to protect polished furniture.



The reproducing unit is substantially along the lines of design of the Brandes Superior headset unit which has proved its correctness of design with certain changes which increase the volume of sound obtained.

Brandes Table-Talker is pleasing in lines and finish and superior in quality of tone and in volume.

New Feature in Phone Construction

THE Penberthy Injector Co. has recently developed a four-pole 4000-ohm double head set phone.

The windings of the four-pole phones are of the spool type. This feature with the

"Empire" fabric insulation in the bottom of the case makes grounding of the case or coils impossible; the result is that this type of phone will withstand a higher voltage without breaking down.

The permanent magnet is of the so-called compound pole type, which are built up of two laminations.

The magnet steel is of the best quality to produce a strong magnetic field and retain its strength indefinitely. Each piece is thoroughly tested by means of a permeameter.

The final test for tone or audibility is made against a master phone and in this way each set is correctly matched at a frequency of 800 cycles.

The Penberthy (four pole) 4000 ohms head phones embody all these features in a unique design that has the following advantages:

1—Especially sensitive to weak signals.

2—True tonal reproduction under varying conditions.

3—Tube noises and strays almost entirely eliminated.

4—Stands highest amplification without distortion of sound while operating at highest efficiency.

5—High tension insulation between case and windings insures safety to operator.

Willard Introduces New Radio Battery

ONE of the latest and most progressive developments in the radio field is the introduction of a new single cell radio battery, by the Willard Company.

It is a rechargeable storage cell which possesses several new and unique features not hitherto claimed for storage batteries for radio use.

For "A" battery use on receiving sets using peanut tubes it appears in units of one cell just as dry cell batteries are used. For "B" battery use it is assembled in trays of high voltage combinations.

In assemblies of ten or twenty cell combinations, it makes a "B" battery that can be depended upon. In addition to the advantages that have long been acknowledged for storage batteries in radio, this cell is small, easily recharged at home and inexpensive.

The container is a cylindrical jar of colorless, annealed glass, practically unbreakable. Its screwed-on cover is of hard rubber with a gasket which makes the cell water tight. There are three plates in the cell, one thick positive and two thinner negatives. They are separated and insulated with threaded rubber insulation.

They require only filling with electrolyte to be ready for actual use on the radio set. Thus the purchaser loses not one moment of possible useful life.

A New Loud Speaker

THE Mu-Rad Laboratories, Asbury Park, N. J., manufacturers of radio receivers and radio frequency transformers have recently announced a new product, a loud-speaker of entirely radical design—the Mu-Rad Audiophone. Their claim is that this radio reproducer is the mechanical and electrical application of the principles of voice production to amplification. The sound producing elements resemble the human larynx in that a mica diaphragm is caused to vibrate by an "exhaling" movement of an armature stylus bar, just as the vocal cords are controlled by the larynx. All previous types of loud speakers operated on an "inhaling" instead of the normal "exhaling" principle.

The Mu-Rad Audiophone is said to reproduce extremely true to life. The normal voice ranges between 300 to 1,800 alternations per second and most music from 60 to 5,000 cycles per second. The extreme frequencies produce timbre or roundness of tone. The Mu-Rad Audiophone converts electrical impulse waves into sound waves from about 40 cycles to 7,000 cycles per second. Hence no broadcasted program is beyond the capacity of this new type of radio reproducer to revive with absolute fidelity even the most delicate overtones.

Blast and distortion are provided against by a ready adjustment of the stylus bar with a thumb screw attachment on the exterior. It also permits exact regulation of the strength of the reproduction. Weaker signals can be strengthened and louder ones toned down in a moment.

No additional battery, transformer or induction coil is necessary for the Mu-Rad Audiophone.

This reproducer represents an innovation in the designing of loud speakers.

New National Audio Transformers

THE National Transformer Mfg. Co. has developed a transformer that is designed to operate equally well on one, two or three

stages of audio-frequency amplification. The new transformers are of the shell type, with a laminated core of high grade silicon steel and are said to have a low distributed capacity. They are completely enclosed in metal cases, tending to eliminate any stray magnetic fields and noises produced by interaction between the circuits. These transformers are fitted with extra long binding posts plainly marked to insure easy connections and are furnished complete with screws for mounting and instructions for installing.

INDUSTRIAL INKLINGS

National Radio Week

WITH the hearty co-operation of the broadcasting stations, National Radio Week, which has been set for November 25 to December 1, will be the biggest event in the history of the radio business.

The basic idea back of National Radio Week is to present the very best of radio in the very best possible manner to the largest possible number of non-radio set owners.

To bring about this very desirable end, special programmes will be broadcast from every broadcasting station in the country, programmes will attempt to show the wonderful possibilities of radio broadcasting.

The Radio Week National Committee, which is working under the guidance of the Radio Trade Association, has planned the following programme:

Sunday, November 25. National Radio Sunday, at which time the attention of the public will be called to the wonderful church services broadcast, and the use of radio sets for shut-ins advocated. Every station will be asked to feature their religious programme on this day.

Monday, Nov. 26. Radio and the Stage. Showing what radio has done for the amusement world — programmes featuring popular performers and calling attention to what radio has done for plays and music.

Tuesday, Nov. 27. Government Day. The possibilities of radio as a factor in government has never been properly realized. Prominent National, State and City government officials will be asked to address the radio audience. Tuesday afternoon will be devoted to the children.

Wednesday, Nov. 28. Radio and Music.

Thursday, Nov. 29. Thanksgiving Day. Sports Day. Thanksgiving Day football games will be broadcast from many stations.

Friday, Nov. 30. Education Day, with perhaps some special feature in the line of orchestra music, especially for the smaller station.

Saturday, Dec. 1. Radio in the Home, Radio for Pleasure. Programmes especially designed as the basis for home radio parties, and the rendering of dance music.

The programme committee seems to have covered practically every feature of radio programme activity, and it is believed that stations that follow this suggested programme will benefit greatly from the advance publicity which Radio Week will receive.

The committee that drew up this programme consisted of the following: Charles B. Popenoe, director of Radio Broadcast Central, Radio Corporation of America, chairman; C. B. Cooper, vice-president of the Radio Trade Association in charge of the broadcasting committee; Bernard Freedman, news editor; E. R. Doyle, of the Allan D. Cardwell Company, Brooklyn, N. Y., and H. G. Cisin, Dictograph Products Corp., New York City.

Broadcast Station Directors who desire more information in regard to National Radio Week programmes are invited to communicate with the secretary of The Radio Trade Association, 1133 Broadway, New York City.

Coming Radio Shows

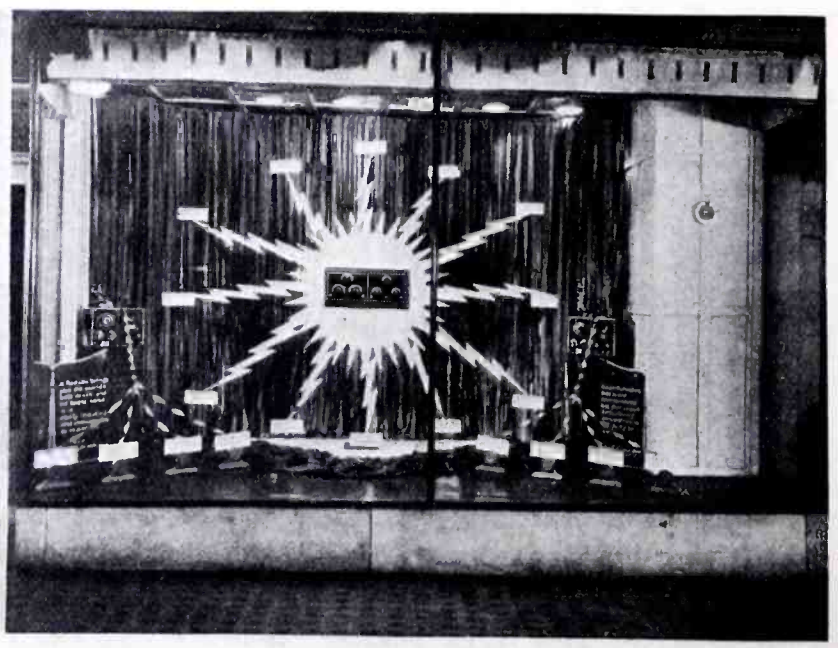
THE second annual Philadelphia Radio Show will be held at the Arena (formerly the Ice Palace), Forty-fifth and Market Streets, Philadelphia, November 12 to 17, inclusive.

E. B. MALLORY, manager of the Westinghouse Electric & Manufacturing Company's radio sales department, who is located in New York City, acted as the chairman of the Radio Communication Committee of the American Marine Congress held in New York City, November 5-10, in connection with the American Marine Exposition.

Mr. Mallory is also chairman of the radio section of the Associated Manufacturers of Electrical Apparatus.

Radio Displays That Reach the Public

A worth-while wireless window display by the St. Paul Electric Co. of St. Paul, Minn.



A three-circuit electric flash display by The National Electric Supply Co. of Washington, D. C.

Applause Cards

ONE of the hits of the Radio Show held in New York during the week of October 6th to 13th, was the distribution from the booth of the Dictograph Products Corporation, of envelopes containing five Applause Cards.

These Applause Cards have been received with enthusiasm by the radio public, as it gives them for the first time, in a simple form, a means of showing their approval or disapproval, as the case may be, of the programs being rendered by broadcasting stations.

The radio public has become quite critical of the programs which are being furnished and stations, from time to time, ask expressions of opinion and approval in order that they may be able to keep in touch with the public's pulse and in order that they may be able to furnish to the public such entertainment as the majority seem to appreciate and demand.

The Applause Card was originated by the Dictograph Products Corporation, has been copyrighted and is being distributed by them to jobbers and dealers throughout the country and will be available for further distribution in radio shops everywhere.

This is the first organized effort to link up broadcasting listeners more closely with the stations from which they receive their amusement, and will bring about a much closer spirit of co-operation.

"Popular Radio Circuits"

THE Horne Electric and Manufacturing Company has just published a very comprehensive booklet on "Popular Radio Circuits," which should be welcomed by every enthusiast who comes into its possession.

They're all here—Reflex, Cockaday, Reinartz Tuned R. F. and the rest, and being fans ourselves, we are going to hold fast to our copy for future reference.

It gives us a fine feeling to know of a manufacturer like Horne, whose advertising literature is prepared with a view to really help the enthusiast first, and sell their products on the basis of a genuine service rendered.

Our guess is that this edition of the circuit booklet won't last long. Better drop a card today and be sure you get your copy.

Literature for Radio Fans

THE Jones Radio Company is to be complimented on the unique method of presentation they have developed for their latest circular showing Jones parts. The rear view of a set is illustrated, and from the various parts, such as transformers, rheostats, etc., diagrammatic lines lead the eye to type paragraphs below which explain the electrical and mechanical virtues of each item. The caption for this page reads "It's not the Face of the Watch. It's the works that tell the Story," which certainly is true of Jones equipment, we'll say. On the back of this sheet, the Jones "Liberty" audio transformer is featured in an attractive manner, together with circuit diagrams showing proper connections. The radio fans, for whom this was prepared will find it a handy piece of literature to have on hand.

Radio Operators in Demand

ACCORDING to recent advices from Washington, D. C., it is understood that approximately 100 first-class radio operators will be needed to fill vacancies on vessels of the U. S. Shipping Board during the next few months.

On the first of last July, the Government increased the pay of all its commercial operators approximately 15 per cent. The monthly rates of pay now in effect range from $85 per month to $125. A few positions pay a higher salary.

Radio operators aboard Shipping Board ships are classed as officers, and, in addition to their regular monthly pay, receive free lodging, meals and such other accommodations as are accorded to officers.

Applicants for berths as radio operators must hold commercial first-class radio operators' licenses, which are issued by the Department of Commerce. Examinations for such licenses may be taken at the offices of the Department of Commerce's Radio Supervisors, located at the following places: Custom House, Boston, Mass.; Custom House, Baltimore; Custom House, New Orleans; L. C. Smith Bldg., Seattle, Wash.; Custom House, New York; Federal Bldg., Atlanta, Ga.; Custom House, San Francisco, Cal.; Federal Bldg., Detroit, Mich., and Federal Bldg., Chicago, Ill.

Radio operators who desire employment on board Shipping Board vessels and holding required licenses should communicate with the radio companies which employ operators for the Board. These companies are: Radio Corporation of America, Ship Owners Radio Service, Inc., and Independent Wireless Telegraph Company, all of which have offices in large American ports.

New Headquarters for Fourth District

NEW headquarters for the Fourth Radio Inspection District have been established at Atlanta, Ga. Walter Van Nostrand, Jr., formerly of the Norfolk office, has been assigned to the new office. The Fourth District, which comprises the States of North Carolina, South Carolina, Florida, Georgia and the Territory of Porto Rico, was formerly combined with the Third District, with headquarters at Norfolk, but the growth of radio in the southeastern section of the country has made necessary the establishment of a separate headquarters for that section.

International Notes

By CHARLES BAILLY
PARIS

Want to Ban American Apparatus

FRENCH manufacturers of radio apparatus, fearing the competition of American and other foreign radio apparatus, are taking steps to prevent or lessen its importation. Both American and English parts are much liked by the French amateur, such apparatus as has reached the market being marked by great care in construction, excellent assembly, and complete practicality. Moreover, certain parts such as variometers, variocouplers and rheostats have not as yet been produced in France with entire success. In spite of the difficulties of the unfavorable exchange rates and the high tariff, American and English parts are being sold at retail in France at about the same prices as are charged for French and German apparatus. This can only be explained by the superior equipment of American factories, and the fact that manufacturing there is carried out in large quantities, with resultant major economies that are reflected in low prices. French apparatus of a similar nature is usually turned out by small manufacturers poorly equipped, relatively, and working with small outputs, the most expensive way of producing merchandise.

As for German radio articles, they may be made cheaply enough, but the export tax and the efforts of the Germans to make up for their depreciated currency by raising prices, results in their goods being laid down in France at figures comparable with articles from other countries.

The French National Syndicate of Electric Industries at a recent meeting voted a resolution demanding higher tariffs to remedy this condition. Since then, this body has begun the task of listing all radio parts that should thus be protected, and determining the tariff percentage that should be applied to each in order to protect the French radio industry. As soon as this work is complete it will be submitted to the authorities. The proposed new radio tariff rates are being worked out at about the figures to be found in the tariffs of other countries on the same materials.

Loop Reception of American Broadcasting

A FRENCH amateur, Mr. J. Plotard, has obtained particularly interesting results in receiving American broadcasting with a loop. During his experiments at night he has received under excellent conditions, among others, stations WOR and WHAZ, operating on 360 and 400 meters.

Plotard does not use a heterodyne. His receiver contains three stages of radio frequency, transformer coupled, a galena detector, and several stages of audio frequency, as needed. The crystal is connected in the secondary of the last radio frequency transformer, which also is provided with a .0005 variable condenser to tune the plate circuit and thus secure regeneration.

The loop consists of two turns separated 5 centimeters (1.95 inch) and is 4 meters by 2.5 meters (13.2 by 8.25 feet) in size, the wire is a large seven-strand cable.

Metallic Vibrations in Loud Speakers

IT is reported that a Belgian amateur, Mr. C. Dambal, is meeting with success in suppressing the metallic vibrations of loud speaker horns. He makes use of a composition of pitch from Judea and paraffin, dipping the horn in this mixture. The horn is subsequently covered with a very uniform coat of a dark brown fluid. Mr. Dambal states that the nasal quality of the horn is completely abolished and excellent quality is to be gotten from even poor horns after this treatment.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

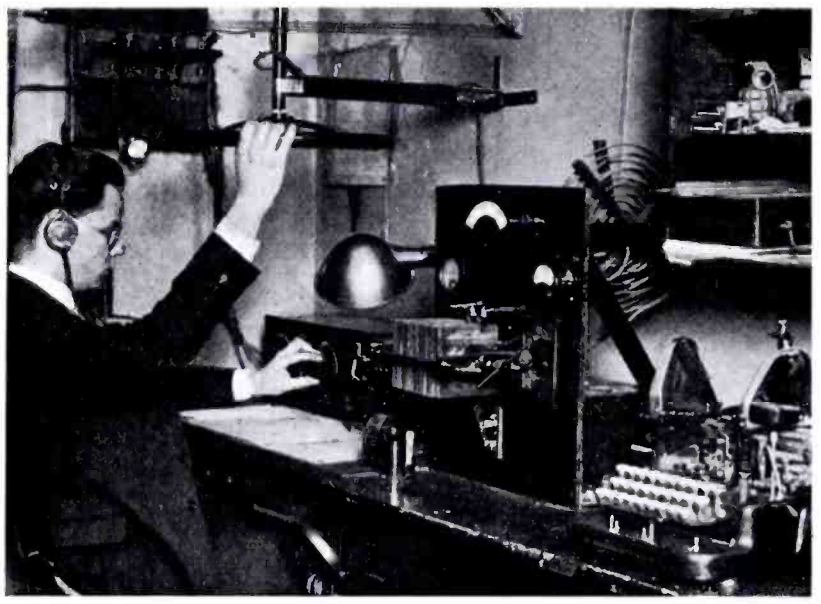
Guglielmo Marconi, *President* — J. Andrew White, *Acting President* — H. L. Welker, *Secretary*

Founded to promote the best interest of radio communication among wireless amateurs in America

RANKING among the best of school and institution radio stations in the East is that of the Newark Preparatory School. Early in the fall of 1922 a radio club was organized and, the sum of $2,000 appropriated by the trustees of the school. A honeycomb regenerative receiver with detector and two stages of radio frequency amplification was constructed and a Magnavox bought. All the broadcasting stations within a radius of two thousand miles have been heard with this outfit and amateur signals from nearly every district.

Next, the CW, ICW and phone transmitter was built, the circuit being a modification of the well-known 1 DH, sure-fire circuit, using one 50-watt tube. Three thousand volts is used on the plate, supplied by the secondary of a 750-watt transformer. As this is A. C., the current is fed through a chemical rectifier to obtain pure CW. This rectifier was built by the pupils and consists of forty jars containing a saturated solution of borax, with electrodes of lead and aluminum. The current thus obtained being a pulsating direct current, a filter system was built, consisting of a 1.5 Henry choke coil in each lead and two condensers having a capacity of 2 mfd. across the line. A radio-frequency choke coil made by the members is also in the circuit. The filament current is obtained from a step-down transformer giving twelve volts. A rheostat on the primary of the transformer is used to counteract the changes in line voltage. The secondary is tapped at center which is kept at ground potential so that overloads will not injure the tube.

Modulation for the phone is obtained by use of a magnetic modulator in series, with which is placed a Western Electric microphone and six-volt battery. For ICW work a buzzer is substituted and a high note obtained. The grid inductances and antenna were made by the members. In the aerial lead is a hot wire ammeter by which the circuit is measured. The antenna is supported by two steel masts rising seventy feet above the street level. They are eighty feet apart and support an eight-wire cage "T" type aerial. The ground consists of the water pipes and sheets of copper and iron pipe buried in the ground. Experiments are now being made with a counterpoise in hopes of raising the radiation. Three amperes are now put into the antenna, and first, second, third, fourth and eighth district stations worked regularly. It is expected that in a short time signals will be heard from 2 BNT not only in every State in the Union, but also in Europe.



Wendell Kilmer, 2KX, who was instrumental in exposing the German radio station at Sayville during the war, has equipped his station with a loop antenna with which he tunes in the DX stations

△ △

RANNY GALUSHA of the Caldwell High School Radio Club and expert trick circuit man, has gone and invented a circuit all by himself. He claims that he has a circuit, called the "Galusha circuit," that will make the Reinartz, Reflex and all the rest of the new trick circuits look like second raters. The big points of this circuit, we learn, are simplicity, ease of control, high amplification and last, but by no means least, cheapness of construction. All the circuit contains is a vario-coupler, variometer, two condensers, a dry battery, inserted in the ground lead, and a detector unit with as many steps of amplification as one may wish to put on it. The design and hookup seems pretty queer but its inventor claims that nothing can be compared to it for pulling in the distant stations. Incidentally, the circuit only works on broadcasting waves and higher wavelengths, no good results having been gotten on amateur waves. In other words, the hookup refuses to function on waves below 250 meters. Galusha admits that when two steps of audio-frequency amplification are used KDKA can be heard almost a block from the loud speaker, with closer stations coming in considerably louder. One of the unique features of the "Galusha circuit" is that the vario-coupler is inserted in the plate lead, which makes the working of the hookup all the more mysterious.

△ △

PARTICIPATION of French radio amateurs in the proposed trans-atlantic tests of this year was assured by Monsieur Leon Deloy, operator of French station 8AB, at the Second National A. R. R. L. convention recently held by the Chicago Radio Traffic Association.

Since he arrived in this country for the purpose of studying amateur conditions Monsieur Deloy has been conferring with amateurs on the precautions which must be taken in order to establish two-way communication between the continents. He says the difficulty lies in copying signals through heavy static and that with mild static low power signals could be more easily logged. Of the great number of amateur stations seen he said: "I have been impressed by the business-like way in which they are installed and operated.

"In France our transmitting stations are very much less numerous, for we have been allowed to transmit only a year and a half, but if their number continues to increase as fast as it has of late we will soon have a great many stations. We are not allowed to exchange messages and we can only use our transmitters for experimenting. That is why the average station over there is built somewhat differently than here. In France we are greatly interested in trans-atlantic communication with the amateurs of this country. A big effort is being made now and many good stations should be ready to bridge the Atlantic very soon."

△ △

RADIO operators seeking employment will find excellent opportunities this fall for real radio work on board ships of the United States Shipping Board, which

sail the seven seas and call at every port in the world.

The annual turnover of radio personnel is large, due to several causes, among them being the fact that many college men spend their summer vacations sailing the "briny deep," as marine radio operators, and then return to their studies at the end of the vacation season.

It is understood that approximately 100 first-class radio operators can be placed on government vessels alone during the next few months.

The government, July 1 last, increased the pay of all its commercial operators approximately 15 per cent. The monthly rates of pay now in effect range from $85 per month to $125. A few positions pay a higher salary.

Radio operators aboard Shipping Board ships are classed as officers and, in addition to their regular monthly pay, receive free lodging, meals and such other accommodations as are accorded to ships' officers.

Applicants for berths as radio operators must hold commercial first-class radio operators' licenses, which are issued by the Department of Commerce. Examinations for such licenses may be taken any time at the offices of the Department of Commerce's radio supervisors.

Radio operators who desire employment on board Shipping Board vessels and holding required licenses should communicate with the radio companies which employ operators for the board.

THE United States Civil Service Commission announces a competitive examination for radio operator. Receipt of applications will close November 20. The examination is to fill a vacancy in the Bureau of Agricultural Economics, Department of Agriculture, at an entrance salary of $1,400 a year, plus the increase of $20 a month granted by Congress, and vacancies in positions requiring similar qualifications.

Applicants must have completed eight grades of common-school or equivalent education, and have had at least six months' experience as commercial radio operator on board a vessel or at a wireless telegraph station, or one years' general experience as radio operator in other than commercial work.

Competitors will not be required to report for examination at any place, but will be rated on the subjects of education and experience. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil-service examiners at the post office or custom house in any city.

A NEW and practical course in radio for beginners is one of the features added to the night courses for the coming year at Carnegie Institute of Technology, Pittsburgh, Pa. Decision to give this new course was made as a result of the apparent demand developing from the widespread interest in radio communication in the Pittsburgh district.

The work will be covered in one year of two terms extending from September to May, and the course has been prepared to appeal especially to amateurs, school teachers, salesmen and dealers in radio apparatus. No previous knowledge of electricity or radio is required, says the announcement. Instruction will be given on Tuesday and Friday nights and will be covered by lectures, demonstrations, and laboratory practice.

The subjects incorporated in the work include elementary electricity covering magnetism, resistance, inductance, and capacity; methods of transmitting energy; properties of wave motion; theory of production and reception of electro-magnetic waves; antenna wavelength and measurements transmission and reception of damped and undamped waves; vacuum tubes, their operating characteristics, uses as detectors, amplifiers and oscillators; radio telephony, methods of transmission and reception; code practice in continental Morse code to a speed of 10 words per minute.

A miniature five-tube radio frequency, detector and audio frequency set using UV-199 tubes built by Sidney Kasindorf of New York and exhibited at the recent N. Y. radio show

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THE German Radio Club established in Berlin earlier in the current year has already attracted a considerable membership and is at present endeavoring to bring pressure to bear upon the Government to relax the restrictions under which private installations are prohibited, the whole matter of radio being under the official control of the Posts Administration.

It is surprising that private radio enterprise in Germany is so far behind other countries. Commenting upon this circumstance at a meeting of the Radio Club a well informed speaker interested a large gathering of members with an outline of recent radio progress and cited the experimental work of Slaby, Braun, Graf, Arco, Goldschmidt and the Meissner Brothers, as deserving of special appreciation. It is, he said, to the Meissner Brothers that the world is indebted for the present method of amplification which makes possible the manufacture of the small pocket sets now so popular in the United States. A small closed circuit (loop) antenna was practically demonstrated by the speaker by means of which London could easily be heard. He concluded his lecture by saying that whereas in former times Germany was well in the front in radio matters, it was now far behind, as a result of official opposition to individual initiative.

Book Reviews

New Signal Corps Pamphlet

A PUBLICATION giving an introduction to the subject of line radio communication has just been prepared under the direction of the Chief Signal Officer of the Army in co-operation with the Bureau of Standards. The pamphlet gives an explanation of how messages are carried to distant points by radio frequency currents directed over ordinary telephone lines or power wires. The fundamental principles of radio and its relation to line radio telegraphy and telephony are discussed.

Copies of the work, known as Signal Corps Radio Communication Pamphlet No. 41, and entitled "Introduction to Line Radio Communication," can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents per copy.

Pamphlet on Amplification Measurements

MEASUREMENTS of voltage amplification of audio frequency amplifiers are discussed in Letter Circular 98, which has just been issued by the Bureau of Standards for free distribution. This circular gives the results of voltage amplification measurements made on 16 audio frequency amplifiers which were on the market during 1921-22. All these amplifiers employed transformer coupling. Measurements were made over a frequency range of 400 to 2100 cycles per second. The amplifiers studied are referred to by arbitrary reference numbers rather than by a statement of the manufacturers' names and model number, the method followed being the same as that used in measuring the voltage amplification of amplifiers, the subject of Letter Circular 86.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. Lists will be published in issue immediately following receipt of list. Spark and C. W. stations should be arranged in separate groups.

9ZT, D. C. WALLACE, 54 Penn Ave., North Minneapolis, Minnesota (September).

C. W.—(1aw), (1er), 1jz, 1uh, 1abc, (1abs), 1acu, (1adn), 1ajp, 1ake, (1ava), 1bbo, (1bcf), (1bcg), 1bkq, 1bom, 1bsj, 1bvb, 1bwj, 1ckp, (1cmp), (1cpo), (1crw), 2fp, (2gk), 2rb, 2rm, 2rs, 2afp, (2agb), 2awh, 2bmr, 2bqh, (2brb), 2bsc, 2bvc, 2ccx, (2cfb), (2cqz), ccvu, 3gs, 3hh, 3iw, 3tj, 3tm, 3abw, 3bji, 3bva, (3bvl), 3ccu, (3chg), 4af, (4ai), (4cs), 4dx, 4eb, 4ft, (4ku), 4mb, (5fx), 5ga, 5ge, (5gm), 5gn, (5lr), 5mn, 5mo, 5pb, (5ql), 5qq, 5sf, 5uo, 5sk, (5za), 5abn, 5afn, 5agj, 5aic, 5aiu, (5akn), 5ama, (5amb), 5anf, 5xad, (5zav), (5zax), 6ec, 6hp, (6km), 6pl, 6acg, (6age), (6ajd), 6alk, (6alv), (6aos), (6arb), 6atz, (6aws), (6awt), 6bkx, (6pz), (6bqb), (6brf), (6bru), 6buo, (6bvg), 6bvn, 6byu, (6cbu), (6cfz), 6cgd, 6cgw, (6chl), (6cpy), 6cpz, (7bj), (7dc), 7dw, (7fd), (7ly), 7wp, 7ya, 7yl, (7zd), (7zf), 7zl, (7zn), 7adp, (7afe), (7agv). CANADIAN—2bn.

Queries Answered

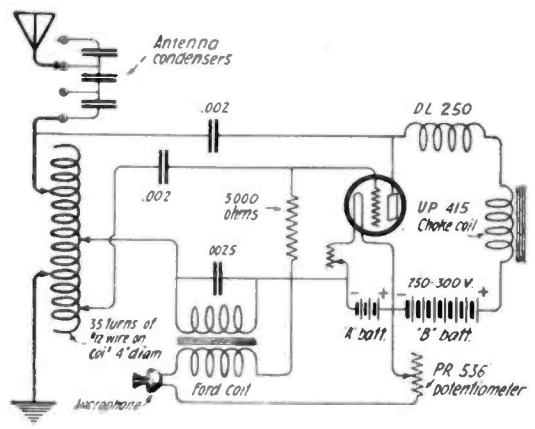
Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no questions answered by mail.

M. N. Field, Scranton, Pa.

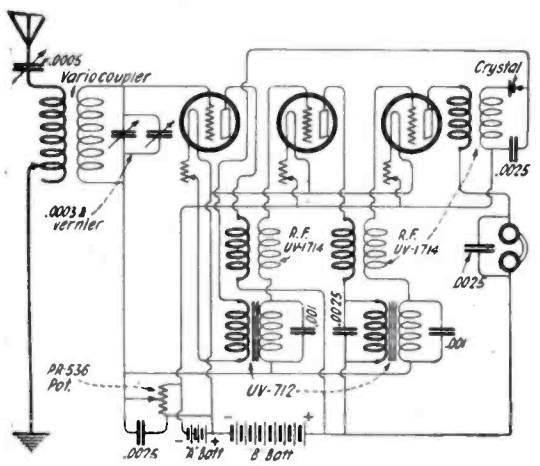
Q. I would be very much obliged to you if you would draw a circuit for me showing a combination receiver and phone transmitter. I would like to use one 5-watt tube in the circuit. What would be the maximum wavelength of transmitting?

A. We would not recommend the use of a transmitting tube for reception. The transmitting circuits do not lend themselves to ease of tuning and the results you will obtain will be far from satisfactory. Below is hook-up for 5-watt phone transmitter. The maximum wavelength for transmitting is 225 meters.



I. Heilweil, Bronx, N. Y.

Q. Would like, if possible, a diagram of a reflex three-tube set using a crystal as detector. Can dry cell tubes be used with same? If so, what difference in tone quality and volume? Can a Reinartz flat coil be used with same?



For greatest volume, UV-201-A Radiotrons or C-301-A are best. The UV-199 will also give good results. A Reinartz coil may be used instead of the variocoupler.

* * *

Charles H. Keiser, Watervliet, N. Y.

Q. 1. Recently I constructed a four-tube reflex Neutrodyne set according to drawings in April issue of THE WIRELESS AGE on page 58, but I am unable to get distant stations, although nearby stations come in with considerable volume and clarity. Will you kindly give me the following information. Are the primary and secondary windings of the radio frequency transformer wound in same direction?

A. 1. See "Queries" columns of previous issues of THE WIRELESS AGE for direction of windings of Neutrodyne.

Q. 2. How may a balance be obtained in regard to windings opposing each other in polarity?

A. 2. A careful study of Mr. Ringel's article will show how neutralization is obtained.

Q. 3. Is there any difference between the UV-712 and UV-712* audio frequency transformers and how should they be used in a Neutrodyne circuit with regard to reflex audio and external audio?

A. 3. The UV-712 has a 9 to 1 ratio and the UV-712* has a 3 to 1 ratio. The latter gives much better quality of reproduction. It is difficult to obtain distant reception in the summer time. Try a UV-200 as a detector and try regeneration by means of a variometer in the plate circuit of the detector tube. All the condensers must be set to within a fraction of a degree.

* * *

R. K. Temple, Lynchburg, Va.

Q. Kindly let me know if there is an accurate formula in any of the publications you handle for figuring the inductance of a coil containing an iron wire or silicon steel core, either straight core or closed magnetic circuit.

In the formula

$$L = \frac{4\pi^2\ r^2\ N^2\ \mu}{l \times 10^9}$$

the permeability μ derived from B. & H. as shown in chart for silicon steel, varies with the amperes passing through the coil. In speaking of an iron core coil of 30 henries inductance do you mean 30 henries under certain conditions only? If so, what conditions?

A. The inductance of an iron core coil will vary with the amount of magnetization, but the formula

$$L = \frac{4\pi^2\ r^2\ N^2\ \mu}{l \times 10^9}$$

is rough approximation. An empiric formula for an open iron core inductance is

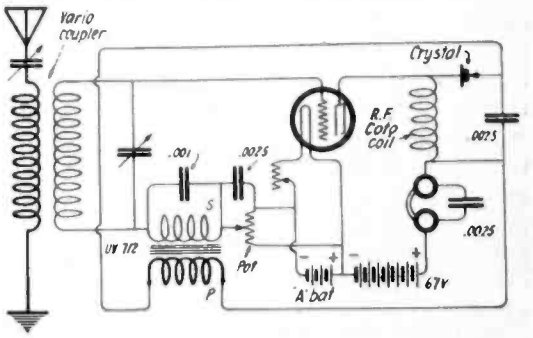
$$L = \frac{(0.00042\ l + 0.00012S)\ N^2}{3140}$$

where l = length of core in inches
S = cross section of core in square inches
N = number of turns
L = inductance in henries.

If you wish to make a standard inductance, it should not have an iron core. If an iron core inductance is specified as 30 henries it means that it is the approximate value with only a small amount of current in the windings.

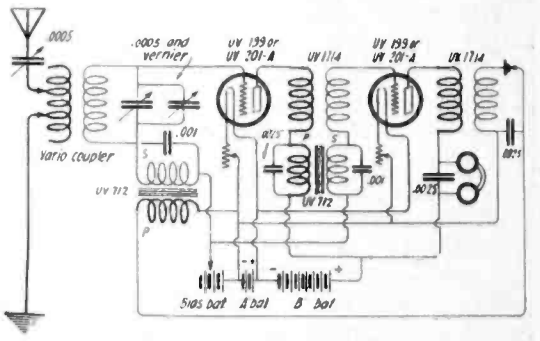
Paul B. Ferris, Champaign, Ill.

Q. In the May issue of THE WIRELESS AGE under the article "A New Reflex Circuit," by Stanley Russell, a Cotocoil radio transformer is stated to have been used. Will you please give me a hookup with such a coil, using the one-tube reflex circuit?



W. A. George, Omaha, Nebr.

Q. Will you please publish a circuit suitable for two dry cell tubes and crystal detector which will provide for the maximum radio frequency and audio frequency amplification, giving values? Referring to figure 1, page 61, May issue of THE WIRELESS AGE, could another tube, radio frequency transformer and audio transformer be added to this circuit and how many stages of radio and audio would result? Referring to figure 2, page 60 in the January issue, could a crystal detector be substituted for the detector tube in this circuit?



A. See diagram. We recommend this hook-up as most suitable for your purpose. It contains two radio and two audio stages. A crystal detector may always be substituted for a tube detector, providing that no regeneration is desired.

* * *

Russell A. Lange, Hawley, Pa.

Q. Please give me directions for winding a loop aerial. What size wire and number of turns, on what size of frame?

A. Wind 14 turns of No. 18 annunciator wire (or 20 x 38 litzendraht), on a frame 30 inches square. Space turns ½ inch apart.

* * *

Howard G. Sommers, Philadelphia, Pa.

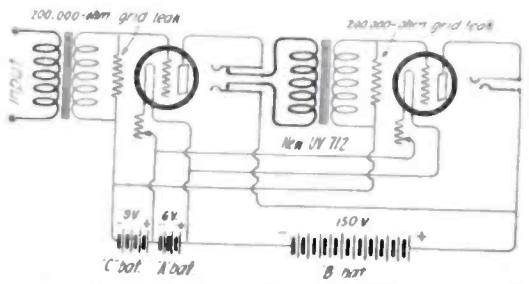
Q. Will you kindly advise me as to how to connect a potentiometer on a 3-tube Copp circuit?

A. We have no knowledge of the "Copp" circuit.

George Cook, Brooklyn, N. Y.

Q. I have a detector and two steps of amplification and get signals loud enough to be heard all over the room, but we have a number of parties in our house and what I would like to have is a hook-up of a two-step power amplifier so I can place the loud speaker in the basement and have the music loud enough to be heard good on top floor of a two-family house. I have two extra 201-A tubes, and please let me know if they can be used in the power amplifier?

A. If you wish to have the receiver in the basement, why not run a pair of wires



up to the loud speaker (which you will place on the second floor)? Below is a hookup for a two-stage power amplifier, using UV-201-A or C-301-A tubes.

* * *

John M. Gates, Pasadena, Calif.

Q. Can you advise how I can make the Grebe CR-5 circuit more selective for distant stations when local stations are broadcasting? My set is quite sensitive. I have heard stations 2,500 miles away.

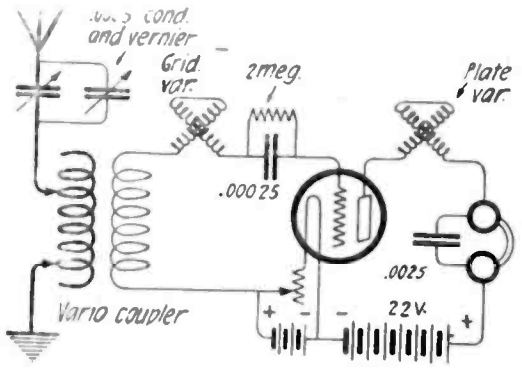
A. We would advise that you get in touch with A. H. Grebe & Co., Richmond Hill, New York. They provide a tuned radio frequency amplifier which will not only give greater range of reception, but also greater selectivity. This unit is the type RORN amplifier.

* * *

F. T. Wilcox, Schenectady, N. Y.

Q. My object in ordering the June issue of THE WIRELESS AGE was to obtain detailed information as to the value of a circuit consisting of variocoupler and two variometers, and detailed instruction as to its construction and operation. My desire is to make a set for dry cell operation, having the best receiving qualities for broadcasting stations, and I thought the above would cover it.

A. Below is circuit you desire. The panel should have tinfoil or copper fastened to the rear, so that the capacity of your hand will not change the tuning. This shield should be connected to ground. Your own experience will teach you the best way to operate it.



* * *

Lee Bates, Springfield, Mo.

Q. 1. Taking into consideration the time spent in searching for stations with a selective set, which is considered best for relay work, a selective set or a single circuit?

A. 1. A single circuit set will enable you to pick up weak stations more easily than the usual two circuit set.

Q. 2. Does a cage-aerial with the lead-in at one end show a directional effect? If so, in what direction from the aerial?

A. 2. The directional effect is noticeable only when the horizontal portion is more than four times the length of the vertical portion. The best transmission is then in the direction away from the open end. Even at best, the directional effect is noticeable only up to a radius of about 20 miles.

Q. 3. Is it true that when the lead-in is connected between the center and end of an aerial that energy transmitted is divided into two different wave lengths? What would be the difference between such a condition and the two parts of a pure wave?

A. 3. No.

Q. 4. What is the code signal representing the dollar mark?

A. 4. It is usually spelled out, although "SX" is frequently used.

Q. 5. Is there any way to obtain the publication, "The Proceedings of the American Association of Radio Engineers"?

A. 5. You may join the Institute of Radio Engineers (as an associate member) and you will then receive the proceedings regularly. We would advise that you address the Secretary of Institute of Radio Engineers, College of the City of New York, New York City, and ask for information regarding membership in that organization.

Q. 6. Using a cage aerial and a cage lead-

in how much effect on the natural period of the system does the length of the lead-in have?

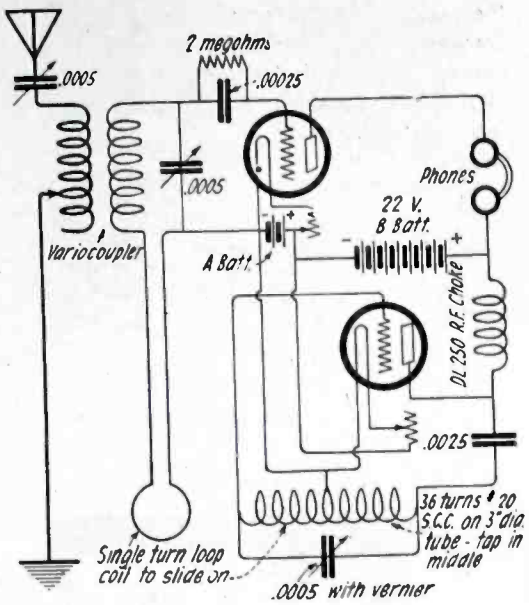
A. 6. The lead-in does affect the natural wave length of your aerial. The natural wave length may be computed by multiplying the total length of the aerial, flat top and lead-in, in feet by 1.40. This will give approximately the fundamental wave length in meters. See E. E. Bucher's "Practical Wireless Telegraphy."

Q. 7. If the aerial was erected on the roof of a house, would a well insulated counterpoise in the basement have the desired effect?

A. 7. A counterpoise in the basement would not have the desired effect.

Q. 8. Please show a good heterodyne receiver that is fairly easy to operate.

A. 8. Receiver using external heterodyne.



F. H. Batton, Springfield, Mo.

Q. Kindly give me the wavelength (approximate) that the reflex circuit on page 61, May issue, responds to figure 1, and figure 2. As the natural wavelength of r.g. coil No. 50 is 114, and a short aerial is specified for this circuit, I do not see how it could respond to more than about 300 meters, entirely inadequate. Will WD-12 tubes do for figure 2?

A. The circuit shown will tune up to about 600 meters. A single set of radio and audio transformers is sufficient.

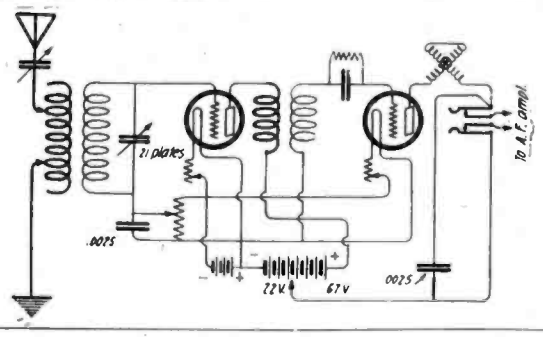
* * *

Lee Epperhart, New Westminster, B. C.

Q. 1. Is the enclosed diagram of one-stage radio, detector, and two stages audio all right? If not, can you give me a hook-up showing only the instruments used in

the enclosed hookup, as I don't want to use any other instruments, such as another variometer, as I would have to completely change the front of my cabinet. I especially want the three four-contact jacks shown in the circuit. I am going to use a separate cabinet for the two-stage amplifier, and will use two sets of dry cells (two "A" batteries) for my WD-11 tubes. At present I am using detector and one-stage audio.

A. 1. The diagram you enclose is not entirely correct. You have made no provision for tuning the grid circuit of the radio frequency amplifier. The variometer should be inserted in the plate of the detector tube and a blocking condenser connected across the jack. The corrected wiring of the radio frequency amplifier and detector is shown below. You will not require any additional equipment outside of a potentiometer and fixed condensers.



Q. 2. If the enclosed hookup is all right, is there any way in which I can improve upon it?

A. 2. If you wish to obtain loud speaker operation from stations at a moderate distance, or even a great distance, on favorable occasions, one radio frequency and two audio frequency is best.

Q. 3. Which do you consider the better, one radio, and two of audio, or two radio and one of audio?

A. 3. If you wish to get consistent distant reception on head receivers only, two radio frequency and one audio frequency is advisable. We recommend the former as more desirable.

Q. 4. Will a 21-plate variable condenser across the secondary of the variocoupler help any?

A. 4. The 21-plate condenser across the secondary is shown in the diagram.

Q. 5. Why is there so much difficulty experienced by amateurs when operating or trying to operate radio frequency amplification?

A. 5. Difficulty is experienced in operating a radio frequency amplifier when using only a single circuit receiver, and in not taking the necessary precaution about using very short connections. It is also worth while to try various tubes in the radio frequency stages to determine which works best.

Q. 6. In the cooler months, what is the average range of one stage radio and two of audio?

A. 6. The average range of one radio frequency and two audio frequency is about 1,500 miles and probably more when good conditions prevail.

* * *

Peter R. Copping, Jr., New Orleans, La.

Q. 1. In the October issue of 1922 on pages 82-83, Mr. Ames of Baltimore asks for a hookup using certain radio apparatus to speak to his friend a few squares away. You gave him a hookup which you said he could use to speak to his friend. Now I am using a WD-11 tube in a circuit I am enclosing. Do you think a microphone in the ground lead of this hookup would enable me to speak to my friend about 2 or 3 squares away? Will the WD-11 tube stand 100 volts on the plate?

A. 1. A microphone in the ground lead may not be enough to communicate 3 or 4 squares. Better try it first and if it does not work, add a Ford coil as shown in the diagram. Yes.

Q. 2. Would I be able to speak to my friend with a lower voltage on the plate of my tube?

A. 2. It is best to use a fairly high voltage.

Q. 3. If the hookup I am enclosing will not work satisfactorily, please give me a hook-up, using as much as possible the apparatus mentioned in the diagram I am enclosing.

A. 3. See answer to Question 1.

Q. 4. Please give me full instructions covering the operation of such a set.

A. 4. In order to operate the set, adjust the tickler coil and obtain strong oscillations. Be sure that you are below 200 meters. Best operating adjustments will be found only by experimenting with plate voltage, grid condenser, grid leak, and other variable units.

Q. 5. Will the reception be changed any by adding a microphone in the ground lead, or would it be advisable to use a switch to connect the microphone in series with the ground lead or disconnect at will?

A. 5. It is best to short circuit the microphone whether in the ground lead or in the new connection shown, since it will probably pick up local sounds and thus interfere with reception.

C. F. G. Neuhaus, Chicago, Ill.

Q. 1. I desire to build a receiving set capable of receiving broadcast music, with a range of 2,000 miles or more, *i. e.* Pacific Coast radio stations. Can you enlighten me as to the best hook-up known at this time?

A. 1. The best hook-up for receiving from great distances is the super-heterodyne which requires the use of about 7 or 8 tubes for best results.

Q. 2. I have read with interest your article on the Neutrodyne receiver in the April issue of THE WIRELESS AGE, and if this is your recommendation at this time I would like to ask several questions before beginning to build same. Are the coils, primary and secondary windings alike? Are they both wound clockwise or anti-clockwise, away from you when assembled and looking down into both of them?

A. 2. Both primary and secondary windings of the Neutrodyne are wound in the same direction, but connection is so made that from the grid terminal, the secondary appears wound in one direction, and from the plate terminal the primary is wound in the opposite direction. See other "Questions and Answers" in this issue.

Q. 3. This same article speaks of the condenser as being of the 11-plate type, with a maximum capacity of .0005 microfarads. Which is correct?

A. 3. The condensers used may be either 11- or 13-plate.

Q. 4. I will probably want to build the one shown in figure 11, Reflex Neutrodyne, but would like a range of from 180 to at least 600-meter wavelengths. What will I have to do to get this?

A. 4. To go up to 600 meters, wind 18 turns on primary and 70 turns on secondary.

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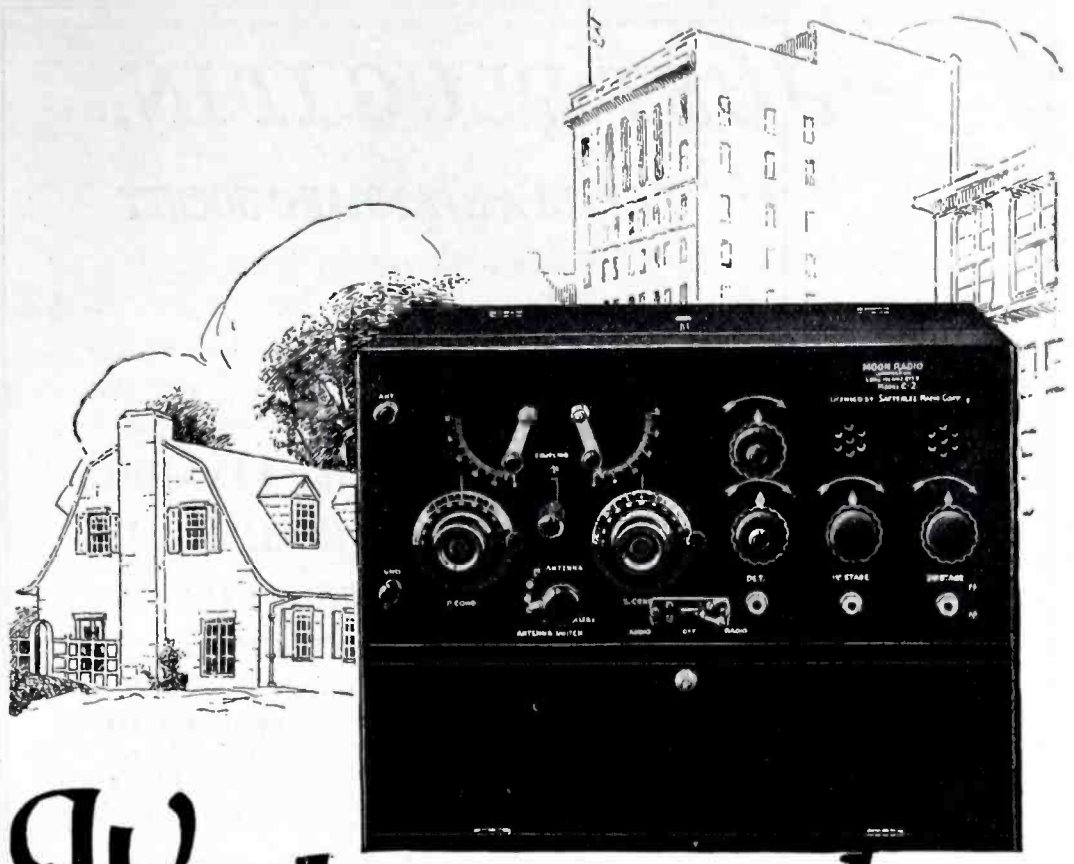

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