The WIRELESS AGE

"America's Foremost Radiophone Review"

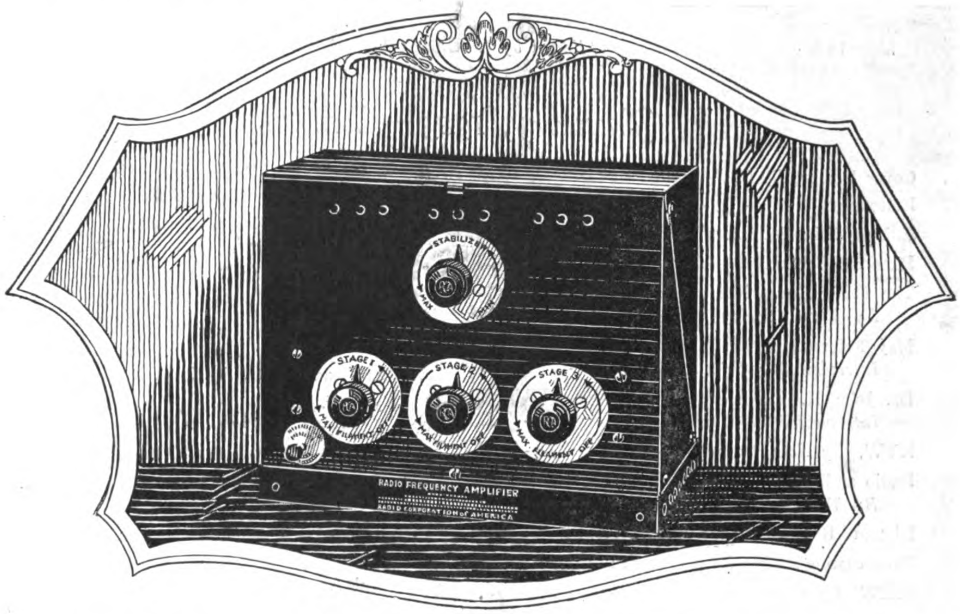
January
25 Cents

A Church That Enfolds Its Flock by Radio — KTW

Art Pictures
Complete List of Broadcasting Stations

The Farm Moves Nearer to the City

Reach out for GREATER DISTANCE!



JUST as you can command a better view of surrounding country from a lofty tower, so can you select at will from the programs of many broadcasting stations with the new Radiola Model AA-1520, a three-stage, radio-frequency amplifier.

Radiola AA-1520 makes possible excellent reception with nothing more than an indoor loop antenna, a variable condenser for tuning, and the customary detector and two-stage amplifiers. It amplifies the feeble energy received from the distant station so that the addition of the usual detector and two-stage, audio-frequency amplification will allow the use of a loud speaker for local broadcasting stations. And of course, when head telephones are worn, one may listen to stations beyond the "loud speaking" range.

A really handsome receiver can be made up of model AA-1520 in combination with model AA-1400, a companion unit, and the new beautifully finished trays, placed top and bottom, which contain the two models as a complete Radiola, attractive enough for the best appointed living room.

Your nearest RCA dealer will be glad to demonstrate.

Price of Radiola AA-1520 three-stage, radio-frequency amplifier—$80.00

No radio enthusiast should be without the book "Radio Enters the Home." Price 35 cents at your dealer or by mail.

Radio Corporation of America

WORLD WIDE WIRELESS

RCA

This symbol of quality is your protection

Sales Office, Suite 2064
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New York City

District Office
10 South La Salle St.
Chicago, Ill.

THE WIRELESS AGE

Volume 10 — *Edited by* J. ANDREW WHITE — *Number* 4

January, 1923—Contents

PUBLISHED MONTHLY AT WIRELESS PRESS, INC., 326 BROADWAY, NEW YORK

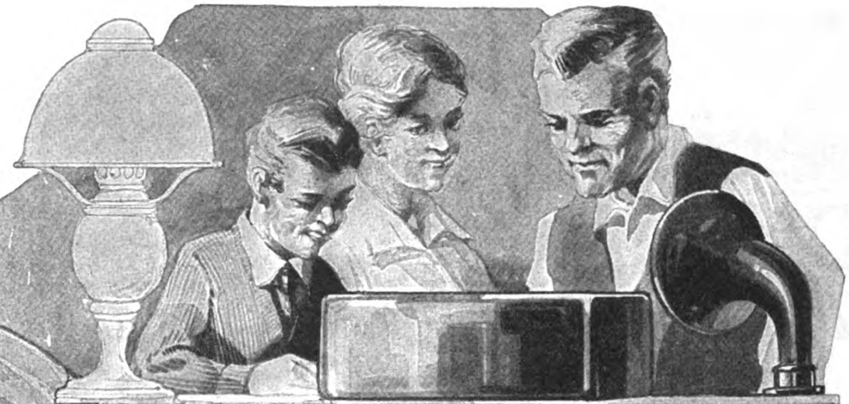
GREAT BRITAIN, 12-13 Henrietta St., London. AUSTRALIA, 97 Clarence St., Sydney, N. S. W.

Yearly subscription in U. S. A., $2.50—Outside U. S. A., $3.00; Single Copies, 25 cents. Entered as second class matter Oct. 9, 1913, Post Office, New York, N. Y., under the Act of March 3, 1879.

When subscription expires you will find a renewal blank enclosed. Return with remittance promptly. Notify us of any change in your address, giving both the old and new location.

Edward J. Nally, Pres. J. Andrew White, Vice-Pres. L. MacConnach, Secy. George S. DeSousa, Treas.

"America's Foremost Radiophone Review"



—if you can afford to pay more—you will still prefer CROSLEY efficiency

From the most humble home to the elaborate drawing room, Crosley Instruments are preferred. Regardless of the many higher priced instruments on the market, the man who knows—even if he can afford to pay more—will choose Crosley.

There is no secret in this. Crosley instruments are the acme of efficiency and simplicity and their construction is based on sound fundamental principles. Numerous tests by disinterested parties all over the country will bear us out in this statement.

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CROSLEY
BETTER·COST LESS
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Complete sets from $25 up, all kinds of parts and experimental units

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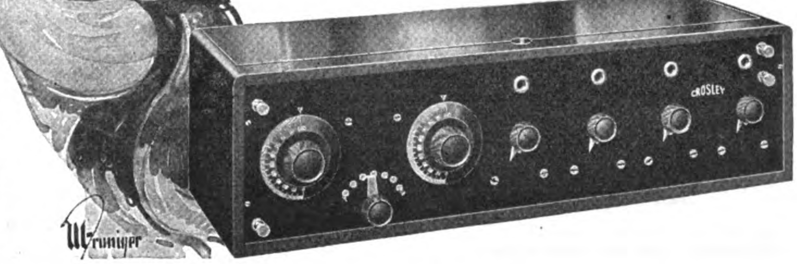


CROSLEY RECEIVER MODEL X. A four tube outfit the same as shown in the above scene. It consists of tuner, one stage of Tuned Radio Frequency Amplification (the feature that has made this set so popular) Detector and two stages of Audio Frequency Amplification in a beautiful mahogany cabinet. It will bring in distant stations loud and clear. With this set, listeners in Florida have heard Winnipeg, San Francisco and Honolulu. Price without phones, batteries or tubes....................$55.00

MAGNAVOX—pioneers in the RADIO field

IT was in 1913 that the Magnavox electro-dynamic receiver made its first public demonstration, when telephone communication was held between Denver and New York—a revolutionary advance.

The rise of Radio Broadcasting found Magnavox apparatus already fully developed to make possible the reproduction of wireless music and speech in ample volume and marvelous clearness.

R-2 Magnavox Radio with 18-inch horn

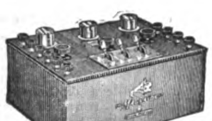
This instrument is intended for those who wish the utmost in amplifying power; for clubs, hotels, dance halls, large audiences, etc. It requires only .6 of an ampere for the field.

Price **$85.00**

R-3 Magnavox Radio with 14-inch horn

(as illustrated)

The ideal instrument for use in homes, offices, amateur stations, etc. Same in principle and construction as Type R-2. Price **$45.00**



3-stage

Model C Magnavox Power Amplifier

For use with the Magnavox Radio and insures getting the largest possible power input.

2-stage $ 80.00
3-stage 110.00

The facilities and experience back of each piece of equipment bearing the Magnavox trade mark are unrivaled anywhere in the world.

PALS AGAIN~

Never a dull evening in the home

The relaxation, the gayety and the stimulus which all the world is seeking, Magnavox Radio will bring to your own hearth and home.

With the Magnavox Radio every incoming signal registered by the receiving set is reproduced to the utmost degree of sensitivity and power. This incomparable superiority, based on scientific reasons known to every expert, has by general popular opinion given Magnavox the distinctive title of the *Reproducer Supreme.*

Magnavox Radio and Power Amplifier are readily attached to any good receiving set—no other equipment gives you the uniform enjoyment of radio at its best.

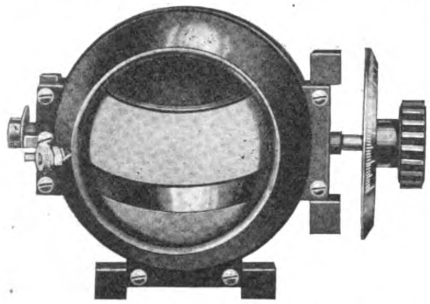
Magnavox Products can be had from good dealers everywhere. Our interesting new booklet (illustrated in three colors) will be sent on request.

The Magnavox Co., Oakland, California
New York: 370 Seventh Avenue

MAGNAVOX Radio

The Reproducer Supreme

DAYTON RADIO PRODUCTS



MOULDED BAKELITE VARIOMETER

SELLS ITSELF, WHY—BECAUSE:

It is genuine Bakelite throughout and all unnecessary metal parts are eliminated.

It has positive contact to rotor by use of pig-tails.

It is convenient for either table or panel mounting.

It has ledge for mounting inductance coil to it, making a complete tuner in one unit.

It has high polish, beauty of design and unequalled efficiency.

Its price is only $6.75.

Vario-coupler, companion instrument, $7.00

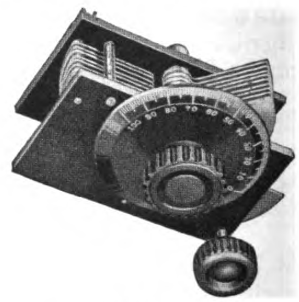
VERNIER VARIABLE CONDENSER

Capacity .0005 and .001

Vernier Variable Condensers are necessary for precision tuning under present broadcasting conditions. This Vernier attachment is operated separately from main condenser control, permitting greatest degree of ease in tuning.

Bakelite is used throughout on this condenser, because good insulation is very essential in condenser construction. The plates are heavy aluminum, separated by accurately machined spacers.

Prices—.0005 Mf. Type 17 PCV—$4.40.
.001 Mf. Type 31 PCV—$5.30.



Complete catalog, with useful Radio information, and drawings of different hook-ups for receiving sets—mailed on receipt of six cents.

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Don't Waste Money, Time and Patience on Cheap, Improperly Designed Radio Parts

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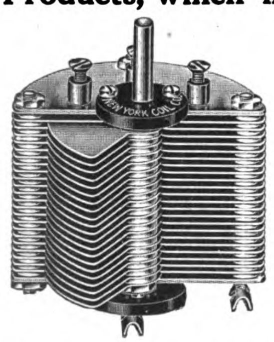

New York Coil Company's Variable Condensers have set a standard by which all others are judged. Plates are of extra heavy aluminum, accurately spaced. The framework of the supporting elements is such that permanency results. Adjustable bearings with provision to take up wear and means for always insuring positive contact is provided.

11 Plate	$1.50
23 Plate	2.00
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THE NEW YORK ENTERTAIN-A-PHONE RECEIVING SET, consisting of Tuner, Detector, and two stages of Amplification, priced at $50.00, is the greatest value ever offered in Radio.

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Exterior of PACENT Universal Plug. The original radio plug. If not PACENT it's not Universal. Price now $1.00.

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Write for Descriptive Bulletins W J 104

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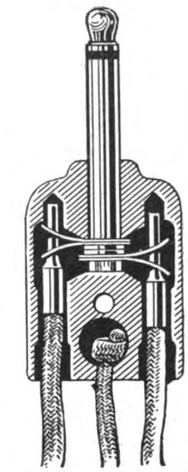
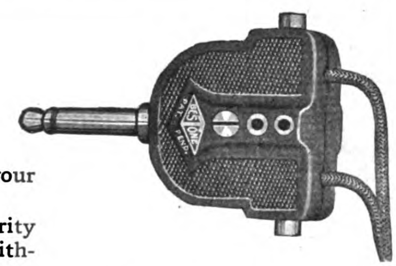


Interior of PACENT Universal Plug showing perfect insulation and spring terminals which insure perfect biting contact.

New! Better!
Bestone Radio Products



Are you satisfied with mere "noise" and distorted "sounds" from your Receiving Set? It's all in the QUALITY of the apparatus used.

Bestone Wireless Apparatus are noted for scientific accuracy, clarity of tone and unusual volume. The Bestone products illustrated are without equal in design, construction and actual RESULTS.

We manufacture a wide range of Crystal and Vacuum Tube Receiving Sets as well as a complete line of radio parts.

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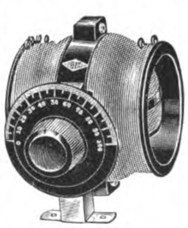
No. 727

New design — new construction — new features. The Plug that requires no dis-assembling. Just press the buttons—the cord tips cannot loosen. No more fussing or mussing with tools. You do not have to take the Plug apart for any reason whatever. Saves time, temper and assures better results. Provides connection for three Head Phones. Price........ $1.25

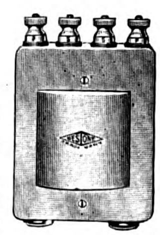


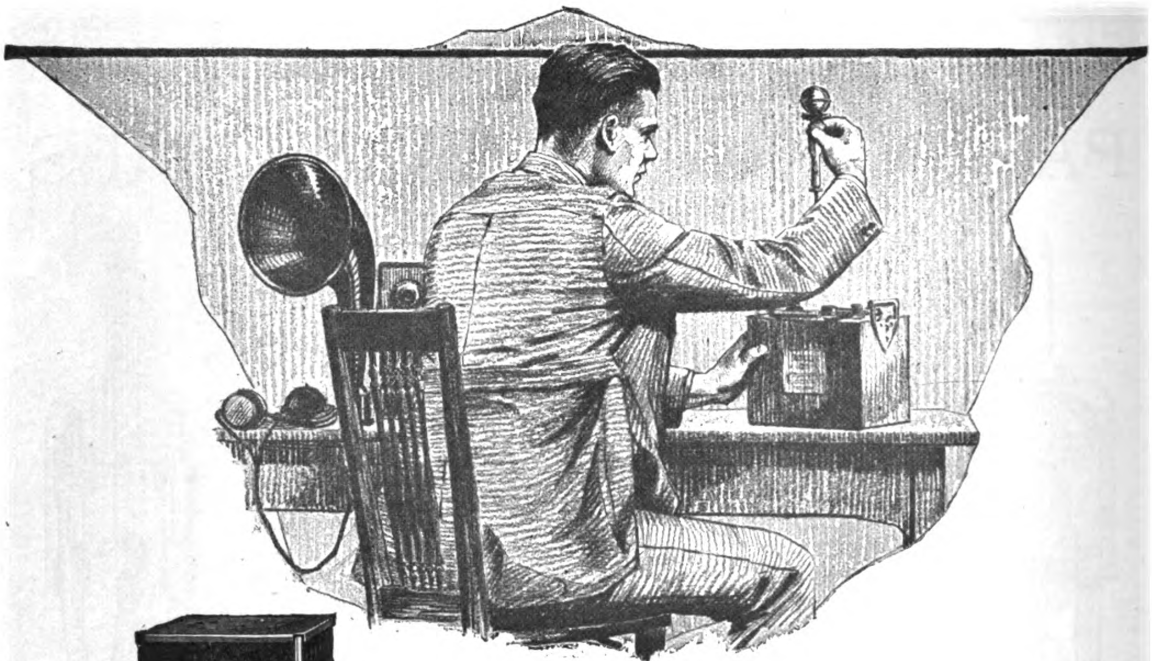
Bestone Condensite Vario-Coupler
No. 712

The most improved vario-coupler on the market. Unequalled for appearance and results. Is constructed of genuine mahogany colored condensite. By its unique design the primary and secondary coils take the same general outline within each other, placing them in very close proximity. Primary divided into 16 taps enables very close tuning. Equipped with 3-inch Bakelite dial. Price $7.50

Bestone Amplifying Transformer
No. 715

Without doubt this apparatus is the foremost type of its kind. Assures clarity and volume of tone as well as undistorted reception. This Bestone product is characterized by superiority of design, excellence of materials and scientific construction. Spaghetti tubing insulates all internal wiring. Is fully enclosed in handsome aluminum case. Price $5.00





Your Battery Should be Kept Fit

The Tungar Battery Charger makes it a simple matter to keep your storage battery tuned-up and fit. With it you can recharge your battery at home—and at little cost.

Tungar is a small, compact rectifier, which can be connected with any a-c. lighting circuit. It is easy and safe to operate—in fact, requires no attention after starting. And when properly connected, the current can go only the one way, eliminating any danger of ruining the battery.

There is no excuse for allowing your battery to run down and spoil the evening's fun. A Tungar doesn't cost much—and it charges the starting and lighting battery in your automobile also.

Send for our new booklet on Tungars for radio, if your dealer cannot supply you.

Address Merchandise Dept., General Electric Company, Bridgeport, Conn.

Tungar

BATTERY CHARGER

This enables you to keep batteries fit, right at home. With simple attachment, it will also charge "B" storage batteries.

This is the way "B" Storage Batteries are charged with Tungar and attachment.

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35A-78

Don't Blame it on Static!

The Real Explanation of Much of the Trouble You Have with Your Radio Set

ONE of the things which the radio world is rapidly learning is that the term "static" has been very loosely used to cover a multitude of radio sins for which static is really in no way responsible.

It is discovering that many of the frying, crackling noises and much of the so-called interference laid at static's door are due to nothing more or less than *the use of batteries of the wrong kind or that leak an excessive amount of electricity.*

Any one of these battery faults can undo the most careful work in construction of set and aerials, and usually not only one, but two or three of them are present in the same place.

Radio operators should remember particularly that "B" Batteries are in series with the phones or amplifying horn and that any noises set up within the "B" batteries themselves will come in strong. You can demonstrate this to yourself by scratching your "B" batteries with your finger-nail. The noise you get through your phones will surprise you.

A growing understanding of these facts is leading to much greater care in the selection of batteries and to the use of high-grade storage batteries for both A and B work, since such storage batteries have just the characteristics needed for both efficiency and economy in radio service.

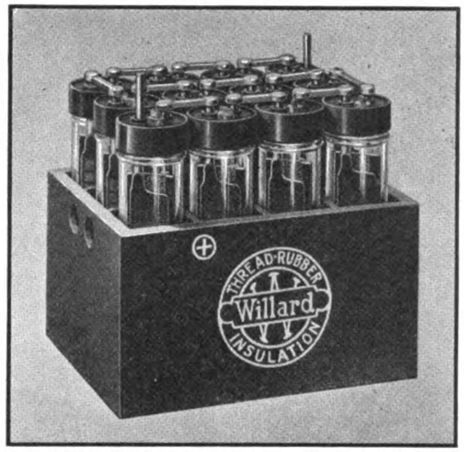
An interesting development in this connection is the new type of "B" battery and an all-rubber "A" battery put on the market by the Willard company. In these batteries, electrical leakage, which is present to such a great extent in the ordinary battery and which accounts for so much noise, is to a great extent ingeniously overcome.

The "B" battery cells are cylindrical glass jars with hard-rubber, screwed-on covers. These are so spaced that the only contact between cells is through heavy, burned-on connectors. No sealing compound is used and the box is cut down so that the sides reach up only about half way to the tops of the jars.

These features and the use of threaded-rubber insulation, operators find, result in a battery which holds its voltage, is never sluggish and, with occasional recharging, lasts for years.

Inasmuch as this big improvement can be effected at an actual saving of money because of the long life of a really good storage battery, there is no question that this type of battery will rapidly be adopted for a great majority of sets. When this is done, the bugaboo of "static" will lose much of its terror.

Willard Storage Battery Co., Cleveland, Ohio



The Willard Radio "B" Battery is a 24-volt rechargeable battery. Glass jars — Threaded Rubber Insulation — screwed-on covers.

The Willard 6-volt, All-Rubber Radio "A" Battery has one-piece rubber case—Threaded Rubber Insulation—special Radio plates.

The new Willard lower priced Radio "A" Battery (Type FW3) Willard-quality plates—selected wood separators—tested rubber jars, specially-designed terminals.

Result of
14 Years' Experience

Supersensitive sound mates ~

It was Reginald Fessenden, distinguished radio engineer and inventor, who designed the first Brandes headset fourteen years ago. Ever since Brandes headsets have been not only supersensitive, so that they respond to the faintest signal, but *Matched Tone* headsets. Counterfeits are offered with the statement that they are "as good as Brandes"—but their phones are not supersensitive sound-mates.

In radio receiving two telephones are better than one, but only when they are absolute sound-mates.

Send ten cents in stamps for the "Beginner's Book of Radio." It explains radio in terms that anyone can understand.

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International Elec. Co., Wellington, N. Z.

C.Brandes, INC.

"Matched Tone" Headsets
TRADEMARK REG. U.S. PAT. OFF.
237 Lafayette St., New York
Dept. WA

Made in Canada by Canadian Brandes, Ltd., Toronto and distributed by Perkins Electric, Ltd., Montreal.

New Paragon Audio-Frequency Amplifier Transformer $5.00

Specially designed for reception of radio telephone signals. Reduces tone distortion. Chokes out vagrant currents that cause scratching, hissing and hollow tones. Gives the soft, full, well-rounded tones essential for good radio telephone reception. May be mounted on either panel or base. Has four terminals conveniently arranged and marked for connection. Completely housed in polished condensite shell. No. 81.

Paragon V. T. Control No. 70
Attractive—compact—efficient
$6.00

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Panel or Table
rugged—dependable—smooth action
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Paragon V. T. Sockets
Perfect contacts—heatproof—mirror finish—non-breakable
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Positive—noiseless—rapid—ideal
$3.00

Paragon Potentiometer No. 35
300 ohms—economical—rugged
$1.75

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DEALERS—The Adams-Morgan Company has an interesting proposition to make to reputable radio dealers who believe in quality merchandise. Details on request.

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Reliable Radio Specialties

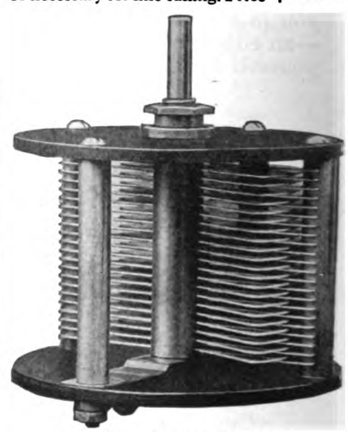
for Good Results!

THE name "Pruden" back of standard Radio Equipment is a guarantee of mechanical excellence and scientific correctness of design. You can pin your faith to "Pruden." Money-back unconditionally if you do not get complete satisfaction.

Just a few leaders of Pruden Reliable Products shown here that will give you better radio results at no greater cost.

VERNIER CONDENSER

Requires only one ⅜ inch hole in panel. Requires little space — can be added to sets already built, thus providing vernier adjustment, which is so necessary for fine tuning. Price **$1.50**



VARIABLE CONDENSER

23 Plate .0005 MFD. *Requires only one ½" hole in Panel.* Plates soldered in slotted tubing (not spaced with washers), insuring perfect alignment. Price.................... **$3.50**

43 Plate .001 MFD. *Requires only one ½" hole in Panel.* Plates soldered in slotted tubing (not spaced with washers), insuring perfect alignment. Price.................... **$4.50**

Dealers write for our interesting proposition.

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HE'S ONLY A BOY

But when he installs a set—
IT WORKS!

WHY?. Because, boylike, he's a human interrogation point. He wasn't satisfied to follow a diagram of connections. What's the condenser for? Why the tuning coil? He wanted to know the reason!

Are you a broadcast listener—one of the many bewildered ones who hear the radio programmes now clear, now fuzzy? Perfect tuning makes a big difference in the quality of music or speech. There's a wide gap between the results secured by the novice when compared with those secured by the radio fan who knows the function of each part and its relation to the other apparatus in a receiver.

2 Volumes
Size 3⅛ x 5 inches
Flexible Leather Covers
Fully Illustrated
96 pages in each volume
Price 2 Vols. ***$1.00***

AN INTRODUCTION TO RADIO (The Title Tells the Story)

ANSWERS YOUR QUESTIONS—Every novice in radio always asks the same questions: What is a radio wave? How is it made? How long does it take to get to me from the broadcasting station? Is there any difference between the dot and dash waves and the music waves? What is a condenser for? What is a variometer? What is the difference between a variocoupler and a loose coupler? How are the ear phones made? What does the crystal detector do? How does a vacuum tube work? What is the grid leak for? Is there any danger that my antenna will be struck by lightning? How can I tune my set to get the loudest signals? What is the difference between radio frequency and audio frequency? What is a potentiometer for and how does it differ from a rheostat? And scores of other questions. All are answered in this book.

FOR THE BEGINNER—Make no mistake. This is an elementary book. All who can read English can understand it. Funny how hard it is for an expert to talk shop so everyone can understand—there are a number of good technical books, but this is the best book we have ever seen of the hardest kind to do well.

An introduction to Radio. That is just what it is. Mr. (Miss or Mrs.) Reader, we take great pleasure in introducing Radio. After a few hours you can meet the other members of the family and talk radio with them as you can't now.

If you were sailing for France you would study an elementary text book on the French language—here is your book for your trip to radio land, the most fascinating country ever discovered by modern science. Explore it knowingly, as thousands are now doing, with a receiving set and "An Introduction to Radio."

In Two Volumes — Handy Pocket Size — For the Whole Family

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VOLUME 1
- An Introduction to Radio
- Radio Telephony
- The Various Instruments Used in Radio Transmitting and Receiving Outfits

VOLUME 2
- Technical Terms Explained
- How to Set up Receiving Outfits
- Primer of the Vacuum Tube.
- How to Set up Radio Transmitters
- International, Morse Code and Conventional Signals

"Great!" is what the first readers of this book said. Just what they had been looking for. Everything in plain language, all the facts you need to know. One thing leads right to another in this book, for it starts with the A, B, and C and goes on through to the end in the proper order. You understand everything because there's nothing left out, no illogical jumps from one subject to another.

Make "An Introduction to Radio" the foundation of your radio library, the basis of your real understanding of what radio is and how its wonders are done.

Examine these two volumes. Go to your dealer and ask for them. If he hasn't them, ask him to order a supply, or, if you wish, pin a dollar bill or a check to the coupon and we will send the books on approval. Look them over for five days. If you are not wholly—100 per cent.—satisfied, return them and we will refund your money. Send for these books today. Pin a dollar to the coupon →

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For $3.00 we will send you these books and THE WIRELESS AGE for a year (outside U. S., $3.50). This saves you 50c. If you want to grasp this opportunity check one of the squares below.

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BURGESS
RADIO BATTERIES

—ARE RECOMMENDED by leading manufacturers of radio equipment.

—ARE SPECIFIED by radio engineers.

—ARE DESIGNED AND BUILT by radio engineers.

—ARE A GUARANTEE of satisfactory service.

—ASK ANY RADIO ENGINEER.

Burgess No. 6 Batteries

Are highly recommended for use in "A" or filament circuits where Westinghouse WD-11 Vacuum Tubes are used.

Burgess Radio Batteries are handled by all progressive jobbers and dealers. Look for the distinctive black and white stripes. If your dealer doesn't handle the Burgess line just address the nearest Burgess office below.

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—DRY BATTERIES—
Manufacturers

FLASHLIGHT—RADIO—
IGNITION—TELEPHONE

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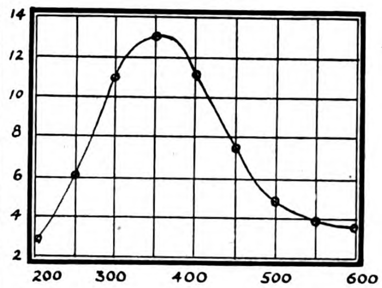
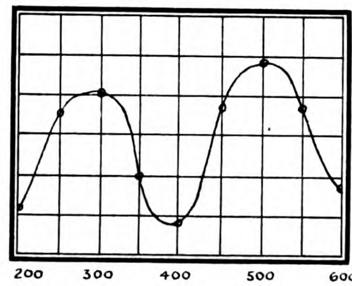
"ASK ANY RADIO ENGINEER"

BURGESS
RADIO BATTERIES





Find this out

before you choose your radio frequency transformer

DOES this particular radio frequency amplifying transformer have marked depressions and peaks in its amplification range curve between 200 and 600 meters (indicating absence of amplification at the depressions)—or does it keep the amplification range curve uniform with its maximum efficiency around 360 meters—the place you need it most?

A test

The two charts above tell a graphic story of tests made on radio frequency transformers in the laboratories of a well known concern. The chart at the left plots the amplification range curve of an Acme R-2 taken from stock. The chart at the right represents a composite plot of the curves of 6 ordinary types of different makes taken from stock. The superiority of the Acme R-2 is self evident. Note its steadily increasing amplification curve with its maximum at 360 meters—just where it is most needed.

Acme R2 Radio Frequency Amplifying Transformer. Price $5.00 (East of Rocky Mountains)

Getting greater distances

Equally important is the greater distances over which you can get broadcasting when using the Acme R-2. The R-2 used in a radio frequency amplifier builds up wave energy before passing it on to the detector. You hear signals that would ordinarily be inaudible. Even the simplest and most elementary type of set, either vacuum tube or crystal receiver type, will have its range tremendously increased when the Acme R-2 is employed in conjunction with a vacuum tube.

The best method

To secure maximum results over long distances use both Acme *Radio* and Acme *Audio* Frequency Transformers. This insures maximum sensitivity and intensity, quietness in operation and freedom from distortion. A small indoor antenna or loop may be used and sufficient intensity obtained to operate the Acme Kleerspeaker, providing perfect entertainment for a roomful of people.

You can get these and all other Acme Products at radio, electrical and many hardware stores. Write for booklet R-2 showing proper hook-ups and other information

THE ACME APPARATUS COMPANY, Cambridge, Mass., U. S. A.
New York, 1270 Broadway

Pioneer transformers and radio engineers and manufacturers

ACME *~ for amplification*

Their Deep, Natural-Voiced Pitch is Rapidly Selling Thousands

ACTUALLY—thousands are being snapped up on the strength of their pleasing voice tone and keen sensitiveness. The same hairline refinement of design which for over eleven years has been so sharply pronounced in hundreds of Basco electrical units, here again shows itself in these skillfully constructed

BASCO RADIO Head Phones
"Hear" More *and* Cost Less

They are built *right*, pitched *right* and priced *right*. Close examination is convincing proof. They embody every high priced quality—perfect balance, clear, scratchless reproduction. Coils encased in aluminum shell—light weight, easy on the head. Employ solid horse shoe magnet—no laminations. Bus-bar connections, no loose hair-like wires.

Light, extra sensitive diaphragm, set to thousandths-of-an-inch accuracy from magnet poles. Clean cut, rugged design throughout. Compare them with any other head set—irrespective of price—then you'll be convinced they're what you want. Ask your dealer to show you Basco Head Phones. If he hasn't them write us direct.

We also make the Basco Radio Frequency Transformer, Vernier and Plain Rheostat, Variable Air Condensers, Tube Socket, Dials and a Complete Crystal Outfit.

Jobbers and Dealers! Write for our exceptional discount proposition, and name of our nearest factory representative.

Put up in attractive orange and black cartons.

Briggs & Stratton Co.
A BASCO PRODUCT
Milwaukee Wisconsin

In Our Opinion

The Dividing Line

THAT a ban had been placed upon mechanical music for Class B broadcasting stations was noted in an editorial in last month's issue. It stirred up an impressive volume of protest among our readers. Some express themselves in vigorous terms to the effect that it is the function of the Department of Commerce to concern itself with regulation of radio traffic and the technical composition of transmitters solely, and that it is not the intent and purpose of any existing statute to permit censorship and arbitrary rulings as to music. Others heatedly denounce what they style an attitude of "paternalism" in the fields of those things that make for America's culture.

On the whole, a nice question has been raised. It's a new one in radio, but one certainly that strikes at the foundation of present and future broadcasting programs.

The basic fact is this: Under date of September 22, 1922, an amended regulation governing Class B stations was issued, reading: "The use of mechanically operated instruments is prohibited."

Formerly the use of phonographs and reproducing pianos was permitted during intermissions and in emergencies. Now they cannot be used at all; they must be, and are being, removed from radio station studios by the Radio Inspectors.

Devotees of the phonograph resent this, pointing out that to the musically educated the art of a Kreisler is preferable, even if mechanically recorded, to the playing "in person" of a half-trained violinist whose only justifiable public appearances have hitherto been limited to church sociables or recitals of conservatory students. As one reader expressed it, the surface noise from the phonograph record may be distracting, but the rasp of the untrained bow is distressing!

The disc-record defenders' protests take the line of preference for a fair counterfeit to a bad imitation of art. But those who take up the defense of the reproducing piano brook no compromise!

And the evidence submitted is impressive.

Pre-eminent among the expressions that have reached the Editor are these:

The great Paderewski says that through the reproducing piano the listener "may acquire an intimate knowledge of the style of leading pianists, may hear the subtleties of great master works expounded by the most competent authorities." Of dizzy eminence, too, is the noted Josef Hoffman, who says: "The keys of the piano are struck by the fingers of the artist, a purely mechanical process, developed and refined by years of painstaking toil, and this process can be reproduced mechanically. This is perfectly obvious." Then the ultra-poetic pianist, Percy Grainger, famed as a composer, who observes: "I am amazed at the absolute accuracy with which the instrument reproduces the artist's most personal characteristics." Food for serious reflection, too, lies in the words of Leopold Godowsky, greatest of piano teachers, who relates of his own experience with the reproducing piano, that, "It would be inconceivable if I had not experienced this marvel of hearing myself play—if I had not recognized my touch, my characteristics, my art itself."

There are other expressions, in similar vein, were the space available for their printing, ranging from the man who says, "I am not musically trained, but I know what is good in music," to the word of one of America's leading critics, Deems Taylor, who states that against long-standing prejudice he has been convinced that the mechanical piano reproduces "the touch, style and interpretation of any concert pianist with uncanny fidelity."

Words of master artists cannot be taken lightly on a highly specialized subject such as music. If broadcasting is to develop a taste for the best in music for Americans—and it appears that thousands of radio fans hold to this ideal—then it seems that Department of Commerce officials have stepped out of character in the regulation prohibiting mechanical music. Authority for such action under existing legislation cannot be found and majority opinion inclines to the view that such arbitrary power never should be given.

We will willingly print the views of readers on both sides of the question.

To THE WIRELESS AGE it seems that determination of what constitutes value in a broadcasting program is something for the public—the listeners—to decide.

* * *

A Vision Realized

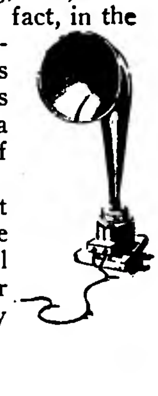
WHO, now, can predict the ultimate destiny of the radiophone?

With entire programs broadcasted from station WJZ, at Newark, N. J., heard in England, and parts of them in France, trans-oceanic broadcasting is no longer visionary—it is an accomplished fact.

On an evening late in November, David Sarnoff, vice-president and general manager of the Radio Corporation of America, prophesied during an address, that in time to come the peoples of one continent would listen to radio broadcasting from another continent. Within twenty-four hours his prophecy was fulfilled!

The feat in itself is astounding, but the promise it holds for the future fairly staggers the mind. For this trans-Atlantic broadcasting of American programs followed close upon the reception here of radio entertainment in a foreign tongue from Cuba, and considering, too, that broadcasting in England and in France and, in fact, in the rest of Europe, is just in its infancy, but coming along rapidly—certain it is that the day is not far distant when all the nations and peoples of the world will be welded by radio into a bond of comradeship and closer community of interest for the advancement of mankind.

At present, statesmen tour the world, great artists and great musicians spend their time in other countries, often undergoing material sacrifices in fulfillment of what they consider a mission in the world. They are frequently



hampered by restrictions of one kind or another, and the arrangement is ofttimes unsatisfactory to them and to their audiences. International radio broadcasting will make all this unnecessary. The words of statesmen and sages, the creative arts and the drama of current events, the wonderful music of great artists—all these are to be heard direct from the country of origin and in native languages. What an influence in the homes of America!

Radio crosses all boundaries. It levels mountains, disregards wind and wave, and pushes through the very space that heretofore has been a barrier to human intercourse. Nation is speaking to nation; people to people; citizen to citizen. Broadcasting is creating a new era in human thought. A new day is breaking over the world.

* * *

Killing a Bugaboo

THE peril of German competition in radio apparatus doesn't exist. That can be stated authoritatively. For months radio dealers have been getting periodic frights at reports of shiploads of German apparatus crossing the sea, to be sold at two cents on the dollar. Some radio fans have wetted their chops in anticipation of the 49-cent tube set, and even some manufacturers, who should have known better, have trembled in their shoes.

All this is futile. The shiploads of German apparatus may go to other countries, but not to America. The radio industry is quite completely protected by patents, and any German apparatus entering this country would be subject to licensing arrangements just as are instruments made here. "Made in Germany" holds no peril for the radio industry.

* * *

The Mayor Started Something

THE experience of the man who caught a wildcat by the tail and then had to get seven other men to help him let go was in a measure duplicated by the Mayor of one of our southern cities when he recently introduced an ordinance in the City Council to locally legislate the transmitting amateurs out of existence.

The ordinance did not specifically state that the amateurs were to quit altogether, but it did prohibit them from using their transmitters at any time excepting for a few hours after 2 A. M. Great scheme, that! It appears that its origin was the Mayor's claim that the amateurs had interfered with broadcast reception.

Hardly had the ordinance been introduced in the City Council when the storm broke, with many manifestations of the well-known faculty of the amateur fraternity to protect its interests, even to the extent of engaging legal talent to fight the case. Whereupon the Mayor began asking for outside advice, and present indications are that the matter has died a slow and peaceful death, to the soft hum of the transmitting sets of the amateurs of the town.

If there is a moral in this tale, it is that those who hold the reins of municipal government should learn in advance of any contemplated action that the amateurs themselves are only too anxious to avoid interference with broadcast listeners and take every precaution to prevent such interference. Wherever interference has occurred, there have been very few cases where the transmitting amateurs have not made an honest effort to meet the proposition on a fifty-fifty basis by observing a division of the evening hours, so that the broadcast listeners will not be disturbed during the early evening.

* * *

The Amateur Trans-Atlantics

UP to the time this issue went to press reports from England indicated that over forty American amateur stations had been heard there during the preliminary trans-Atlantic tests, and at odd times during various nights. Late reports from England, France and Switzerland during the actual tests, indicate that several hundred American amateur stations have been heard in those countries. This seems to establish the fact that American amateur stations can be readily heard in Europe under good radio conditions which exist during the Winter.

The attempt of the European amateurs to transmit to this side of the ocean will, therefore, be of the greatest interest. Some preliminary tests have already been made by the station of the Manchester Wireless Society, Manchester, England, call letters 5MS. On November 24th and again on December 8th, this station made preliminary transmitting tests on 270 meters, but so far as is known the station was not heard here.

The definite schedule of wave lengths for transmission by the English stations is not known at this time, although it is presumed the transmission will take place on wave lengths between 180 and 200 meters, and also probably on 440 meters. The French stations will transmit on wave lengths between 180 and 300 meters.

There is apt to be some difficulty in the reception in this country of European signals on wave lengths between 180 and 200 meters, due to the interference from harmonics from broadcasting stations on 360 and 400 meters, and these harmonics occur very close to each other all through this band of wave lengths. The 440-meter wave length is, of course, subject to considerable interference from commercial traffic handled on 450 meters between ship and shore. It is understood that in England the wave lengths between 200 and 300 meters are practically free from interference, except for occasional harmonics from distant high powered stations. It seems therefore, that conditions for reception of amateur signals are more favorable in England than they are in the United States. If the use of the 270-meter wave length is allowed the Manchester station and other stations in England and France, it is quite probable that the signals will be heard, otherwise it looks as though there would be considerable difficulty in hearing them.

In addition to the troubles of harmonics and commercial work already referred to, there is the great task of keeping silent the 20,000 or more American amateur stations.

The amateurs of America, however, are making a supreme effort to accomplish the unprecedented undertaking of two-way trans-Atlantic communication and while at this writing it is impossible to predict the outcome we hope in the next issue to be able to record that this gigantic undertaking has become an achievement.

* * *

What Is Your Suggestion?

ABOUT two months ago The Wireless Age sent a questionnaire to many of its regular readers with the idea of obtaining an expression from them as to what they most desired in the way of articles.

A large percentage of these reports intimated that the readers were well satisfied with the magazine as it is now being published. Others suggested a certain class of non-technical articles. Still others requested tried and proven types of articles; and, in fact, hardly a single reply was received which did not contain constructive criticism or suggestions which were of the greatest value to the Editor and which will, in turn, be of value to the readers, as they will have what they want printed.

But, of course, we could only communicate with those whose names are on our subscription list, and there are thousands who buy their copies at the newsstand and of their identity we have no record.

Newsstand Buyers! We want to reach you with our questionnaire. We want to know what you think of The Wireless Age; what you would like to see in the magazine; what criticisms or suggestions you have to offer.

—The Editor

Edison Visits Steinmetz Workshop

HERE are the two leading electrical wizards of America, Thomas Alva Edison and Dr. Charles Proteus Steinmetz, the one the pioneer who created the incandescent bulb, the electric generator and thousands of important electrical devices; the other the genius who has built a magic edifice on the foundations laid so firmly by the older man. This is one of the most unusual pictures ever taken. It could not have been made more dramatic except by including Benjamin Franklin, which would have been most appropriate, for Franklin it was who first demonstrated that lightning is a form of electricity, and what Edison is examining so carefully in this photograph is an insulator shattered by one of Dr. Steinmetz's artificial lightning bolts.

LOVELY May Peterson, of the Metropolitan Opera Company, came to realize the full pleasures of radio only when she found herself in a hospital, after an accident. *On page 27 you will find an intimate word-picture of her*

GLOBE-TROTTING was hobby—and still is—of Barnitz, well known lecturer. has been heard by radio audi frequently. On page 31 he give count of some of his travel adven

From Coast to Coast, and at Sea—With Radio

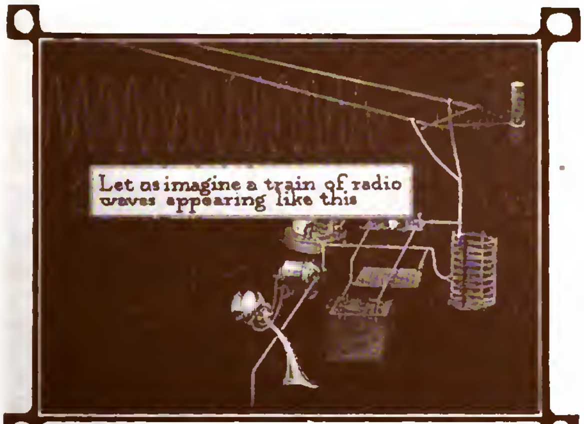
Wallace Reid and his son "Bill" spend many enjoyable hours listening in in Hollywood. The movie star is "registering" pleasure

While somewhere out at sea a naval aviator flew this kite, in order to hoist a radio antenna from his floating seaplane

And in Washington Senators Edwin F. Ladd, of North Dakota (left), and Thomas Sterling, of South Dakota, get election returns by radio on a powerful set

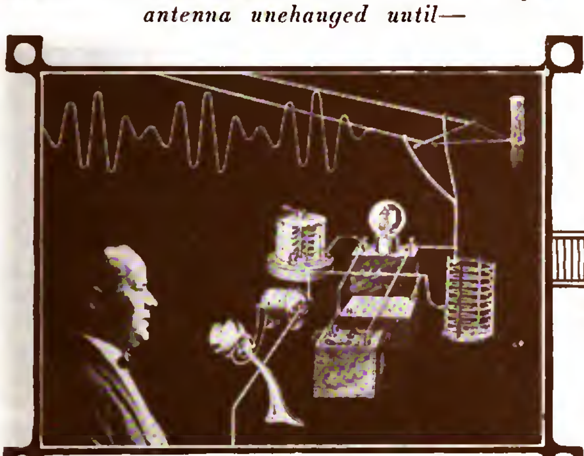
Movies Join Magazines in Explaining Radio

Educational Film Pictures Radio Operation for Patrons of the Silent Drama

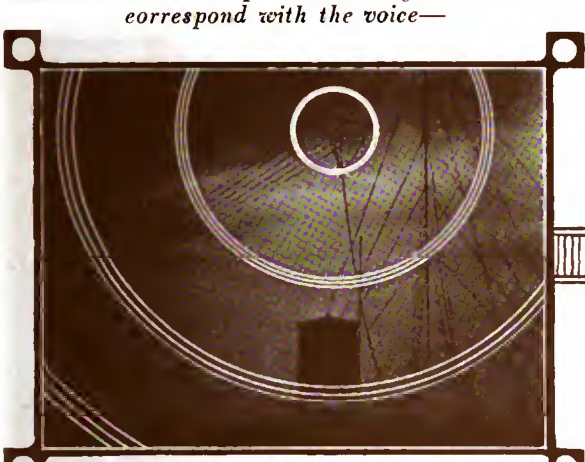


1: Radio waves leave the broadcasting antenna unchanged until—

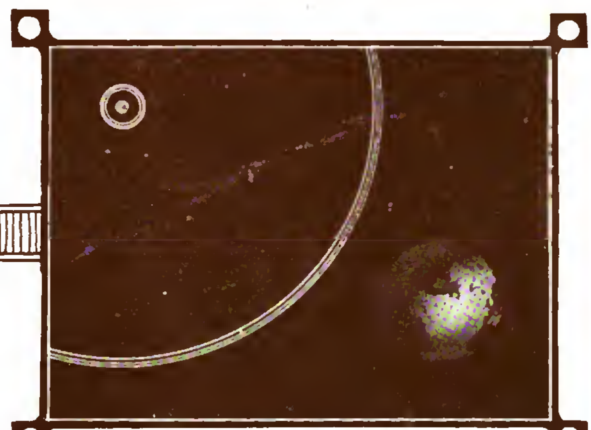
Clara Kimball Young obtains her information from "The Wireless Age"



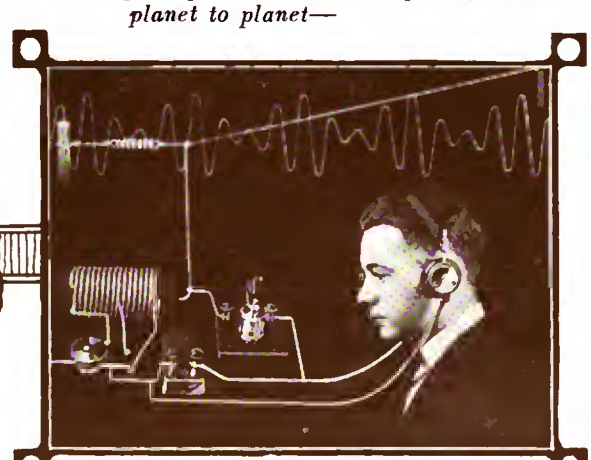
2: Someone speaks, altering them to correspond with the voice—



3: and thus they spread in concentric circles in all directions—



4: perhaps even into outer space, from planet to planet—



5: while receivers in their path vibrate in tune with them

The film, a few photos from which are shown above, is called "The Mystery Box," produced by The Bray Productions, Inc. It probably is the first movie to be shown the public explaining the seeming mysteries of the radio telephone. The movie world, by the way, is deeply interested in radio. Clara Kimball Young, star, shown in the oval at the upper right of the page, has taken considerable delight in mastering the assembly of a set of her own. Her information was obtained from the technical pages of The Wireless Age, *the radio magazine that is most popular among the celebrities of the motion picture studios on both coasts*

The Farm Moves Nearer the City

Mr. Herschel Jones, pioneer in the broadcasting of market reports and agricultural information to the rural districts

How Broadcasting Is Rendering a Stupendous Service in the Remolding of Rural Life, Aiding Farmers to Produce at a Profit and Increasing Everybody's Prosperity

By Ward Seeley

HOW can radio serve the farmer better? That may seem a strange question to the hundreds of thousands of broadcast listeners who hear the daily market and crop reports as broadcast in all parts of the country. What could be more admirable, more serviceable, of greater influence in the economic life of the country than the present system of detailed radio reports of markets for farm products of all kinds, weather warnings and music and educational features? Yet nothing is ever so good that it can't be better.

As a result of a country-wide survey made by THE WIRELESS AGE, it seems that there is just one answer to the question of serving the farmer better by radio.

That answer is not what one might expect.

It is this—*put more radio stations in farm homes, more and more every day until not a farm in this country is without a receiving set.*

Now it is a strange thing that practically everyone who is in touch with reception of broadcasting by farmers should make practically the same comment.

More receiving sets on the farm.

Usually an investigation into any phase of a great movement, such as radio, discloses a multiplicity of opinions and a great diversity of detail. But in farm broadcasting, opinion is practically unanimous. The broadcasters all say that more farm receiving sets are needed. The farmers themselves, as one by one they begin to listen to the material broadcast specially for them, have few suggestions to make, except that their neighbors should all listen too. The most usual request on the part of farm listeners is this, "Please read a little slower so we can write it down."

What is broadcasting to the farmer? Everyone who listens in has heard more or less data and information of all kinds designed to reach the rural population and yet no one listener, unless he has moved from state to state during the past six months, can have even the faintest conception of what farm broadcasting really is.

Probably those who live in the big cities have heard more or less frequently during the daily programs, the reading of a long list of quotations on cattle and hogs, hides, butter, eggs, wheat, corn, oats, hay and all the other products of the farm, and they have merely turned the dials around in hope of picking up something more interesting to the city dweller. Yet once in a while the city housekeeper hears something startling in the midst of it all.

> **Springfield, N. J.**
>
> **As I live in a lonely spot radio is as a dear friend to me. This evening's entertainment was most wonderful. Kindly extend my best wishes to all who took part. My only regret was I could not see them.**
>
> **MRS. P. SIDNEY**

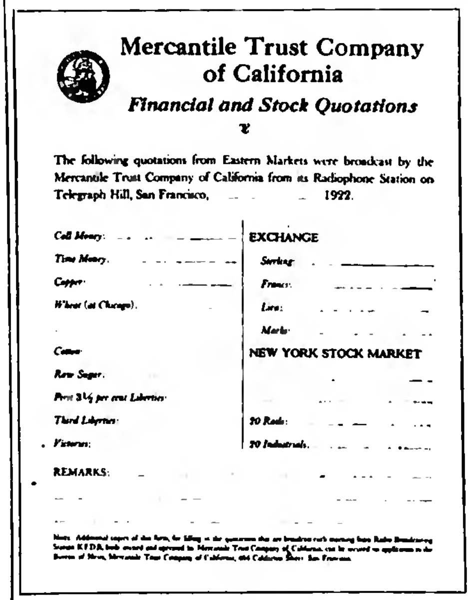
This came over the air one night last summer from a station in New York state. "Cantaloupes are in large supply in the central portion of the state, and are being shipped to New York in great quantities where, we understand, high prices are being charged. In view of the large supply, consumers should not pay more than 12 cents each for the Rocky Ford variety." At that time cantaloupes were selling for 18 to 20 cents, and even 25 cents each. The next day a virtual buyer's strike brought the prices down to the figure that the market experts knew was correct. Thereby each little household was saved a few pennies and in the aggregate probably many thousands of dollars were kept out of the hands of profiteers.

This is a simple little illustration that brings market broadcasting home to those far removed from the food-

At Osseo, in Minnesota, is one of the country's greatest potato markets, and here we find Mrs. Albertina Schockweiler, her daughter and grandson, listening daily to market reports, lectures and concerts producing centers. Multiply this example many thousands of times during the year and apply it not to cantaloupes but to such basic and vital foodstuffs as meat of all kinds, and the essential grains. Realize that information such as this goes daily and nightly into thousands of farms in all parts of the country, beating the mail many hours, sometimes as much as forty-eight. Multiply the saving in each case hundreds, even thousands of times, and you will get some faint idea of the stupendous service of broadcasting to the farmer.

Another little example, again drawn from New York state, will give a faint idea of the astounding scope of the subject. New York City, as is well known, has a very large Jewish population and many of its meat and grocery stores are conducted by Jews. At the time of their religious holidays, consumption of food-stuffs of all kinds is materially curtailed in New York City, first, because of fasting in many homes and second because of closed shops. Last Fall, just previous to the Jewish New Year, a warning was broadcast throughout New York state that shipments to New York City should be curtailed, if not stopped entirely, in order to prevent loss that would be entailed if they were maintained at normal volume at a time when buying was at its lowest ebb. Many tons of produce thereby were saved to the farmer, and instead of rotting in the markets, in freight cars and on the wharves, they were held on the farm for a day or two and shipped later when the Jewish holidays were over and buying in New York once more was normal.

Farmers emphatically are told how they can benefit from radio broadcasting at the fair exhibit of the Missouri State Marketing Bureau



Mercantile Trust Company of California

Financial and Stock Quotations

The following quotations from Eastern Markets were broadcast by the Mercantile Trust Company of California from its Radiophone Station on Telegraph Hill, San Francisco, ______ 1922.

Call Money:	**EXCHANGE**
Time Money.	*Sterling:*
Copper:	*Francs:*
Wheat (at Chicago).	*Lira:*
	Marks:
Cotton:	**NEW YORK STOCK MARKET**
Raw Sugar.	
First 3½ per cent Liberties:	
Third Liberties:	*20 Rails:*
Victories:	*20 Industrials.*

REMARKS:

Investment quotations are copied on these blanks issued by Mercantile Trust Co., San Francisco

Livestock raisers are Rauen and Gordon Curtis, and, incidentally, radio fans. Gordon herds sheep on the plains of Minnesota, but when the photo was taken he had just come in out of the rain to hear the football score

Once again, expand this to national scope. Make what is but the example of a single state the established policy in all states, and you will again get an inkling of what broadcasting is meaning to the economic life of the country.

It has been said that the prosperity of a nation depends upon the prosperity of its farm population; that unless the farmer produces, at a profit, the food upon which the life of the nation depends, he will not produce that food at all, and starvation inevitably will get nearer and nearer.

Radio broadcasting is increasing the profit of the farmer.

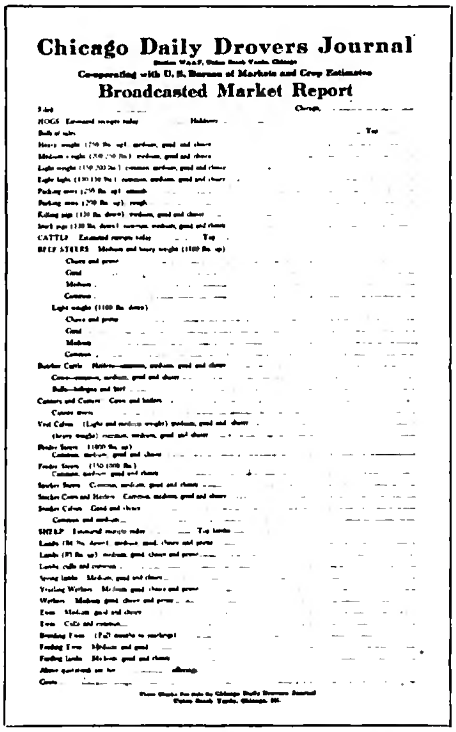
That is why the most specialized farm broadcasting that is being done in America today is being conducted by organizations that consider the farmer as their clients and customers. At the time of the recent convention of the American Bankers' Association in New York City, some of the biggest financiers in the country were literally astounded by the scope and range of the broadcasting activities of some of their correspondent banks in farming states. A number of banks in various parts of the country have installed broadcasting stations for the sole purpose of aiding their farmer customers. Among these banks are the Union Trust Co., Cleveland, Ohio; Northwestern National Bank, Minneapolis, Minn.; Mercantile Trust Co., San Francisco, Cal.; First National Bank, Centerville, Iowa, and a number of others which cooperate with local firms in operating stations. In addition, bank after bank—the list is much too long to mention—has installed receiving equipment and erected bulletin boards on which are posted all reports received by radio for the information of the farmers calling at the bank.

Bankers are traditionally conservative and usually are the last to adopt a new thing. Yet they have been among the first to seize upon the astounding advantages of radio for the farmer, realizing that their own prosperity is dependent upon that of the farmer and that radio is the biggest single asset that has been added to the business of the American farm in many a year.

There are two other main classes of institutions that come into intimate contact with the farmer. One is the college, particularly the agricultural institution. The other is the farm publication. Both of these classes likewise are constant broadcasters, either through operating their own stations or through cooperation with others. There is hardly a college or university in the country that does not possess radio transmitting apparatus in its electrical laboratory, and which does not broadcast at least the daily crop reports as furnished by the United States Bureau of Agriculture. A few of these institutions are: Kansas State Agricultural College, Nebraska Wesleyan University, New Mexico College of Agriculture, Oregon Institute of Technology, State College of Washington, University of Colorado, University of Texas, Clarke University, Worcester, Mass.; St. Louis University, University of Wisconsin, Iowa State College, University of Illinois, Union College, Schenectady, N. Y.

> Station 9YD:—
> I had a non-believer of the radio who is a prominent young farmer three miles south request that I get the market for him. He came and I caught the spark first and knew it was you, so waited and caught your carrier wave, and it was my good fortune to get you good, and it has made a convert of this fellow. I have one suggestion to make, if I may. That you speak slower, as these people, as well as myself, cannot write your market reports and carry on the theme of what you are saying. Also to repeat each quotation.
> DR. M. D. MCCOMMAS, *Courtland, Kans.*

The list of farm publications is even longer and includes not only local and territorial but national mediums. The *Northwest Farmstead*, in Minneapolis, operates station WLAG in cooperation with a number of other firms, and is regarded by listeners as one of the most progressive of the stations that broadcast purely for the rural community. The Corn Belt Farm Dailies, an organization of four daily papers, has not less than three broadcasting stations, WAAF owned and operated by the *Daily Drovers Journal* in Chicago, WMAJ, the *Daily Drovers Telegram* in Kansas City, and WIAK, the *Daily Drovers Journal-Stockman* in Omaha. This net of three stations gives most of its attention to live stock. Quotations on cattle are determined by four major markets, those of Chicago, Kansas City, Omaha, and St. Louis, which are the big marketing centers whose prices prevail wherever live stock is sold. These three stations blanket the entire Middle West with their daily reports from the four big live stock markets.


Chicago Daily Drovers Journal
Co-operating with U. S. Bureau of Markets and Crop Estimates
Broadcasted Market Report

Thousands of blanks like this are filled out daily

This is but a short list of the stations broadcasting particularly to farmers, a list made by selecting a few of the great outstanding examples. Anyone who cares to go through the list of broadcasting stations printed in this issue of THE WIRELESS AGE, may well be astounded at the great number whose firm names alone indicate that their primary interest is in the farm.

The data broadcast by these stations is exceedingly varied. Probably the basic service is that given on a nationwide basis by the United States Department of Agriculture. This bureau for years has been distributing market and crop reports by means of telegraph to all parts of the country, where such reports have been made available through bulletins in post offices, county court houses and similar local structures, through printing in newspapers and magazines and through the mails. Comparatively recently these reports have been broadcast by radio, first in code on 485 meters, and a number of radio telephone broadcasting stations have secured the right to transmit these reports daily in telegraph code on that wave length. In addition, most of them also follow the code transmission with the voice, reading over the radio telephone what has just been sent by means of the key.

> Station WLAG:—
> I have listened to several of your broadcasts, but was particularly interested in a portion of your evening program in reference to alfalfa. The variety which originated in Russia has spreading roots which will to quite an extent overcome the winter killing. Kindly advise us where this seed can be obtained, so I can advise my friends, the farmers, where to get it, as with our line we are constantly rendering service to the tiller of the soil. We produce. I only wish that every farmer in our community had a radio and would listen to your programs, as much good would result.
> C. C. BRUSKE & SON, *Good Thunder, Minn.*

Probably it was the great success of the broadcasting of these government reports that stimulated the present high development of what might be called local or territorial broadcasting as conducted by private or semi-public agencies, such as have been named.

As an outstanding example, take station WLAG, in which the *Northwestern Farmstead* is the prime mover.

There is nothing on the program of this station that is not of interest or value to farmers. The first thing in the morning market reports are transmitted. On account of the extreme diversity of agriculture in Minnesota these reports are very complete indeed. They include opening prices on all the northern-grown grains, on all live stock, and on potatoes, which are shipped outside the state in large tonnages, as Minnesota produces more potatoes than any other state. The state also leads in butter, and quotations on that are given and also for cheese and milk, which two items affect butter prices. Fruits and vegetables in their season also receive proper attention.

WLAG also broadcasts the opening prices on Liberty bonds and high class investments, for the benefit of northwestern banks as well as all farmers who own such securities or who may have funds available for their purchase.

(*Continued on page* 35)

In country schoolhouses everywhere farmers gather to listen to special agricultural programs sent by radio

"*I HAVE never had anything brought home to me more impressively," she said, referring to her realization of radio's place in the hospital*

A chummy chat with

May Peterson

(Of the Metropolitan Opera Company)

By Paul S. Gautier

MAY PETERSON, famous soprano of the Metropolitan Opera Company, has some letters she holds priceless; yet they are from absolute strangers. They reached her a few days after she had broadcast from WJZ, giving her the first insight of the power of the radio telephone, in making the lives of others more cheerful. She had thought of radio's humanitarian aspects, she admits, but in a vague and impersonal way. She was glad that she had the opportunity of giving pleasure to hospital patients, the blind, the shut-in, in institutions and homes. But an opera star in full possession of her health, and with a busy daily life taking her every moment, could not be blamed for not fully appreciating what radio means to those not so fortunate as she.

And just two months later the same May Peterson was caught in an automobile wreck and it was very uncertain for a number of weeks whether she would live or not. In fact physicians at one time lost all hope of her recovery. It is no slight thing to have a concussion of the brain, not to mention various other injuries about the body. That is exactly what happened to May Peterson. Of course she spent weeks in the hospital and then—and only then—did she get a full realization of the depth of meaning behind the letters those soldier boys sent to her from their cots.

Now she knew what they meant. Many was the time during her period of convalescence, when she longed to be able to clamp a pair of phones about her ears and tune in with the outside world of which she had been so vital a part, and soon would be again. But her hospital was not equipped with radio telephone apparatus and no such joys as she had been able to give those other patients befell her.

"I have never had anything brought home to me more impressively," she told me, speaking of her experience.

It is probably because of this that Miss Peterson regards radio's opportunity to cheer the unfortunate hospital patients as its most useful purpose. She lauded the effort THE WIRELESS AGE has been making to stimulate interest in the use of radio for hospitals and all other institutions of similar character.

Miss Peterson is a daughter of Wisconsin and earned her high place in the musical world entirely through her own efforts, unaided by wealthy patrons or friends. The money she earned took her to Europe and enabled her to remain there to study for five years. But she never tires to tell about her early days in Wisconsin when she was leading the singing in the little churches in the southern part of the state. Her father was a Methodist Circuit Rider and she would accompany him on his "circuit," playing at times the piano, the pipe organ and possibly a melodeon, but more often standing up and acting as leader when hymns were sung by the congregation.

"That experience taught me self-possession which has never deserted me entirely. I confess sometimes I was very weak-kneed. One of these times was when I went to the broadcasting studio to sing out on the air. So many persons wrote to me afterward. It must have been several hundred of them and the letter you saw is only an indication of what the others were like."

"The Radio Room," Federal Board Training Center, U. S. P. H. S. Hospital No. 61, Fox Hills, Staten Island, New York, December 12, 1921.

Dear Miss Peterson:

The undersigned, two of the boys who are patients at this Hospital and the instructor in electricity and radio at this Post, listening in for the WJZ concert this evening, wish to thank you and all of the artists, and we wish to thank you, Miss Peterson, especially for your kindly greeting at the end of the concert.

We thoroughly enjoyed the various numbers, including your singing. Your rendering of "The Last Rose of Summer" was a treat. We want you to know that we are cheered indeed by the beautiful singing and by your message of good will—which we feel came right from your heart inspired by the true spirit of Christmas.

We feel that we could talk our appreciation better than we can write it and hope some time to have the opportunity of meeting you, as you so kindly suggested.

With good wishes, and a Merry Christmas,

Yours sincerely,

CHARLES VINCENT SMITH,
(Ward 14),
GEORGE A. RHODES,
(Ward 27),
JOSEPH B. BAKER.

Just one of the letters Miss Peterson received after she had "appeared" for her radio audience. Later, when she was injured and confined in a hospital, she realized its full meaning

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This is said to be the first photograph taken of Jean de Reszke, the great European maestro, in ten years. He dislikes to be photographed—unless with a young woman like Miss Peterson

Some day, she says, she is going to start a drive for funds which will be used to buy radio equipment for all hospitals. She believes, in fact, that each community should regard doing such a thing more or less as an obligation which it has to keep. Even after she had left the hospital and secluded herself in a mountain retreat in the far west, where she could live outdoors and recover her health more quickly—even then there were times when she longed to be able to listen in and in that way pass the lonely hours.

She is well again and once more singing with the Metropolitan Opera Company, with which she has been for six years, but she does not confine her activities to New York and at times during the season when she can find an opportunity she makes a concert or recital tour.

It may be interesting to note, as an illustration of the personality of this unusual singer, to tell about the famous European instructor, Jean de Reszke, with whom she studied in Paris.

De Reszke for the last ten years has had an aversion to having his photograph taken for some unknown reason, according to Miss Peterson. Under no circumstances will he allow a pho-

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Army Air Service Broadcast

TWO stations of the Army Air Service have recently made decided hits with the radio fans in their respective neighborhoods by undertaking broadcasting on a small scale —"entering the newest field of indoor sports," they term this public service.

The 91st Observation Squadron, stationed at Eugene, Oregon, on Forest Fire Patrol duty, is using the radio station at its flying field during spare time to entertain neighbors within its radius, and has met with marked success. There is no other station of any size in that locality broadcasting, so they are putting on a program chiefly of phonograph music and short talks on forest fire fighting and prevention, with occasional entertainment of other kinds.

It is their intention to build a regular broadcasting room in order to transmit music by a local orchestra. Great enthusiasm is shown by local fans who listen in at home or attend the loud-speaker concerts held in the city park on special nights.

Brooks Field, at San Antonio, Texas, also has an "amateur" broadcasting station where the officers and men of the aerial squadrons put on a varied musical program. This created considerable interest in the surrounding territory, according to letters received by Lieut. McGregor of the Field Communication Department. The Post jazz band, augmented by piano, saxaphone and cornet solos, furnishes the latest music nightly, and the slogan "own your own radiola" has come to be very common thereabouts.

Garage Uses Broadcasting Station in Business

By D. M. SCOTT.

THE Hollister-Miller movable radio concert was one of the novel features of a recent town parade in Emporia, Kansas. The people on the streets heard music transmitted by a broadcasting set in the Hollister-Miller garage there, and picked up by a radio receiver and loud speaker installed in a car in the parade.

The Hollister-Miller Motor Company, which has a first-class automobile salesroom and garage, has installed

One of the autos in the parade in Emporia, Kansas that picked up music broadcast from station WAAZ, operated by a garage. It is related in the accompanying short article that an auto equipped similarly to this received orders from the garage which enabled the latter to put over a sale

a powerful radio receiving set around which citizens of the town gather of an evening and listen to concerts, lectures, grand opera and many other interesting things picked up from other parts of the country. In addition, a transmitter is used for broadcasting the market quotations from Emporia, as they are received hourly by telegraph from Chicago. Its broadcasting station, WAAZ, has been heard in Canada, Minnesota, Wisconsin, Iowa, Illinois, Texas and in many other states.

Recently, after a hard storm, when long-distance telephone wires were down, the company wished to call one of its salesmen, who was in another county, back to town. The man was driving an automobile, owned by the company, and a buyer had been found for that particular machine if it could be delivered to him in Emporia in a few hours. Not being able to call the salesman by telephone, a general call for him was broadcast by radio. Owners of receiving sets in other towns heard the message and began a search for the man. He was found and drove into Emporia two hours after the call had been sent—and the sale was made.

The efficient staff of WGY, the broadcasting station of the General Electric Company, Schenectady, N. Y. Seated, left to right: Robert Weidaw, announcer; Kolin D. Hager, studio manager; Martin P. Rice, director of broadcasting; W. R. G. Baker, engineer in charge. Standing, left to right: Mrs. William Cramb, Mrs. Kolin D. Hager, stenographers; Russell Huff, Eugene Crippen, and Carl Jester

W. J. B.—Not a Station

WILLIAM JENNINGS BRYAN regards radio as the gift of Providence—to the Democratic party. What it is to the Republican and Socialist parties he does not say, but we quote:

"I regard radio as the most wonderful of all the mysteries that man has unraveled or deals with. I have no doubt that it will play an increasing part in our campaigns. Local candidates will address the people in their territory, and Presidential candidates will talk to the entire nation.

"I have no doubt that arrangements will be made for impartial treatment of candidates, and this will give Democrats a much greater relative advantage than they have when they have to rely upon the press, which is quite largely Republican in the contested States.

"Last March I talked to an invisible audience estimated at 75,000. I presume the number of receivers is double now what it was then. My first experience was with an instrument installed by the Westinghouse plant at Pittsburgh. Letters received from those who listened indicated that my address was heard over an area of 25,000 square miles. Later at Kansas City last June the audience was estimated at 50,000. In August, when I used the radio at Lincoln, Neb., I was informed that the President spoke to twenty-six nations when he opened the station of the Radio Corporation of America at Long Island. The possibilities of radio are unlimited, and none is able to estimate with accuracy the use that may be made of it."

Radio Forecasts in England

WEATHER data is being sent by wireless telephone to English agricultural fair grounds, where it is exhibited on a large chart with a forecaster in attendance to explain how deductions of local interest can be drawn.

"RADIO'S influence will be far-reaching in its ultimate effect upon our people"

Interviewing

Dr. John H. Finley

(Noted educator and editorial writer for The New York Times)

By Maurice Henle

Dr. John H. Finley

TO comprehend fully and appreciate the meaning of this article it is necessary for the reader to allow his mind to drift back fifty-nine years. He must think of, to be exact, October 19, 1863, as the day on which compilation of the material for this article really started.

For it was on that day that John Huston Finley, now one of America's foremost educators, came into the world in which he later was to play an important rôle.

The little boy, John, grew up in the then tiny town of Grand Ridge, Illinois. And strange to say, after he learned to read the boy knew more about the things and people of the ancient world than he did about the men and women who were living in his own country. He studied the Bible because his parents told him he should. He read one religious periodical and such stray newspapers, magazines and books as might happen to find their way into his eager hands. The information that he gleaned from the Bible and other old but ever-new works, gave him a thorough knowledge of civilization in its early stages, but the little farm in Illinois at that time was an isolated place indeed. So far as contact with the contemporary world was concerned, he might just as well have been sitting on the North Pole twiddling his thumbs. As a matter of fact, he used his legs sometimes to good advantage. He recalls once having walked seven miles each way in order to hear Henry Ward Beecher give a lecture. That's how difficult it was in those days.

Of course, the boy grew up and left the home town. Immediately contact between his mind and the outside world was established. He became a mature, well rounded man, an authority on many subjects, brilliant, vigorous, forceful. The man came to be president of Knox College, The College of the City of New York, Commissioner of Education of the State of New York and Associate Editor on one of the world's greatest daily newspapers, the New York *Times*. He was given many degrees and honored in various ways by scores of colleges and universities, as the reader can easily ascertain by looking through a copy of the 1922 "Who's Who in America."

But the thing one cannot get in "Who's Who" is the personality, the genius of this great educator. One will not find in its cold pages a trace of the great longing that exists in Dr. Finley's mind, and has existed there ever since he left the isolated community of his childhood, to be of help to the boys and girls of today who, by accident of birth, must receive their early education in the "small outlying community."

Only recently has he seen a sure way out of the wilderness for these country school districts. It is the radio telephone that is pointing the way.

"While Commissioner of Education for New York State," he told me, "I had the wonderful opportunity of studying at very close range the country school houses of today. In New York State alone there are eleven thousand elementary school houses. Of these, eighty-five hundred are single-room schools and of these eighty-five hundred, three thousand have an average attendance of ten pupils or less. There are one thousand high schools and one thousand libraries in addition.

"Now, how can the radio telephone benefit these schools? Before I answer that, let me tell about a certain convention that was held in New York City some few months ago. There were eleven hundred delegates to the convention, but in a score of other cities throughout the country, there were other groups who were unable to get to the city. We arranged to have wire communication established between the convention city and the score of other cities.

"I would speak into the telephone and talk to these twenty or so groups. A Mr. Smith, out in Chicago, would speak up and offer a motion or a resolution and then another voice would be heard from Mr. Brown, in San Francisco, seconding the motion, and so it went.

"Another time we wanted to confer an honorary degree on Thomas Alva Edison. Mr. Edison was unable to appear in person to receive the degree. He had lost a degree from Oxford University because he was unable to be there for the presentation. I told Mr. Edison that it would not be necessary for him to appear, but that he should agree to sit in his library and talk to us over the telephone, listening to the conferring of the degree and then accepting it. This he agreed to do, and it was just as though Mr. Edison was present in the room.

"Often when called upon to go to distant cities to make addresses, I have thought that it would be a wonderful thing if some force or agency could be devised that would make it unnecessary for me to pick up my body, so to speak, put it in a train and have that train carry this body to some distant point, merely so that tne brain which this body is carrying could express itself there. It seems to me that the radio telephone will solve this problem.

"In making a speech at the University of Wisconsin not so long ago I spoke at the same time into a radio transmitter and my words were broadcast into many of these outlying communities of which I spoke a moment ago. It was not necessary for those people, as it had been for me fifty years ago, to walk miles in order to listen to the few words they might possibly want to hear and could profit from. They could stay in their homes and accomplish the same result.

"And so it is with the country school. I do not know whether the State will ever be in a position to finance the gigantic undertaking of supplying all these country schools with proper receiving apparatus, but certainly many of these communities can take advantage of this wonderful opportunity of being able to listen to the outside world and to know what is going on everywhere. It is a tremendous thought and I know the radio telephone's influence on the educational life of our country will be of huge dimensions in the future and will be far-reaching in its ultimate effect upon our people."

The home of station KTW, Seattle, Washington, known as the "Church on the Corner." Twenty-two parish houses are in touch with the "Mother Church" by radio. One of them is shown opposite

K T W

A Church Which Enfolds Its Widely Scattered Flock by Radio

By Sam Loomis

One of the twenty-two mission houses of the "Church on the Corner" now able to "listen in" to services. In effect twenty-three services thus are held by this Presbyterian church simultaneously

SOME radio broadcasting stations are born with a purpose, others have a purpose thrust upon them, while still others fade away for lack of one.

One of the former type is undoubtedly KTW, known on the west coast as "Brother" and throughout the West and in Canada as the "station with the echo." The name refers to the dollars which pour into the operating room of KTW after its chief announcer has signed off for the week. Which is as it should be, for if there is one kind of radio broadcasting that the public is willing to pay for hearing, it is the broadcast church service. In this there is nothing strange. The church has great influence. KTW proves that whether on the ground or in the air, it reaches the hearts of the people. That is, if it has a purpose. Not even a cathedral could travel abroad on radio waves and have no place to go but back.

What is said to be the largest Presbyterian church in the world is situated on the corner of 7th Avenue and Spring Street, Seattle, Washington. "The Church on the Corner," as it is locally known, is so extensive that it spreads out in no less than twenty-two points of the compass from the location of its main auditorium. In each of these directions are lonely mission houses or chapels, which until lately, plugged along "without benefit of clergy." They were the secondary planets of the First Presbyterian solar system, and, like most planets, they received the direct light of the sun only at stated intervals. At other times, while not exactly without light, they were comparatively dull.

And then came radio. It has given the most distant planets of this solar system the same bright, life-giving light that bathes the central sun.

Here is revealed the purpose of KTW—to connect all these outlying chapels to the mother church so that the many congregations may be but one, may listen to the same music, the same sermons, and the same prayers offered as part of the Sunday morning and evening services in the edifice of the First Presbyterian Church.

To make that possible is one reason why the radio set was installed, but it was not the only one.

Many, no doubt, have wondered how it could be humanly possible for any one church to have as many as 7,500 members and still keep that number within anything like what is known as a "fold." "No one pastor or group of pastors," one may think, "could possibly attend to the wants of so large a congregation." Take the average village parson, who, with a visiting list of no more than twenty-five, fights against time to "get around." And in vain! Yet 7,500 is the sum total of the supporters of the First Presbyterian, and to say that it is somewhat of a job to minister unto them is only to hint at the ministerial difficulties of the Reverend M. A. Matthews, pastor of the church.

Is it any wonder that when radio was suggested to him as a means of reaching some of his flock, he agreed to the plan whole heartedly and without a single reservation? No, it isn't. Dr. Matthews is a minister with broad and progressive views, and he believes that radio, as a medium through which

Rev. M. A. Matthews, far-visioned pastor of "The Church on the Corner," whose progressive views regard radio as a gift from God for the good of the Church

to preach, was a gift from God for the good of the church. He welcomed it, and termed it a necessity which was a long time in coming and one that was to be worked to its limit immediately.

A very powerful radio transmitter was installed: one that would not only reach the members of the First Presbyterian Church over a wide radius, but also bring solace and comfort to thousands of people all over the western section of the country. KTW has a complete sending and receiving outfit, erected at a cost of $15,000. It has a recognized status as a broadcaster, and carries on its work independent of any other station. It is a great radio unity.

Its builders were Mr. J. D. Ross, superintendent of the electric plant of Seattle, and Mr. J. G. Priestley, one of the prominent engineers of the city, together with Mr. Sylvester, Mr. Hachett and others. Altogether, there were some fifteen experts in several lines who contributed their services to the erection of the station.

People who listen to KTW are enthusiastic over the way the messages come in, but Dr. Matthews is enthusiastic about the way they go out. He declares, with a conviction that is characteristic of him: "We have the largest radio set of perhaps any church in the country, and certainly the largest in any other church on the west coast. Our station is perfect. Up to date, KTW has carried the gospel some 2,500 miles from the church, and letters have literally poured in from distant points. I have been heard all over the continent and even on board ships in mid-Pacific."

The unusual clearness of the transmission and the perfect modulation bring blessings to thousands of listeners every Sunday morning and evening, when the service from KTW goes out on 360 meters. In fact, it is a tribute to the quality of the transmission that in long distance telephone conversations with the Rev. M. A. Matthews, it is much more difficult to distinguish his words than when they come thundering in over the ether. The sermon and the religious music come

(Continued on page 40)

"SUPPOSE I had been able to speak into a microphone in England, in France, in Germany—and in each case been able to tell the folks at home what I was seeing in these foreign lands?"

Wirt W. Barnitz Tells About

Radio and the Globe-Trotter

By T. J. Dunham

Wirt W. Barnitz

IT takes a radio wave one second to girdle the globe seven times. It took Wirt W. Barnitz, globe-trotter and lecturer, a year to go around once.

But a radio impulse has no time in its journey to stop off and cruise around the Arctic Ocean; it can't halt and admire the northern lights and lose itself in the great and silent northern expanses. It may go past the Lofoden Islands, and zip over the Enchanted City of Visly, but it has no chance to get acquainted there.

Wirt Barnitz was in no such hurry and as a result of his leisurely wandering over the world, the radio audience, several times, has had the privilege of listening to tales of the wild—stories of adventure that start the hearer's imagination on new flights.

Barnitz began this little interview by telling of his adventures, but it was not long before he was speaking of the things he did in terms of radio; that is, he would, when telling of each incident, always picture it in a second way, through the eyes of one familiar with the radio telephone and its aim to entertain and instruct the public.

"My journey was made," he began, "back in 1919. Radio broadcasting was unheard of. I did not go as a tourist. A friend was with me and the two of us just sort of wandered about, visiting and studying the out-of-the-way places tourists never see. I had lectured a bit before my trip, but I knew that the adventures I would meet would give me material I never could get in any other way.

"Since then, of course, I have lectured extensively, and more recently, have sent my story through the air. Now what could we have done had radio been broadcasting in those days? Possibly it is looking a bit far in the future, but I can see the time when powerful stations will be located in every country on the globe, when the voice will carry as perfectly over great distances as it now does over shorter ones, comparatively. Suppose I had been able to speak into a microphone in England, in France, in Germany, Norway, Sweden, Austria, Persia, Russia, Japan, as I went from place to place on the big journey, and in each case had been able to tell the American public by radio what I was seeing, what I was doing, in the midst of the often beautiful and always interesting foreign lands.

"You have seen, many times, what is known in newspaper circles as a 'running story.' A recent instance is the flight of the airplane from New York to Brazil. Each day the newspapers publish a small story, always from a different place, always from a point nearer the goal of the plane. The public is thus able to follow the course of the plane. Just so can it be worked by radio. It is a new thought, and in my opinion it is a certainty for the future."

In one of his broadcast addresses Barnitz told of an incident aboard a vessel in which he sailed from a port in Russia. It was at the end of one of the many trips he has made to the Old World since his first famous globe-trot. The vessel was a small one and had but three fairly good staterooms. The captain and first mate used two of them, and as special correspondent for a metropolitan newspaper, Barnitz was given the other. The boat was about to sail when there was a knock at his door, and an officer of the vessel entered, accompanied by a small Russian boy.

"He asked me to permit the boy to sleep there. The part of the boat where the other passengers were huddled was not good enough for this lad, it seems," Barnitz said. "Every attention was paid the boy, but his identity was kept a careful secret. Nobody knew who he was, but I believed at the time, and still do, that the boy was none other than the former Czar's son.

"He resembled the pictures of the heir to the throne of all the Russias. When one of the boy's knees started to bleed, I was convinced that it was he, for you will recall that the Czarvitch had trouble with his knee, which would bleed at the slightest bump. I tried to learn something from the boy himself, who spoke three languages perfectly, but it was useless. I believe the Soviet officials shipped him away somewhere. Possibly he is here in America, and the Soviets will use him at the proper time for their own uses. The Bolsheviki seem to regard child life as sacred, and I cannot believe that the boy was killed with the adult members of the Russian royal family."

This is but one incident of the many that his years of travel brought to Barnitz. His experience has been unusually rich, and each time that he has spoken over the radio telephone, grateful letters have come from his listeners, indicating that the same tales of foreign travel and adventure that have interested the American public from the lecture platform, hold their lure when received through the air.

Barnitz has given radio considerable thought and says that the present tremendous interest in it will be small compared with that of the future. He hopes some time to give a radio talk on Scandinavia and the far north, which he visited on his last trip across.

Barnitz asked his manager, William B. Feakins, whether he (Feakins) thought that radio would hurt the lecture platform business, as he put it. And Feakins replied, according to Barnitz:

"At first I thought so. But as radio has developed, and as its hold upon the people is becoming greater, I have reversed my original opinion, and now I believe that the radio telephone will have the opposite effect. It will kindle the imaginations of the listeners, and they will want to see in person, on the platform, the people they enjoyed so much over the ether wave. Radio has a place of its own. It is a great power, and in my opinion, it will not disturb but rather enhance the existing order of things."

Distant Broadcasting Stations Heard

Broadcasting fans daily surprise themselves and others by reaching out across hundreds of miles by a turn of the wrist. Often the most simple bulb equipment will produce astonishing results, as reported below. What have YOU done?

H. W. MAYNARD, Fair Haven, Vt., has heard fifty-five different stations on a single detector tube UV 200. Some distance records are:

		Miles
WWJ	Detroit, Mich.	550
WHA	Madison, Wisc.	850
KSD	St. Louis, Mo.	1,000
WHAS	Louisville, Ky.	825
WDAP	Chicago, Ill.	700
KYW	Chicago, Ill.	700
WOC	Davenport, Ia.	825
WDAF	Kansas City, Mo.	1,175
PWX	Havana, Cuba	1,650

S. F. McCARTNEY, Mercer, Pa., reports hearing WOC at Davenport, Iowa, on a crystal detector, but confesses a tube is better!

		Miles
WGI	Medford Hillside, Mass.	450
2XI	Schenectady, N. Y.	350
WBZ	Springfield, Mass.	375
NOF	Anacostia, D. C.	300
WHA	Madison, Wisc.	500
WGY	Schenectady, N. Y.	350
WCT	Detroit, Mich.	200
WHAS	Louisville, Ky.	375
WKN	Memphis, Tenn.	700
WSB	Atlanta, Ga.	625
WHB	Kansas City, Mo.	775
WHAM	Rochester, N. Y.	200
WOR	Newark, N. J.	300
KSD	St. Louis, Mo.	600
WOI	Ames, Ia.	700
WOC	Davenport, Ia.	650
WLAG	Minneapolis, Minn.	700
WLW	Cincinnati, O.	300
WEAF	New York, N. Y.	300
WOO	Philadelphia, Pa.	275
WDAF	Kansas City, Mo.	775
WLK	Indianapolis, Ind.	375

J. W. BOWSER, Punxsutawney, Pa., operating stations 3AGW and 8CVU reports the following stations on a UV 200 bulb in a non-regenerative set.

		Miles
KSD	St. Louis, Mo.	625
KYW	Chicago, Ill.	550
WBZ	Springfield, Mass.	350
WCK	St. Louis, Mo.	625
WGF	Des Moines, Ia.	750
WGM	Atlanta, Ga.	625
WHA	Madison, Wisc.	550
WHB	Kansas City, Mo.	825
WOC	Davenport, Ia.	600
WOH	Indianapolis, Ind.	380
WSB	Atlanta, Ga.	625
WBAA	West Lafayette, Ind.	420
WEAB	Fort Dodge, Ia.	730
WFAA	Dallas, Texas	1,150
WHAS	Louisville, Ky.	420
WMAQ	Chicago, Ill.	550

THE Cutler & Ellis Radio Station, 9CZT, Sullivan, Indiana, has heard WZJ at Fort Casey, Washington, 2,000 miles away, on a single detector with regeneration.

		Miles
WZJ	Fort Casey, Wash.	2,000
KDKA	E. Pittsburgh, Penn.	425
KDYY	Denver, Col.	950
KLZ	Denver, Col.	950
WAAP	Wichita, Kans.	550
WBAP	Fort Worth, Tex.	725
WBL	Anthony, Kans.	600
WCN	Worcester, Mass.	845
WDY	Roselle Park, N. J.	700
WEAH	Wichita, Kans.	550
WFI	Philadelphia, Pa.	650
WGR	Buffalo, N. Y.	525
WGY	Schenectady, N. Y.	750
WIP	Philadelphia, Pa.	650
WJZ	Newark, N. J.	700
WKY	Oklahoma City, Okla.	620
WPA	Fort Worth, Tex.	725
WRL	Schenectady, N. Y.	750
WRR	Dallas, Tex.	685
NOF	Anacostia, D. C.	550
DS4	Denver, Col.	950
WLAJ	Waco, Tex.	765
WEAY	Houston, Tex.	800
WLAA	Dallas, Tex.	685
2XJ	Deal Beach, N. J.	700
2XB	New York City	720
3XW	Parkersburgh, Pa.	625
KZN	Salt Lake City, Utah	1,300
WEH	Tulsa, Okla.	510
KFAF	Denver, Col.	950
WMAK	New York City	715
WOAI	San Antonio, Tex.	950
WOR	Newark, N. J.	700

HARRY HAMMOND, Little Rock, Ark., using a UV 200 detector tube without amplification, has heard:

		Miles
KDKA	Pittsburgh, Pa.	800
WOAI	San Antonio, Tex.	600
WWJ	Detroit, Mich.	720
WLW	Cincinnati, O.	500
WPX	Havana, Cuba	1,000
WEAV	Rushville, Neb.	720

J. E. MULLEN, Raleigh, N. C., using one bulb, has heard the following:

		Miles
WGY	Schenectady, N. Y.	650
WWJ	Detroit, Mich.	500
WOC	Davenport, Ia.	850
WOH	Indianapolis, Ind.	500
KSD	St. Louis, Mo.	750
WBZ	Springfield, Mass.	750

JAIRUS COLLINS, Jr., Box 620, Lexington, Va., hears the following stations on detector alone, but says he tunes in using two stages of audio frequency amplification:

		Miles
WEV	Houston, Tex.	913
WRR	Dallas, Tex.	913
WLAG	Minneapolis, Minn.	830
WHB	Kansas City, Mo.	747
WDAF	Kansas City, Mo.	747
WAAC	New Orleans, La.	706
WOC	Davenport, Ia.	602
WMAF	Dartmouth, Mass.	544
WGI	Medford Hillside, Mass.	540
WKN	Memphis, Tenn.	540
WPO	Memphis, Tenn.	540
KSD	St. Louis, Mo.	519

FRANK LA BARBA, Los Angeles, Cal., using a single tube, single circuit regenerative set has heard:

		Miles
KFC	Seattle, Wash.	900
KFAF	Denver, Col.	850
KGN	Portland, Ore.	850
KLZ	Denver, Col.	850
KSD	St. Louis, Mo.	1,650
DN4	Denver, Col.	850
KZN	Portland, Ore.	850
WFAA	Dallas, Tex.	1,250
WDAP	Chicago, Ill.	1,800
WSB	Atlanta, Ga.	2,000
WOI	Ames, Iowa	1,500
CHBC	Calgary, Alberta	1,250

WILLARD A. BROWN, Dodge City, Kans., reports hearing 37 stations, some of which are:

		Miles
KHJ	Los Angeles, Cal.	1,050
WSB	Atlanta, Ga.	1,000
WDAR	Philadelphia, Pa.	1,350
WGY	Schenectady, N. Y.	1,400
WWJ	Detroit, Mich.	950
WHAS	Louisville, Ky.	800
KDYS	Great Falls, Mont.	875

C. H. LUKE, Gotebo, Okla., reports hearing the following stations on an Aeriola Senior, without amplification:

		Miles
KHJ	Los Angeles, Cal.	1,100
WGI	Medford Hillside, Mass.	1,600
CJCG	Winnipeg, Manitoba	1,200

GORDON M. BERRY, Waterville, Me., gives a radio concert every night, free of charge, in the Haines Theater. Some of the stations heard are:

		Miles
WOC	Davenport, Ia.	1,125
KSD	St. Louis, Mo.	1,175
WRR	Dallas, Tex.	1,675
WSB	Atlanta, Ga.	1,100
WDAP	Chicago, Ill.	1,150
WHAS	Louisville, Ky.	900

EDWARD DONNELLY, Loveland, O., heard the Pacific Coast on the detector in his R. C. set. His list follows:

		Miles
KGW	Portland, Ore.	2,100
WGY	Schenectady, N. Y.	635
WBAP	Fort Worth, Tex.	1,000
KFAF	Denver, Col.	1,100
WOAI	San Antonio, Tex.	1,150
WFAA	Dallas, Tex.	1,000
KHJ	Los Angeles, Cal.	1,950

SAM A. EDDINS, Lula, Miss., who is 5HN, has been experimenting successfully with long distance on a crystal receiver, and reports hearing the following through a crystal:

		Miles
WOC	Davenport, Ia.	600
WWJ	Detroit, Mich.	675

R. D. LANGDON, Houston, Tex., is exceptionally pleased with his Aeriola Senior, with which he has heard the following stations without amplification:

		Miles
KHJ	Los Angeles, Cal.	1,525
WOC	Davenport, Ia.	823
WFAZ	Charleston, S. C.	920
WWJ	Detroit, Mich.	1,090
WMAC	Fernwood, N. Y.	1,350
WLB	Minneapolis, Minn.	1,035
WIAD	Ocean City, N. J.	1,380
WHAA	Iowa City, Ia.	860

ALBERT BANNISTER, Hudson Falls, N. Y., who reported hearing a number of distant broadcasters early last Fall, has become even more expert with his single tube, as the following partial list testifies:

		Miles
WOI	Ames, Ia.	1,110
KAO	Denver, Col.	1,675
WLB	Minneapolis, Minn.	1,050
WLAG	Minneapolis, Minn.	1,050
WHB	Kansas City, Mo.	1,125
WBAP	Fort Worth, Tex.	1,425
WFAA	Dallas, Tex.	1,415
PWX	Havana, Cuba	1,550

LOUIS MOSES, New York City, has heard the following stations with five tubes:

		Miles
WOU	Omaha, Neb.	1,150
WAAN	Columbia, Mo.	1,000
WHAN	Wichita, Kans.	1,350

FINIS H. HASKINS, Rawling, N. Y., has heard the following stations on a two-step amplifier:

		Miles
WBAP	Fort Worth, Tex.	1,500
PWX	Havana, Cuba	1,400
WOC	Davenport, Iowa	850
KSD	St. Louis, Mo.	850
WSB	Atlanta, Ga.	850
WHA	Madison, Wis.	825

H. S. RAHISER, Pittsburgh, Pa., surprised at the distance records on detector alone reported in these columns, disconnected his amplifier and heard the following:

		Miles
KHJ	Los Angeles, Cal.	2,200
PWX	Havana, Cuba	1,250
DN4	Denver, Col.	1,325
WFAF	Denver, Col.	1,325
KLZ	Denver, Col.	1,325
9ZAF	Denver, Col.	1,325
WEAY	Houston, Tex.	1,175
WBAP	Fort Worth, Tex.	1,125
WFAA	Dallas, Tex.	1,100
CJCG	Winnipeg, Canada	1,100

W. O. PECKSTEIN, who is 6BVA in San Marcos, Cal., hooked up a crystal detector while his battery was charging and heard:

		Miles
KDYL	Salt Lake City, Utah	600
KZN	Salt Lake City, Utah	600

Broadcasting's First Leap O'er Sea

English Amateurs Heard WJZ on November 23 and Many Subsequent Nights—Receiving Apparatus Such as Is Used in Thousands of American Homes, Proves Sufficient

THE English are hearing the American broadcast programs. That fact has been established by THE WIRELESS AGE, which asked its London correspondent to report by radiogram on the reception of American radio transmission, both broadcasting and amateur. From the first message, covering the days of November 23, 24, 26 and 27, it is evident that several amateurs in England, using receiving apparatus of ordinary types, are able to hear broadcasting from the United States with ease.

In one striking case, J. Ridley, South Norwood, London, listened to the entire program from WJZ on November 26. He used two radio frequency amplifiers, detector, and one step of audio frequency amplification, and picked up the WJZ wave at 1.05 A. M. on the 26th, which was 6.05 P. M. on the 25th, Eastern Standard Time. The program that night consisted of music, bedtime stories, a description of the new styles in women's dress, and—a most interesting, this, considering who heard it!—a lecture, "An English Sense of Humor," by Major Vivian Gilbert. Then came dance music, time signals and more dancing.

There is the drama of international radio broadcasting. What more interesting and effective way of promoting international understanding than to listen unawares to the native of another country describing to his countrymen the peculiarities of yourself!

Truly, broadcasting already has become an international force for good, in the very first days of its audition in Europe. Here is great promise for the future, when transmitters even more powerful and efficient than the wonderful 1,000-watt set at historic WJZ shall be heard all over the world, when barriers and boundaries, set by nature or man-made, shall be crossed by the voices and personalities of the nations, for all to hear and understand.

Great complex apparatus will be required at the broadcasting stations, but not in the homes.

"English receiving American broadcast," radiogrammed our English correspondent, "Charles Denny, location Babington, Cheshire, single valve (vacuum tube) 23rd, 5.55 o'clock, 24th, 1.00 o'clock"

Americans who, as recorded in these pages during the past month, have heard many distant stations on a single tube, will know the thrill that Mr. Denny experienced in England when he heard the words: "This is station WJZ, at Newark, New Jersey."

Continuing with his dispatch, the correspondent reports:

"J. Ridley, South Norwood, London, two radio frequency, detector, one audio frequency, 26th, 1.05 o'clock, WJZ entire program twelve feet from phones. E. Wilding, location Wigan, Lancashire, detector, three audio frequency, 27th, 1.30 o'clock, WJZ organ, history composers. R. Williams, location Holyhead, detector, two audio frequency, 26th, 23.40 o'clock (11.40 P. M.), WJZ, 27th, 12.15 A. M., and entire program."

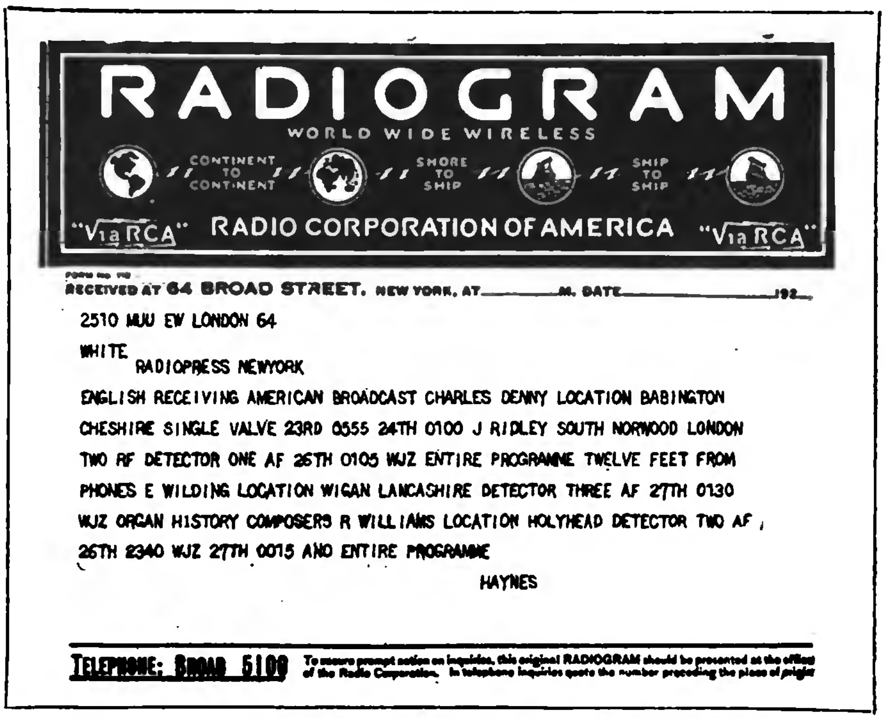
Varied apparatus, none of it unusual, except in simplicity, exactly of the type in use in hundreds of thousands of homes in the United States, suffices the English amateur.

There is the promise for the American fan—that some time in the future he may hear European broadcasting. The Eiffel Tower in Paris has been broadcasting in a small way for some months. England is just starting its programs. When broadcasting has been developed abroad to the point it has reached here, there should be no reason why, under favorable conditions, the foreign stations should not be heard in the United States.

In addition to the American broadcasters, the English amateurs also are hearing American amateur transmitters, being able to pick up their code signals every night. Details of English reception of American amateurs will be found on another page of this issue.

Uruguay Approves Broadcasting

RECENT modifications of the rigid Uruguayan laws governing the installation of wireless telephone and telegraph stations have made radio broadcasting possible, according to U. S. Vice Consul Edwin B. Montgomery, of Montevideo. Applications are now pending which, if granted, should mean the opening of a splendid market for radio telephone receiving apparatus in Uruguay.



RECEIVED AT 64 BROAD STREET, NEW YORK, AT ______ M. DATE ______ 192__

2510 MUU EW LONDON 64

WHITE RADIOPRESS NEWYORK

ENGLISH RECEIVING AMERICAN BROADCAST CHARLES DENNY LOCATION BABINGTON CHESHIRE SINGLE VALVE 23RD 0555 24TH 0100 J RIDLEY SOUTH NORWOOD LONDON TWO RF DETECTOR ONE AF 26TH 0105 WJZ ENTIRE PROGRAMME TWELVE FEET FROM PHONES E WILDING LOCATION WIGAN LANCASHIRE DETECTOR THREE AF 27TH 0130 WJZ ORGAN HISTORY COMPOSERS R WILLIAMS LOCATION HOLYHEAD DETECTOR TWO AF 26TH 2340 WJZ 27TH 0015 AND ENTIRE PROGRAMME

HAYNES

TELEPHONE: BROAD 5100 To insure prompt action on inquiries, this original RADIOGRAM should be presented at the office of the Radio Corporation. In telephone inquiries quote the number preceding the place of origin

The historic Radiogram to THE WIRELESS AGE announcing the first reception in England of American broadcasting. Since this message was received, others have come almost daily, telling of new English amateurs enjoying American programs

Welding the Community by Radio

WLW Has Rapidly Assumed a Vital Place in Queen City Life

By Cincinnatus

THE "Queen City of the West"—Cincinnati — is being supplied with radio entertainment from a number of broadcasting stations, but the call letters most often heard in the Ohio valley are WLW, which is the radio way of designating the station owned and operated by the Crosley Manufacturing Company.

When the company decided to enter broadcasting, it pursued a conservative course. Instead of at once erecting and equipping a costly broadcasting studio, officials of the company decided to commence with a small and modest station. But as soon as they discovered that their programs were becoming an important part of the life of the community, it did not take them long to decide that the old studio and station must be scrapped to make way for a bigger and better one. So the new station was built for WLW and it now is in operation.

The first modest studio of WLW soon gave way to this more elaborate one, in which to the left is seen Fred Smith, announcer, while Miss Louise Koetter is shown singing and Miss Madelon Niesen is at the piano

Four 250-watt radiotron tubes are used, two as oscillators and two as modulators, with the Heising system of modulation used in connection with speech amplifier. This speech amplifier is composed of three Western Electric No. 216 A amplifying tubes, arranged with one connected to the microphone circuit, with its output impressed upon the other two, which are arranged as a push-pull amplifier.

Their output is impressed on two 50-watt radiotrons, operated back to back, or as the push-pull system, while the output of the entire amplifier is impressed upon the grids of the modulator tubes. Normal radiation is nine amperes, using the Hartley oscillating circuit.

This set also can be operated as master oscillator - modulating outfit, using one 50-watt tube as a master oscillator, modulated by another 50-watt tube. The high frequency output of this unit is amplified by one 250-watt tube, and its output, in turn, amplified by three 250-watt radiotrons.

The antenna is 140 feet long, with an average height of 125 feet. This is composed of twelve wires on 23-foot spreaders. The four outside wires are doubled and the lead-in is a cage one inch in diameter and made up of 768 strands of No. 30 wire. The counterpoise is 60 feet below the antenna at the lead-in end and 90 feet at the other end. This contains 15 wires on 34-foot spreaders, the four outside wires being doubled as in the case of the antenna proper.

As regards the high voltage supply, this is obtained from a Glow Electric motor generator composed of two 1,000-volt, 1½ k.w. generators coupled to a five-horsepower three-phase 220-volt squirrel cage motor. One ¾ k.w. exciter is belted to the set and supplies 220 volts for the field excitation.

The opening of the new station last September was the signal for a sort of carnival week for radio in Cincinnati. An elaborate program was put on the air and persons of prominence including the mayor of the city, and governor of the state, appeared.

Equipment of WLW, showing Powell Crosley, Jr., of the company operating the station

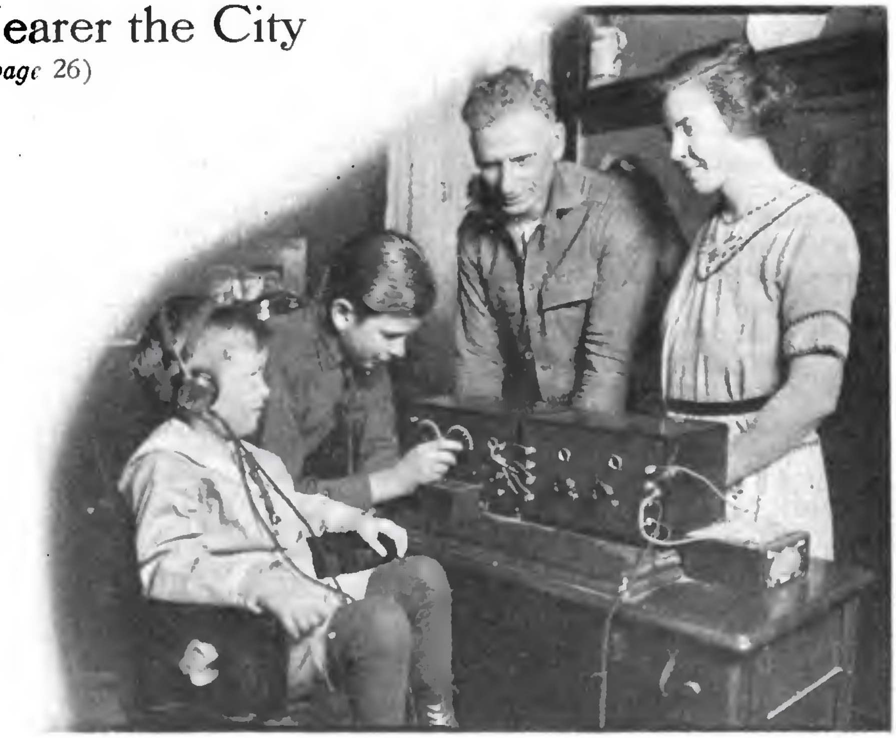
Market quotations, produce and live stock reports, weather reports and other bits of information are sent out daily from WLW which is doing its part to mold the already rather homogeneous population of Cincinnati even closer—into a community that has community spirit and municipal pride developed to a high degree.

Deliver Radiogram to Moving Train

NEW evidence of the practicability of radio for communication with moving trains was obtained recently when a telegraph message was delivered via radio to a passenger on the Buffalo Limited. This is the train that the Lackawanna Railroad has equipped with radio receiving apparatus for the entertainment of its passengers traveling between New York City and Buffalo. In the case in question, a telegram arrived at the Lackawanna station in Hoboken, N. J., for a passenger on the Limited, after the train had left the station. The message was delivered to the operator of the Lackawanna's station, 2XAJ, who called the train by radio, ascertained that the addressee was on board, and then transmitted the message to him while the Limited was making fifty miles an hour. The addressee was so struck with the feat that all the passengers in the train heard about it. The message he received, he explained, contained instructions to stop off en route instead of going straight to Buffalo, as he had planned.

The Farm Moves Nearer the City

(*Continued from page* 26)



Typical of the tillers of the soil is the Guger family. After making a simple set very cheaply, they found radio so valuable that they spent $125 for a "ready made" one, which they attach to their Victrola so all can hear

Mr. George W. Kelley, editor of the *Northwestern Farmstead*, says, "We have found that by talking not about poor investments but about good investments we have been able to save the farmers what formerly went into blue sky promotion."

So complete is the market broadcasting that practically the entire morning is devoted to it. At 1 o'clock markets begin again, giving the fluctuations that have occurred since the opening of trading. After the exchanges close in the afternoon, the closing prices are put on the air, at about 3:45 or 4 o'clock.

The time signals, of course, are retransmitted. In this connection it is interesting to know that often there is a real financial reason for having accurate clocks, a much more important one than the mere satisfaction of having the correct time. A grain elevator manager, just before WLAG started to broadcast the time signals, wrote a request that the correct time be given by the station. He said, "I lost $14.00 for my firm the other day because my watch was 15 minutes slow. I missed the closing prices and as a result paid 7 cents too much for 200 bushels of flax. That was a lesson to me and now I have installed a loud speaker and can hear the markets even when I am out in the driveway and the machinery in the elevator is running. Please send the time regularly."

In the hour from 6 to 7 o'clock in the evening, this station presents two or three short lectures on farm topics by experts, usually by members of the faculty of the State Agriculture College, though often other experts, such as commissioners of agriculture of other states, grain supervisors, men from the stock yards, experts of agricultural marketing organizations and practical farmers, give talks on the subjects in which they have made outstanding successes. In fact, brief, snappy talks by men who are well posted on all agriculture subjects have been broadcast, including one Chinese who talked on agriculture in that Republic, a man who discussed the Philippine Islands, and another who spoke about conditions in England.

In the evening the station transmits a more general program, including music and general educational features which may not have as direct a bearing on the farmer's business as has the matter broadcast during the daytime and early evening.

The station has been heard on the Atlantic Coast and among the Rocky Mountains, along the Gulf of Mexico and far north in Canada. Antennas are being strung up all over the northwest, hundreds of them for the sole purpose of listening to WLAG.

It is interesting to note that the experience obtained in operating this station indicates that not alone is the farmer benefited directly, but also the city man, and that indirectly through him the farmer benefits. Mr. Kelley states "an interesting angle of our broadcasting is the benefit it gives to farmers indirectly through the knowledge of farming and farm problems which has gotten across to city folks.

"The other day we had a lecture on varieties of alfalfa suitable to Minnesota. On another day a lecture on the fact that lime is required on some Minnesota soils to make alfalfa successful. Soon after I got a letter from a merchant who said he never before had known why alfalfa would not succeed for the farmers to whom he had sold seed. He wished to know where to buy seed of Grimm and Cossack varieties, which he proposed to stock and sell hereafter, instead of the common seed, which had always failed. He also wanted to know where ground limestone might be procured."

Another station that is of inestimable value to the agricultural life of this territory is WOS, operated by the Missouri State Board of Agriculture, Jefferson City, Mo., which operates a 500-watt set and has been heard in twenty-eight states with useful effect, although obviously being a state institution, the material that is broadcast is designed primarily for farmers in Missouri.

This bureau is exceptionally active in broadcasting and not only transmits daily markets and similar news and educational features, but is taking the initiative in a broad-scale movement for a standardization of farm broadcasting along lines that will make it of even more value to the farmer. Many of the farm listeners copy down the quotations they hear by radio and as each station has its own individual system of reading them, it is difficult for listeners to shift easily from one transmitter to another.

According to Daniel E. Rogers, associate state marketing commissioner, there is a great need for standardization of practice in the transmission of quotations, in order that uniform

Station 9YD:—
I am an amateur and hear your signals very plain here. I live on the farm and get very much good of the market reports and the weather.
I do not know what I would do if I could not get the market reports and weather, as it is a great help to me in my work. I hope you will keep sending them and many will receive the good of them that I do.
EARL N. LEGER, *Box 23, Oak, Neb.*

Station WLAG:—
Tonight am inviting in 133 farmers and families to be entertained, but fear many will not come until 8:00 o'clock. A program say 9:30 until 10:30 could be made better use of by farmers. They seldom have their work done until 7:30 and can't get out to hear the lectures from 6:00 to 7:00. Appreciated the vesper service Sunday. Gives we people out in the country a chance to get real church service.
J. LAWTON, County Agent, *Clarkfield, Minn.*

Station WLAG:—
We are getting your lectures every day from 6 to 7, and if other listeners are as appreciative as we are, you sure will he well repaid in thanks, if not cash. Thank N. E. Chapman for us for the lecture on October 18, which he gave for the benefit of the Chatfield people. I am sure they appreciated it, hut no more than I did as I ironed my week's wash and drank in all he said.
MRS. J. D. LIFQUIST, *Heming, Minn.*

blanks may be printed and the copying of reports made as easy and simple as possible. Many of the farm broadcast stations now print and distribute blanks for copying the reports, in one or two cases selling them at cost, and in others distributing them free. Each blank is entirely different from all the rest. Obviously there are difficulties in the way of devising a standard blank for the entire country, as the potato quotations that are so vital to the farmers of the northwest would not be at all interesting to the sugar cane and cotton growers of the south. In other words, territorial conditions as regards produce necessitate a considerable variety of broadcast quotations. However, the present condition may be much simplified, with exceedingly beneficial results.

In station WOS the feeling is that standard procedure is greatly needed and a detailed questionnaire is being distributed widely to listeners in order to form the basis for drafting such a uniform method. The broadcasting station of the Missouri State Board of Agriculture probably is going further into the handling of market news than any other single station, in view of the great diversity of interests in the State of Missouri, and also the fact that many other stations are reached by the transmitter, although the Board is not supposed to have any interests outside the boundaries of Missouri. WOS has a United States Government leased wire running direct to it, and in this detail has established a precedent.

Another interesting station is WPG, operated by the Nushawg Poultry Farm, New Lebanon, Ohio. At first it might seem odd that a poultry farm should run a broadcasting station, yet this firm, one of the best known of its kind in the country, is a large supplier of poultry foods, remedies and equipment of all kinds to farmers through a large section of the country and has done a great deal to increase the productiveness of poultry on the American farm. Its broadcasting program, however, does not confine itself by any means, to discussion of poultry but includes reports of all markets, lectures by experts on every possible farm subject, and musical entertainment. The City National Bank of Dayton, Ohio, frequently cooperates with this station in arranging programs.

It would be possible to go on and on outlining the work done by station after station, but enough has been said to indicate the general outlines of radio's tremendous service to the whole community.

Station WLAG:

I was very interested with your lecture the other evening on alfalfa, and have just returned from a visit up in Burnett County, Wisconsin, where some of the blue flowered alfalfa was tried out several years ago. On making inquiry, found out that it had all been winter killed and I was telling the gentleman on the farm that you now had a yellow flowered alfalfa that could stand the winters in this part of the country and told him that I would get some further information regarding it for him. Will you kindly advise me the name of the variety, where the seed can be purchased and the price it is?

W. C. Hutchinson, *Minneapolis, Minn.*

How can radio serve better?

Radio service to the farmer is dependent on the farmer's attentiveness. Radio can serve him only as he listens.

WISCONSIN STATE JOURNAL
RADIO BROADCASTING STATION
W. G. A. Y.

CHICAGO GRAIN TABLE

CHICAGO................

Month	OPEN	CLOSE	Month	OPEN	CLOSE
Oats			Wheat—		
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
Lard—			....	....	....
....	....	....	Corn—		
....	....	....	....	....	....
....	....	....	....	....	....
Pork—			....	....	....
....	....	....	....	....	....
....	....	....	Rye—		
....	....	....	....	....	....
Ribs—			....	....	....
....	....	....	....	....	....
....	....	....			
....	....	....			

W. G. A. Y. BROADCASTING STATION
is run in connection with the
NORTH WESTERN RADIO CO. INC.
250 STATE ST.
MADISON, WISCONSIN
Standard Receiving Equipment
For Sale at Reasonable Prices
Prompt Deliveries — Installations
Send for our free pamphlet containing valuable information.

One of several types of blank provided by WGAY

Put more radio sets on the farm. A radio receiving set in a farm home serves the farmer, serves the city man, serves the nation.

When you tour in your automobile and see an antenna stretching possibly from the farmhouse to the peak of the barn, it is as though you saw a great sign hung from that wire, reading, "Radio Serves You Here."

More radio sets on the farm. More farm listeners. A greater audience for the astoundingly valuable data being broadcast day and night to the farmer.

Those are the needs of farm broadcasting.

Radio Telegraph Carried Transcontinental Traffic

TRANSMISSION of election returns on November 7 was accomplished not only by the broadcasting stations, but also for the first time in the history of wireless by one of the great commercial transmitters of the Radio Corporation of America, which was drafted in an emergency service to send the returns by radio telegraph from New York to San Francisco. Early in the afternoon of Election Day the large news associations learned from the telegraph companies that severe storms in the West had broken all the transcontinental wires. Both the United and the International associations appealed to the Radio Corporation for aid, stating at 2 p. m. on Election Day that unless their election return dispatches could be transmitted by radio, the Pacific Coast would be without news from the East.

Normally the Radio Corporation's transmitters would have been unable to take on the emergency service, but the holiday had cut down commercial traffic to Europe to such an extent that it was possible to turn over a transmitter to the press associations for the evening. This worked continuously from 5 p. m. on Election Day until 2 o'clock the next morning, sending thousands of words across the country to the Radio Corporation's receiving station at San Francisco. There the messages were put on the regular land wires for distribution to newspapers on the Pacific Coast.

In the three hours that elapsed between the appeal of the press associations and the actual commencement of transmission to the Pacific, much helter-skelter work had to be done. The San Francisco receiving station normally pays no attention to signals from the Atlantic Coast, and there was no way of calling it by radio. Wire messages were dispatched via Canada, Arizona, and over all possible routes that might possibly be open, to ask San Francisco to listen to Rocky Point.

One of them finally got through in a very roundabout way, and ten minutes later the stream of election returns commenced. The other messages dribbled through much later, in fact some of them were still on the way the next day. At 11 o'clock on Election Night the Pacific Coast returns were transmitted to New York by radio, the Rocky Point engineers making use of an experimental antenna, the highly directional aerials used for reception from Europe being useless for reception from the opposite direction.

Once more radio proved its strikingly universal flexibility by bridging a gap in the wire services. It will be remembered that the Radio Corporation's trans-Atlantic services were able to take care of the communication emergency with Europe when the Irish cut the cables. In the latest instance of public service in time of need the feat was even more striking, for the Election Day performance amounted to turning a transmitter around.

Talking With Ships at High Speed

Tests Show Practicability of Working at Rate of 100 Words a Minute at Sea as Well as on Land—"Majestic" First Vessel to Achieve Both Transmission and Reception by Automatic Devices

"HOW long will it take you to send this message to New York?"

The passenger fidgets before the window of the radio room, fingering a Radiogram blank containing a few important words.

The operator checks it hastily. Ten words.

"We're sending at the rate of 100 words a minute," he explains briefly. "It will take six seconds to transmit this. There are a few messages ahead of it, so we won't be able to start it for two or three minutes. It'll be in New York in five minutes or less."

That is the new picture of ship-to-shore radio telegraphy, painted with the aid of high speed sending apparatus, now installed for the first time on board ship. The *Majestic* is the vessel that created radio history and pointed to an even bigger future for radio on shipboard. On a recent voyage the first tests with automatic transmission were entirely successful from the start.

No longer can there be sudden congestion of traffic, caused by numbers of passengers wishing to send radiograms at once. Nor, if high speed be used, is it possible for important radio messages to be picked up and understood by all who can read the international Morse code. High speed transmission on board ship is at a rate too fast for any human ear to understand, and goes at a gait five times faster than hand sending.

The successful use of high speed equipment on board ship is of great significance. It indicates that ship to shore radio telegraphy has developed to such a point that the demands made upon it by the voyaging public have necessitated its elevation to the same stage of reliable and swift operation that has been reached on transoceanic circuits. Only twelve years have elapsed since radio, having demonstrated its great service in time of emergency, has been required on all steamers carrying fifty persons or more. In that short time radio communication has made such fast strides that today on ship and shore it gives a service fully comparable with the best wire service on land.

Radio broadcasting has ended isolation in the United States and radio telegraphy has ended isolation at sea.

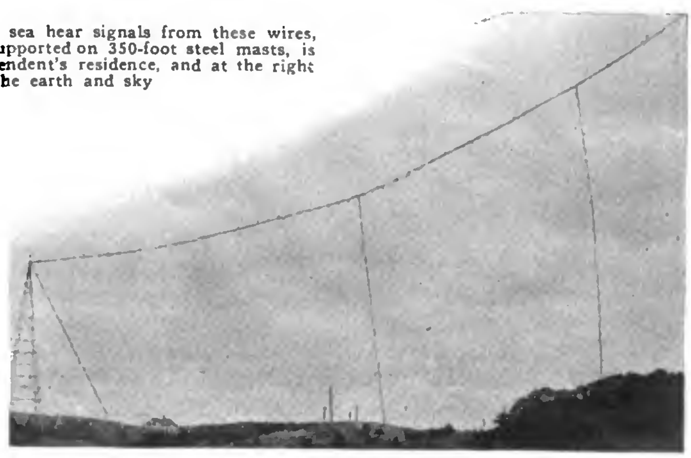
Take a big ocean liner, equipped with the automatic transmitter, and carrying 720 passengers. Each one of those passengers could send 100 words a day by radio, yet the transmitter would have to work only half a day, twelve hours, to send each day's grist of 72,000 words.

That is an exaggerated picture, yet it fails to exhaust the possibilities revealed by the success of the first tests, which were conducted between the *Majestic* and WCC, the Chatham, Mass., station of the Radio Corporation of America. At Chatham, the signals were recorded automatically on a moving tape in exactly the same fashion that the dots and dashes of transmitters in the various countries of Europe, working at the same speed, are recorded in Radio Central, 64 Broad Street, New York City. On board ship, transmission was done in the same manner used at Radio Central, as described in the article "What 'via RCA' Means to a Message," in the November number of THE WIRELESS AGE. The message that is to be sent is first perforated on a tape, by means of a machine having keys like a typewriter. The tape is then fed through a mechanical transmitter, which takes the place of the hand key and can be operated at any desired speed.

The two machines, perforator and the transmitter, used on the *Majestic* are of British make, as the ship is owned by an English company, but are substantially similar to the American machines. When they were placed in the radio room on the ship when she was at her dock in England, the operators were told that possibly some time during the voyage they might be able to transmit one message at high speed and that probably after three or four months of experimentation they might be able to operate the new apparatus at will. However, such is the perfection of the high speed machines, and such the intelligent ingenuity of the operators of the *Majestic,* that on the first voyage they were able to operate it successfully, and in their first trial sent ninety-seven messages in forty-two minutes. Formerly, using the hand key, it would have required two hours to clear this mass of traffic.

Not only does the new use of high speed transmission afford secrecy to ship-to-shore telegraph messages, as only those equipped with recording devices can copy at the rate of a hundred words a minute, but it also relieves the congestion in radio traffic between sea and shore. Obviously, if the same number of messages can be sent in one quarter of the time, there will be just that much more capacity added to the wave lengths used in ship communication. The greater part of the radio

Ships fifteen hundred miles away at sea hear signals from these wires, **sent on 600 meters. The antenna, s**upported on 350-foot steel masts, is seen at the left back of the Superintendent's residence, and at the right as it swings over the earth and sky



congestion between ship and shore occurs when the vessels are about twenty-four hours away from their docks. It is at that time when the passengers learn the approximate hour of docking, upon which most of them file messages to their friends or offices on shore. This sudden flood of traffic, plus service messages between the Captain of the ship to his office on shore, jams the air and the radio rooms. By the use of the high speed transmitter it will be possible to take care of this big volume in just about a quarter of the time, as the fastest hand sending is between twenty and twenty-five words a minute.

At present the *Majestic* is the only ship equipped with this high speed apparatus and the station at Chatham is the only land station in the world that is capable of copying a ship transmitter operated at high speed, for other land stations and ships use the old, familiar hand key and ear phone. However, in view of the instantaneous success of high speed transmission on the *Majestic* it is certain that the time is not far distant when every important passenger liner will be able to send at the rate of 100 or more words a minute at will, and that every important land station will be able to receive at that speed.

At present it does not seem likely that it will be necessary to install high speed receiving apparatus, in other words adopt automatic recorders, on board ship. This for the reason that experience shows that ship traffic proceeds from ship to shore in a greater volume than from shore to ship, the ratio being about 3 messages to the shore against one to the ship. However, it has been the experience in all development of communication facilities that the adoption of new methods and new facilities creates new traffic. The high speed transmitter on ship, therefore, is expected to stimulate additional traffic in both directions and in the case of the largest liners such as the *Majestic, Olympic, Homeric, Paris, France,* the *Leviathan,* and similar ships of the first class, it may eventually be necessary to use automatic methods for receiving as well as sending.

In fact, following the first successful trial of high speed transmission on board ship, the English engineers installed a tape recorder for reception at 100 words a minute. Just as was the case with the transmitter, the operators on the *Majestic* far exceeded expectations, and successfully used the new mechanism on the first trial, thereby making it plain that when ncessary ship traffic can be handled in both directions automatically at great velocity.

The operating building at Chatham, with one of the local aerials used for work on 600 meters. The telegraph poles faintly seen back of the structure support one end of a receiving antenna a mile long

In the case of ships of British registry the advent of the high speed transmitter is especially welcome, as the radio regulations applying to English ships require that 20 per cent. of the time be spent in listening on 600 meters for distress signals. In the case of a ship carrying hundreds of passengers and having thousands of messages to transmit during the course of the voyage, this enforced silence for a fifth of the time seriously limits the possibilities of handling traffic. During this listening period the operators now can be punching the tape for high speed transmission when the next sending period arrives. By speeding up the transmitter four times, British ships having a large volume of traffic will be able to overcome their handicap of their long listening periods.

The successful high speed operation with the *Majestic* is only one outcome of the heightened activities of the Radio Corporation of America at its great station at Chatham and Marion. This has been the scene of intense activity during the past eighteen months, since the present transmitting and receiving sets there were put in service. New transmitters and receiving apparatus have been installed, and recently the addition of high speed recording apparatus was made.

At the present time the Chatham station has three transmitters, operating on 2,200 meters, 2,300 meters and 600 meters, and has five distinct receiving sets capable of receiving on any wave length. It is not at all unusual for this entire equipment to be busy for twenty-four hours a day, handling messages from as many as five ships at a time, and during the course of twenty-four hours taking traffic from ships in all parts of the Atlantic Ocean, and even in the North Sea and the Mediterranean. Reliable communication across 1,500 miles of water during the day is a commonplace, and at night the range is practically unlimited.

What a contrast between the old days when a radio message for a ship at sea had to be relayed from ship to ship! The old days are gone.

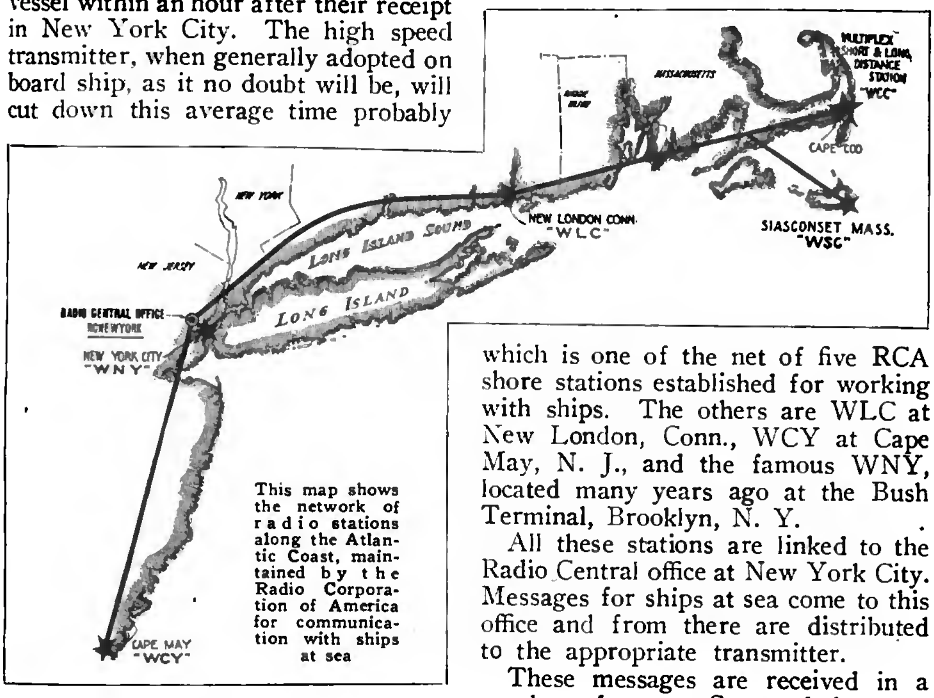
Today a radio message from the shore reaches the ship at sea without a single relay. It is possible, in fact, for a message to be received on board ship, in the middle of the Atlantic Ocean, within a few minutes after it has been filed in New York City. This speed is not always achieved, however,

One corner of the operating room at Chatham. The telegraph instruments are connected to land lines to New York and Boston for receipt and dispatch of radio messages to and from ships at sea

Another view of the operating room. The machine in the immediate foreground, with keys, is a perforator for the tape used in high speed transmission, and is similar to the device used on the "Majestic" due to the fact that most ships cannot operate receiver and transmitter simultaneously, though this also is an engineering possibility and is promised for the future. Sometimes a message has to be held by the transmitting station until the ship clears some of its traffic and then indicates that it is ready to receive. On the average, however, radiograms for ships at sea in the Atlantic Ocean are dispatched to the vessel within an hour after their receipt in New York City. The high speed transmitter, when generally adopted on board ship, as it no doubt will be, will cut down this average time probably to fifteen minutes. The only case in which messages between ship and shore should be subjected to a longer delay is when a disaster at sea has resulted in a general order for all stations to cease sending in order that there may be no interference with the traffic of an emergency nature with a vessel in distress. Even in this case the use of wave lengths far above that of 600 meters on which distress traffic is handled, will, generally, permit other messages to go ahead.

The Chatham station, WCC, which is also known by the call WIM, which latter applies to its interrupted continuous wave transmitter operating on 600 meters, contains the most modern apparatus known to radio science. Each transmitter uses three 1 kw. vacuum tubes. Although this is only a fraction of the power put in the antenna by the great Rocky Point station of the Radio Corporation, which transmits day and night to Europe, Chatham's work compares very favorably with that of Rocky Point, communication with ships on the European coasts being not at all unusual, and it is quite possible to exchange messages with most of the European land stations. Though the Chatham station was not erected for that purpose, its location seems to have been unusually favorable, resulting in an unexpectedly great range. Additional equipment is being installed at WCC and the station is being brought to such a point that it well merits the name of "The Marine Radio Central."

In fact, it is considered as entirely possible that within a few months WCC will have such additional facilities as will enable it to take over the traffic now being handled by WSC, the RCA station at Siasconset, Mass., which is one of the net of five RCA shore stations established for working with ships. The others are WLC at New London, Conn., WCY at Cape May, N. J., and the famous WNY, located many years ago at the Bush Terminal, Brooklyn, N. Y.



This map shows the network of radio stations along the Atlantic Coast, maintained by the Radio Corporation of America for communication with ships at sea

All these stations are linked to the Radio Central office at New York City. Messages for ships at sea come to this office and from there are distributed to the appropriate transmitter.

These messages are received in a number of ways. Some of them are delivered in person to Radio Central at 64 Broad Street, some are telephoned there, and some are telegraphed. In the case of the latter it is possible for a person anywhere in the United States to file a radiogram with any telegraph company, for transmission to a passenger on board a ship at sea. It is simply necessary to address the radiogram to the person, the name of the steamer and then "RCNewYork." Through rates from the point of origin to the ship are quoted by all telegraph offices. "RCNewYork" means the most modern, the most speedy and the most reliable communication with ships at sea.

The social room in the hotel for the staff at Chatham, Mass.

Pacific Islands Hear Coast Broadcasting

HEARING a broadcasting station far distant across the sea gave added significance to the observance of the peace ceremonies on November 11th. All who had receiving sets in the Hawaiian Islands were able to listen to the broadcast Armistice Day program transmitted by KUO at Los Angeles, Cal., 2,600 miles away. The concert and speeches from KUO were picked up by KIE, the receiving station of the Radio Corporation of America at Koko Head, near Honolulu, which connected its receiver with the land wire to Honolulu, where connection was made with the broadcast transmitter of the Mutual Telephone Co. Thereby the Los Angeles concert was automatically retransmitted, in exactly the same way that the Arlington time signals are retransmitted by broadcasters throughout the United States.

The preliminary test, arranged through cooperation between the Radio Corporation of America and the Mutual Telephone Co., was entirely successful, though only a few minutes were consumed in preparatory work. Since then the feat has been repeated at will. No special apparatus was used beyond that already installed at the Koko Head station, and it is considered possible that by using apparatus designed for the purpose the U. S. Navy station at Arlington on the Atlantic Coast, which frequently transmits by radio telephone, will broadcast in Honolulu by retransmission. Any other broadcasting station in the United States using sufficient power likewise might be heard in Hawaii in a similar manner.

This is considered as opening astounding vistas. It not only brings the Hawaiian Islands within earshot of the United States, of which they form an important Territory, but brings nearer the day of exchanged speech between peoples in all parts of the globe. Humanitarians long have prayed for the day when the nations would bring mutual understanding to annihilate the distances and varying viewpoints that keep them apart; the feat in Honolulu demonstrates that that day is not far distant, that international broadcasting is a possibility that only awaits the development of broadcasting in other countries to the height it has reached in the United States.

Argentine Regulations

ACCORDING to Commercial Attache Feeley, no laws have yet been passed to govern wireless telephony in Argentina, but a bill is being drafted for presentation to the next Congress to regulate the use of radio sets.

KTW—Enfolding the Flock by Radio

(*Continued from page* 30)

in with fewer imperfections than selections usually come from a first-class talking machine.

The letters that pour into the offices of the church are appreciative, sympathetic and congratulatory. There are many thousands of them, and they all prove that countless shut-ins, sick people, convalescents, and even prisoners, are grateful for the chance to hear the word of God as brought to them by radio. What a vast power for good is here uncovered! Atheists have been made to believe by radio, and men who were "just indifferent" have been awakened to a better and more active participation in the work of the church.

"I have been previously very bitter against churches and ministers," writes one listener-in to Dr. Matthews, "but since listening over radio to your sermons, instead of antagonism and prejudice, I am beginning to believe in you and the gospel you preach."

This man is now a convert. He is not the first to be so drawn into the church, and he will not be the last.

"This Sunday morning," writes another listener, who suddenly felt the call to "echo," "is the first time I have been able to tune in on your broadcasts, although I have tried every Sunday. This morning was very plain, and I heard and enjoyed the entire service. The plainest part was when you asked for the offering. Let the Dollars Pour Out. HERE'S MINE!"

The letters which follow are fair samples of thousands now on file at KTW.

"It may interest you to know that your sermon preached last night dealing with the betterment of our boys and girls came in here at High River, Alberta, very clearly and was read distinctly on a home-made three-valve receiving set with an average antenna. Should the radius of reception hold as good in all directions, it would be difficult to estimate the number of listeners you had.

"Congratulations! both on the excellency of your sermon and the size of your audience."

"I thought you would be interested in knowing that Sunday evening a little crowd of our friends gathered in our apartment 300 miles from Seattle and 2,626 feet above sea level, and heard Dr. Matthews deliver a sermon, also the sacred program which followed. Could hear clearly and understand everything."

Recalling the popular opposition, not yet entirely overcome, to the adoption of movies to aid the work of the church, we must in all fairness concede that radio already has ascended, by virtue of its nature, to a pinnacle to which moving pictures perhaps may never climb—a place in the pulpit beside the minister of the gospel. So elevated, radio is doing its best work, in a way peculiar to itself and truly indispensable to the masses which are hungry for religious consolation and comfort. Radio is truly a great gift of God to man, and man is only beginning to utilize it.

This man is called the "critic" of KTW. He checks up on quality of transmission when the station is in "action"

May Peterson

(*Continued from page* 27)

tographer to come within snapping distance, and yet THE WIRELESS AGE is able on page 27 to reproduce a photograph, showing the famous instructor with Miss Peterson. She says she had to use all her powers of persuasion.

May Peterson is well known as the girl who has never allowed romance to interfere with her artistic success. A metropolitan newspaper once said of her that "she is the only grand opera singer who has never been known to have a love affair. She avoids these affairs as conscientiously as she would avoid a sore throat. And with this program of self-protection in mind she barricades herself in Society. All she has to say to men she impresses in singing."

How Radio Time Signals Are Made Accurate

ONE of the most appreciated services of radio broadcasting has been the transmission of Arlington time signals at noon and 10 p. m. daily. These signals indicate the exact time for the 75th meridian west of Greenwich, or Eastern Standard Time. The signals heard when the time is being transmitted by radio are not sent by hand, but are the actual ticks of a special transmitting clock. This clock is carefully checked with three Riefler clocks, kept in a special vault in the cellar of the Naval Observatory at Washington. These clocks are the most accurate in the country and keep sidereal or star time, being corrected by observations of the stars. Their error is very small, and they indicate most exactly the precise star time at any moment at the observatory at Washington. As the 75th meridian does not pass through Washington, a slight correction of eight minutes and fifteen seconds has to be made in order to arrive at exact Eastern Standard Time.

The transmitting clock, which is heard on the air twice daily, is kept running on this time. Just before sending the time signals it is checked with one of the three Riefler clocks, its ticks being recorded on a chronograph. By comparing the records of the clocks as written down in wave lines on a strip of paper, it is possible to determine how closely they are in harmony. If an error is discovered in the transmitting clock it is speeded up or slowed down by a very fine electrical control until its ticks correspond exactly with those of the standard Riefler clock.

At five minutes before the hour a switch is closed at the Naval Observatory, connecting the transmitting clock with the radio station. Those who set their watches by these ticks have the satisfaction of knowing that they are, for the moment, at least, as accurate as the best timepieces known to science, held in a vault in Washington. The only error would be that caused by the short time necessary for the radio waves to travel from the transmitter to the receiving set.

More Worries For Juries

A NEW chapter in the history of jury system was written in a recent murder case in Los Angeles. The jurors were admonished by the presiding judge not to "listen-in" with their radio sets while accounts of the case were being broadcast.

Talking Movies Successfully Demonstrated.—*News Item.*

Maybe they'll begin referring to the Winter Winds as the Talking Blowies.

Laughter on the Radio Wave

Molecules

By Charley Meinstetz
(as dictated to M. H.)

I HAVE made a great discovery. As I write, I tremble at the importance of the message I bring.

For this is it: From now on restaurant chefs will boil eggs just right. You have noticed that it matters not what kind of boiled eggs you order—whether soft, medium, four-minute, or what-not—you consistently get the same thing. A four-minute egg may turn out to be a four-second one, or what tastes like a four-year one.

All this is to be remedied by radio.

You are familiar with the vacuum tube. Of course, you are. But for the benefit of those who came in late, let me say that the vacuum tube contains as nearly perfect a vacuum as human beings are able to produce. But despite its apparent perfection, each cubic inch in a vacuum tube contains 450,000,000,000 molecules of air. Since it is evident that this is a much greater quantity of matter than is contained in the head of the average chef, I suggest that each restaurant proprietor decapitate his chef and substitute for his headpiece a vacuum tube.

Even though each cubic inch contains 450,000,000,000 molecules of air, each one of these molecules can dart around within the cube for four-tenths of a mile without hitting other molecules.

That is an important discovery in itself. So, getting down to it: if each of these molecules darts four-tenths of a mile without striking any one of the other 449,999,999,999 molecules in this cubic inch of vacuum, it will be possible, by frying some ham to have ham and eggs if the hens are laying well. But, on the other hand, the Woolworth Building is 52 stories high.

It all depends on the sex of the molecule.

VOICE on the Air:

"The Voice of the South will now be presented by Miss Brown, lyric soprano, in the Old Oaken Bucket."

SCIENCE

"How jolly! We'll be able to listen to the next world war by radio."
—*Simplicissimus* (*Munich*)

Dear Editor: The Department of Commerce has just given the Detroit Police Department the call KOP. Wassa matter, is the D. of C. taking up fonetik speling? KURYUS

No, the Department of Commerce originally intended to spell it correctly, COP, but the Navy Department objected, saying that it controlled the seas, so the kall had to be korrekted by the Department of Kommerce to KOP.

Farming by Radio

I would like to be a farmer,
With rolling acres spread,
And raise the wheat and barley
To bake the nation's bread;
But plowing takes the labor;
'Tis hard to plant and hoe—
I think I'll plan some method
To farm by radio.

I know it would be pleasant,
Be naught but jolly fun,
To loll within a hammock,
Away from scorching sun,
Receiver tuned to tell me
How pumpkins thrive and grow—
It seems an endless picnic
To farm by radio.

So I'm studying Marconi,
And the wireless control,
For a way to guide the tractor
Where'er my thoughts may roll.
It will surely prove a wonder
When I get the thing to go,
And can plant and spray potatoes,
And dig by radio.

CHARLES H. CHESLEY—The N. Y. *Sun.*

Wise Crack-les

Readers of THE WIRELESS AGE are urged to sharpen their wits and send in their Wise Crack-les to this column. Get busy, you merry-makers, and if you originate a laugh, pass it along for the rest of us to enjoy.

A HORSE named Radio won a race and incidentally set a record at Latonia recently. Small chance of losing, with radio traveling 186,000 miles a second.

FROM the Baltimore *Evening Sun*:

"Sir Thomas Lipton in his efforts to have his voice heard in Europe by radio probably used a 'T' aerial.

"The main difference between attending a World Series baseball game and listening to a broadcast description is $1.10 to $5.50."

EVEN though development of the radio makes wire obsolete, official Washington will no doubt keep enough on hand for pulling purposes.

RADIO RAGTIME

SPX Nutville.

Oh, Ralph, are you there?

Right here, Jim.

Try this on your piano:

"What are the best known bands of men?"

"Husbands."

Here's another:

"What does the buffalo on a nickel stand for?"

"He hasn't room enough to sit down."

Gosh. Thought that one would stick you. Try this.

"Why isn't there any difference between a gum-chewer and a locomotive?"

"Because they both go chew-chew."

You're too smart today Ralph. Buzz me up to-morrow.

So long. —N. Y. *Evening Journal.*

RADIOTIC

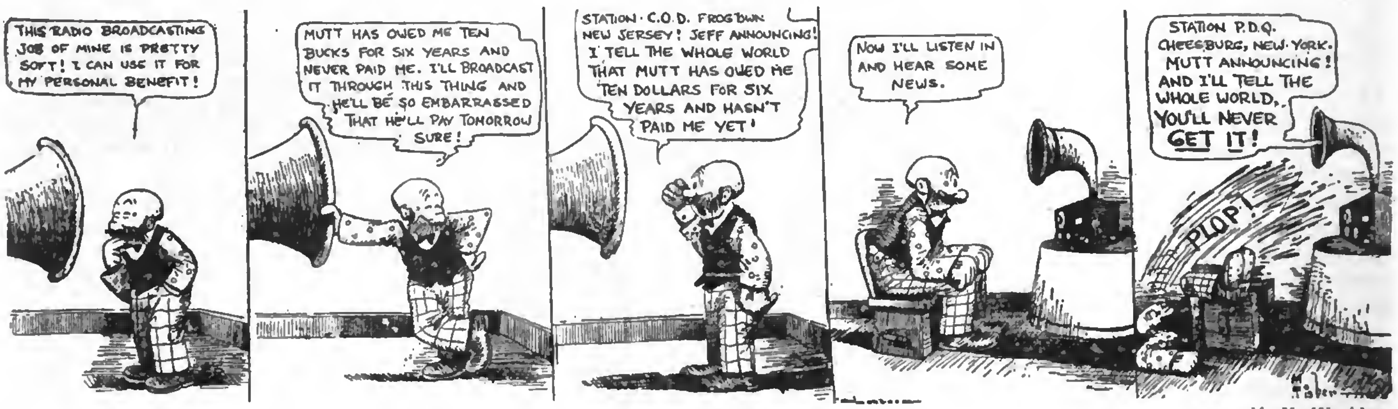
The radiotic thinks it says he that has ears to hear, let him hoist an aerial.
—*Dallas News.*

Cartoonists' Quips Cause Merry Convulsions

GAY AND GLUM

—*Bayonne Review*

EVIDENTLY MUTT HAS NO PERSONAL PRIDE



— *N. Y. World*

THE OLD GRAD GETS THE BIG FOOTBALL GAME OVER THE RADIO

—*N. Y. Globe*

THERE STILL IS HOPE

—*N. Y. Evening Journal*

BROADCASTING STATION DIRECTORY

(Revised to December 20th, 1922)

Class B stations, broadcasting on 400 meters, are designated by ★

KAO Young Men's Christian Association..Denver, Colo.
KDN Leo J. Meyberg Co.......San Francisco, Calif.
KFC Northern Radio & Electric Co.....Seattle, Wash.
KFI E. C. Anthony..............Los Angeles, Calif.
KFV Foster Bradbury Radio Store......Yakima, Wash.
KFZ Doerr Mitchell Elec. Co.........Spokane, Wash.
KGB Wm. A. Mullins Electric Co......Tacoma, Wash.
KGF Pomona Fixture & Wiring Co.....Pomona, Calif.
KGG Hallock & Watson Radio Service...Portland, Ore.
KGN Northwestern Radio Mfg. Co........Portland, Ore.
KGO Altadena Radio Laboratory.......Altadena, Calif.
KGU M. A. Mulrony..............Honolulu, Hawaii
KGW Oregonian Publishing Co.........Portland, Ore.
KGY St. Martin's College..............Lacey, Wash.
KHD Aldrich Marble & Granite Co., Colorado Springs, Colo.
*KHJ Times Mirror Co. ....Los Angeles, Calif.
KHQ Louis Wasmer ....Seattle, Wash.
KJC Standard Radio Co.........Los Angeles, Calif.
KJJ The Radio Shop.............Sunnyvale, Calif.
KJQ C. O. Gould ....Stockton, Calif.
KJR Vincent I. Kraft..................Seattle, Wash.
KJS Bible Institute of Los Angeles, Inc., Los Angeles, Calif.
KLB J. J. Dunn & Co...............Pasadena, Calif.
KLN Noggle Electric Works..........Monterey, Calif.
KLP Colin B. Kennedy Co.........Los Altos, Calif.
KLS Warner Brothers ....Oakland, Calif.
KLX Tribune Publishing Co..........Oakland, Calif.
KLZ Reynolds Radio Co...............Denver, Colo.
KMC Lindsay-Weatherill & Co........Reedley, Calif.
KMJ San Joaquin Light & Power Co.....Fresno, Calif.
KMO Love Electric Co.................Tacoma, Wash.
KNI T. W. Smith......................Eureka, Calif.
KNJ Roswell Public Service Co.......Roswell, N. M.
KNN Bullock's ....Los Angeles, Calif.
KNT North Coast Products Co.........Aberdeen, Wash.
KNV Radio Supply Co...............Los Angeles, Calif.
KNX Electric Lighting Supply Co....Los Angeles, Calif.
KOA Y. M. C. A........................Denver, Colo.
KOB New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.
KOG Western Radio Electric Co....Los Angeles, Calif.
KON Holzwasser, Inc. ....San Diego, Calif.
KOP Detroit Police Dept..............Detroit, Mich.
KOQ Modesto Evening News..........Modesto, Calif.
KPO Hale Brothers..............San Francisco, Calif.
KQI University of California.........Berkeley, Calif.
KQP Blue Diamond Electric Co......Hood River, Ore.
KQV Doubleday-Hill Electric Co. .....Pittsburgh, Pa.
KQW Charles D. Herrold ....San Jose, Calif.
KQY Stubbs Electric Co..............Portland, Ore.
KRE Maxwell Electric Co. ....Berkeley, Calif.
*KSD Post Dispatch ....St. Louis, Mo.
KSL The Emporium ....San Francisco, Calif.
KSS Prest & Dean Radio Resh. Lab...Long Beach, Cal.
KTW First Presbyterian Church..........Seattle, Wash.
KUO The Examiner Printing Co...San Francisco, Calif.
KUS City Dye Works & Laundry Co.Los Angeles, Calif.
KUY Coast Radio Co...................Del Monte, Calif.
KYQ J. C. Hobrecht ....Sacramento, Calif.
KWG Portable Wireless Telephone Co....Stockton, Calif.
KWH Los Angeles Examiner.........Los Angeles, Calif.
KXD Herald Publishing Co............Modesto, Calif.
KXS Braun Corporation ....Los Angeles, Calif.
KYF Thearle Music Co. ....San Diego, Calif.
KYI Alfred Harrell ....Bakersfield, Calif.
KYJ Leo J. Meyberg Co.............Los Angeles, Calif.
KYQ Electric Shop ....Honolulu, T. H.
*KYW Westinghouse Electric & Mfg. Co...Chicago, Ill.
KYY The Radio Telephone Shop...San Francisco, Calif.
KZC Public Market & Mkt. Stores Co...Seattle, Wash.
KZM Preston, D. Allen ....Oakland, Calif.
KZN The Deseret News ....Salt Lake City, Utah
KZY Wenatchee Battery & Motor Co.Wenatchee, Wash.
KZY Atlantic Pacific Radio Supplies Co.Oakland, Calif.
*KDKA Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
KDPT Southern Electric Co. ....San Diego, Calif.
KDYL Telegram Publishing Co.....Salt Lake City, Utah
KDYM Savoy Theatre ....San Diego, Calif.
KDYO Carson & Simpson ....San Diego, Calif.
KDYQ Oregon Institute of Technology....Portland, Ore.
KDYR Pasadena Star News Pub. Co....Pasadena, Calif.
KDYS The Tribune, Inc ....Great Falls, Mont.
KDYV Cope & Cornwell Co.........Salt Lake City, Utah
KDYW Smith Hughes & Co...............Phoenix, Ariz.
KDYX Star Bulletin Publishing Co....Honolulu, T. H.
KDZA Arizona Daily Star..................Tucson, Ariz.
KDZB Frank E. Siefert ....Bakersfield, Calif.
KDZE The Rhodes Co. ....Seattle, Wash.
KDZF Automobile Club of So. Calif..Los Angeles, Calif.
KDZG Cyrus Peirce & Co..........San Francisco, Calif.
KDZH Fresno Evening Herald..........Fresno, Calif.
KDZI Electric Supply Co. ....Wenatchee, Wash.
KDZK Nevada Machinery & Electric Co.......Reno, Nev.
KDZL Rocky Mountain Radio Corp.........Ogden, Utah
KDZM E. A. Hollingworth ....Centralia, Wash.
KDZP Newberry Electric Corporation..Los Angeles, Cal.
KDZQ William D. Pyle ....Denver, Colo.
KDZR Bellingham Publishing Co......Bellingham, Wash.
KDZT Seattle Radio Association ....Seattle, Wash.
KDZU Western Radio Corporation ....Denver, Colo.
KDZV Cope & Cornwell Co..........Salt Lake City, Utah
KDZW Claude W. Gerdes ....San Francisco, Calif.
KDZX Glad Tidings Tabernacle....San Francisco, Calif.
KDZZ Kinney Brothers & Sipprell.......Everett, Wash.
KFAC Glendale Daily Press...........Glendale, Calif.
KFAD McArthur Brothers Mercantile Co..Phoenix, Ariz.
KFAE State College of Washington.......Pullman, Wash.
KFAF Western Radio Corporation........Denver, Colo.
KFAJ University of Colorado ....Boulder, Colo.
KFAN Electric Shop ....Moscow, Idaho
KFAP Standard Publishing Co. ....Butte, Mont.
KFAQ City of San Jose..................San Jose, Calif.
KFAR O. K. Olsen ....Hollywood, Calif.
KFAS Reno Motor Supply Co. ....Reno, Nev.
KFAT Dr. S. T. Donohue ....Eugene, Ore.
KFAU Independent School District ...Boise City, Idaho
KFAV Abbott-Kinney Co. ....Venice, Calif.
KFAW The Radio Den, Ashford & White, Santa Anne, Cal.
KFAY W. J. Virgin Milling Co......Central Point, Ore.
KFBB F. A. Buttrey & Co. ....Havre, Mont.
KFBC W. K. Azbill ....San Diego, Calif.
KFBD Clarence V. Welch ....Hanford, Calif.
KFBE Reuben H. Horn..........San Luis Obispo, Calif.
KFBH Thomas Musical Co. ....Marshfield, Idaho
KFBJ Boise Radio Supply Co.............Boise, Idaho
KFBK Kimball-Upson Co. ....Sacramento, Calif.
KFBL Leese Brothers ....Everett, Wash.
KFBM Cook & Foster ....Astoria, Ore.
KFBN Borch Radio Corporation ....Oakland, Calif.
KFBQ Savage Electric Co. ....Prescott, Ariz.
KFBS Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.
KFBU Bishop N. S. Thomas..................Laramie, Wyo.
KFBV Clarence O. Ford..........Colorado Springs, Colo.
KFCB Nielsen Radio Supply Co. ....Phoenix, Ariz.
KFCC Auto Supply Co. ....Wallace, Idaho
KFCD Salem Elec. Co. ....Salem, Ore.
KFCF Frank A. Moore...............Walla Walla, Wash.
KFCH Electric Service Station..........Billings, Mont.
KFCK Colorado Springs Radio Co., Colorado Springs, Colo.
KFCL Los Angeles Union Stock Yds..Los Angeles, Calif.
KFCQ Motor Service Station ....Casper, Wyo.
KFDA Adler's Music Store.......................Baker, Ore.
*KFDB Mercantile Trust Co. ....San Francisco, Calif.
KFDC Radio Supply Co. ....Spokane, Wash.
KFDD St. Michaels Cathedral................Boise, Idaho
KFDF Wyoming Radio Corp. ....Casper, Wyo.
KFEB The City of Taft...........................Taft, Calif.
KFEC Meier & Frank Co.....................Portland, Ore.
KFED Billings Polytechnic Institute..Polytechnic, Mont.
KFEJ Guy Greason..............................Tacoma, Wash.
KFFA Dr. R. C. Shelton.................San Diego, Calif.
KFFE Eastern Oregon Radio Co.......Pendleton, Ore.
KFGG Astoria Budget ....Astoria, Oregon
KFGH Leland Stanford, Jr., Univ...Stanford Univ., Calif
WAH Midland Refining Co. ....El Dorado, Kans.
WBL T. & H. Radio Co. ....Anthony, Kans.
WBS D. W. May, Inc.............................Newark, N. J.
WBT Southern Radio Corporation......Charlotte, N. C.
WBU City of Chicago ....Chicago, Ill.
WBZ Westinghouse Elec. & Mfg. Co..Springfield, Mass.
WCE Findley Electric Co. ....Minneapolis, Minn.
WCJ A. C. Gilbert Co. ....New Haven, Conn.
WCK Stix-Baer-Fuller ....St. Louis, Mo.
WCM University of Texas ....Austin, Tex.
WCN Clark University ....Worcester, Mass.
*WCX Detroit Free Press.........................Detroit, Mich.
WDM Church of the Covenant ......Washington, D. C.
WDT Ship Owners Radio Service .....New York, N. Y.
WDV John O. Yeiser, Jr. ....Omaha, Nebr.
WDZ James L. Bush ....Tuscola, Ill.
WEB Benwood Co. ....St. Louis, Mo.
WEH Midland Refining Co. ....Tulsa, Okla.
WEV Hurlburt-Still Electrical Co. ....Houston, Tex.
WEW St. Louis University ....St. Louis, Mo.
*WFI Strawbridge & Clothier........Philadelphia, Pa.
WFO The Rike Kumler Co. ....Dayton, Ohio
WFY Cosradio Co. ....Wichita, Kans.
WGF The Register & Tribune ......Des Moines, Iowa
WGI American Radio and Research Corporation, Medford Hillside, Mass.
WGL Thomas F. J. Howlett ....Philadelphia, Pa.
*WGM Atlanta Constitution ....Atlanta, Ga.
WGR Federal Tel. & Tel. Co. ....Buffalo, N. Y.
WGV Interstate Electric Co. ....New Orleans, La.
*WGY General Electric Co.........Schenectady, N. Y.
WHA University of Wisconsin ....Madison, Wisc.
*WHB Sweeney School Co...........Kansas City, Mo.
WHD West Virginia University....Morgantown, W. Va.
WHK Warren R. Cox ....Cleveland, Ohio
WHN Ridgewood Times Printing & Pub. Co., Ridgewood, N. Y.
WHW Stewart W. Seeley..........East Lansing, Mich.
WHX Iowa Radio Corporation.........Des Moines, Iowa
WIK K. & L. Electric Co................McKeesport, Pa.
WIL Continental Electric Supply Co.Washington, D. C.
*WIP Gimbel Brothers ....Philadelphia, Pa.
WIZ Cino Radio Mfg. Co...............Cincinnati, Ohio
WJD Richard H. Howe.....................Granville, Ohio
WJH White & Boyer.....................Washington, D. C.
WJK Service Radio Equipment Co........Toledo, Ohio
WJX DeForest Radio Tel. & Tel. Co.New York, N. Y.
WJZ Radio Corporation of America—Westinghouse Elec. & Mfg. Co., Newark, N. J.
WKA Landau's Music & Jewelry Co...Wilkes-Barre, Pa.
WKC Joseph M. Zamoiski Co...........Baltimore, Md.
WKN Riechman-Crosby Co. ....Memphis, Tenn.
WKY Oklahoma Radio Shop......Oklahoma City, Okla.
WLB University of Minnesota.......Minneapolis, Minn.
WLK Hamilton Mfg. Co. ....Indianapolis, Ind.
WLW Crosley Mfg. Co. ....Cincinnati, Ohio
WMA Arrow Radio Laboratories..........Anderson, Ind.
WMB Auburn Electrical Co.....................Auburn, Me.
WMC Columbia Radio Co...............Youngstown, Ohio
WMH Precision Equipment Co..........Cincinnati, Ohio
WMU Doubleday-Hill Electrical Co.....Pittsburgh, Pa.
WNJ Shotton Radio Mfg. Co...............Albany, N. Y.
WNO Wireless Telephone Co. of Hudson County, N. J., Jersey City, N. J.
*WOC Palmer School of Chiropractic....Davenport, Iowa
WOE Buckeye Radio Service Co...............Akron, Ohio
WOH Hatfield Electric Co...............Indianapolis, Ind.
WOI Iowa State College ....Ames, Iowa
WOK Arkansas Light & Power Co.....Pine Bluff, Iowa
*WOO John Wanamaker ....Philadelphia, Pa.
WOQ Western Radio Co................Kansas City, Mo.
*WOR L. Bamberger Co......................Newark, N. J.
WOS Missouri State Mktg. Bureau..Jefferson City, Mo.
WOU Metropolitan Utilities District.......Omaha, Nebr.
WOZ Palladium Printing Co...............Richmond, Ind.
WPA Fort Worth Record.....................Fort Worth Tex.
WPE Central Radio Co......................Kansas City, Mo.
WPG Nushawg Poultry Farm.......New Lebanon, Ohio
WPI Electric Supply Co......................Clearfield, Pa.
WPJ St. Joseph's College ....Philadelphia, Pa.
WPM Thomas J. Williams ....Washington, D. C.
WPO United Equipment Co.....................Memphis, Tenn.
WQX Walter A. Kushl ....Chicago, Ill.
WRK Doron Brothers Electric Co.......Hamilton, Ohio
WRL Union College ....Schenectady, N. Y.
WRM University of Illinois....................Urbana, Ill.
WRP Federal Institute of Radio Telegraphy, Camden, N. J.
WRR City of Dallas (Police and Fire Signal Department), Dallas, Tex.
WRW Tarrytown Radio Research Laboratory, Tarrytown, N. Y.
*WSB Atlanta Journal ....Atlanta, Ga.
WSL J. & M. Electric Co..........................Utica, N. Y.
WSN Ship Owners Radio Service...........Norfolk, Va.
WSX Erie Radio Co....................................Erie, Pa.
WSY Alabama Power Co...........Birmingham, Ala.
WSZ Marshall-Gerken Co. ....Toledo, Ohio
WTG Kansas State Agr. College......Manhattan, Kans.
WTP George M. McBride.....................Bay City, Mich.
WVP Signal Corps, Bedloe's Island, N. Y. Harbor, N. Y.
WWB Daily News Printing Co..........Canton, Ohio
WWI Ford Motor Co......................Dearborn, Mich.
*WWJ The Detroit News........................Detroit, Mich.
WWL Loyola University ....New Orleans, La.
WWZ John Wanamaker ....New York, N. Y.
WAAB Valdmar Jensen ....New Orleans, La.
WAAC Tulane University ....New Orleans, La.
WAAD Ohio Mechanics Institute ....Cincinnati, Ohio
WAAF Chicago Daily Drovers' Journal......Chicago, Ill.
WAAG Elliott Electric Co.....................Shreveport, La.
WAAH Commonwealth Electric Co.........St. Paul, Minn.
WAAJ Eastern Radio Institute...............Boston, Mass.
WAAL Beamish Electric Co...........Minneapolis, Minn.
WAAK Gimbel Brothers ....Milwaukee, Wisc.
WAAM L. R. Nelson Co. ....Newark, N. J.
WAAN University of Missouri ....Columbia, Mo.
WAAO Radio Service Co. ....Charleston, W. Va.
WAAP Otto W. Taylor...........................Wichita, Kans.
WAAQ New England Motor Sales Co...Greenwich, Conn.
WAAR Groves-Thornton Hardware Co.Huntington, W. Va.
WAAS Georgia Radio Co..........................Decatur, Ga.
WAAV Athens Radio Co............................Athens, Ohio
WAAW Omaha Grain Exchange ....Omaha, Nebr.
WAAX Radio Service Corp. ....Crafton, Pa.
WAAY Yahrling-Rayner Piano Co......Youngstown, Ohio
WAAZ Hollister-Miller Motor Co........Emporia, Kans.
WAJT Kelley-Vawter Jewelry Co.........Marshall, Mo.
WAJU Yankton College ....Yankton, S. D.
WAJV Indian Pipe Line Corp.............Princeton, Ind.
WBAA Purdue University ....West Lafayette, Ind.
WBAB Andrew J. Potter ....Syracuse, N. Y.
WBAD Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.
WBAF Fred M. Middleton ....Morristown, N. J.
WBAG Diamond State Fibre Co. ......Bridgeport, Pa.
WBAH The Dayton Co. ....Minneapolis, Minn.
WBAJ Marshall-Gerken Co. ....Toledo, Ohio
WBAN Wireless Phone Corp. ....Paterson, N. J.
WBAO James Millikin University ....Decatur, Ill.
*WBAP The Star Telegram...............Fort Worth, Tex.
WBAU Republican Publishing Co. ......Hamilton, Ohio
WBAV Erner & Hopkins Co..............Columbus, Ohio
WBAW Marietta College ....Marietta, Ohio
WBAX John H. Stenger, Jr...........Wilkes-Barre, Pa.
*WBAY American Tel. & Tel. Co.......New York, N. Y.
WCAB Newburgh News Printing & Publishing Co., Newburgh, N. Y.
WCAC John Fink Jewelry Co..........Fort Smith, Ark.
WCAD St. Lawrence University............Canton N. Y.
WCAE Kaufman & Baer Co...............Pittsburgh, Pa.
WCAG Daily States Publishing Co....New Orleans, La.
WCAH Entrekin Electric Co..............Columbus, Ohio
WCAJ Nebraska Wesleyan University, University Pl., Neb.
WCAK Alfred P. Daniel.........................Houston, Tex.
WCAL St. Olaf College.....................Northfield, Minn.
WCAM Villanova College ....Villanova, Pa.
WCAO Sanders & Stayman Co.........Baltimore, Md.
WCAP Kalamazoo College ....Kalamazoo, Mich.
WCAQ Tri-State Radio Mfg. & Supply Co.Defiance, Ohio
WCAR Alamo Radio Electric Co......San Antonio, Tex.
WCAS William Hood Dunwoody Industrial Institute, Minneapolis, Minn.
WCAT South Dakota State School of Mines, Rapid City, S. Dak.
WCAU Philadelphia Radiophone Co....Philadelphia, Pa.
WCAV J. C. Dice Electric Co.........Little Rock, Ark.
WCAW Woodmen of the World ....Omaha, Nebr.
WCAX University of Vermont............Burlington, Vt.
WCAY Kesselman O'Driscoll Co.......Milwaukee, Wisc.
WCAZ Robert E. Compton ....Carthage, Ill.
WDAC Illinois Watch Co...................Springfield, Ill.
WDAE Tampa Daily Times ....Tampa, Fla.
*WDAF Kansas City Star..................Kansas City, Mo.
WDAH Mine & Smelter Supply Co........El Paso, Tex.
WDAI Hughes Electrical Corp.............Syracuse, N. Y.
WDAJ Atlanta & West Point R. R. Co.College Park, Ga.
WDAK The Courant ....Hartford, Conn.
WDAL Florida Times Union............Jacksonville, Fla.
WDAM Weston Electric Co. ....New York, N. Y.
WDAN Glenwood Radio Corp. ....Shreveport, La.
WDAO Automotive Electric Co. ....Dallas, Tex.
WDAP Midwest Radio Central, Inc. ....Chicago, Ill.
WDAQ Hartman-Riker Elec. & Mech. Co.Brownsville, Pa.
WDAR Lit Brothers ....Philadelphia, Pa.
WDAS Samuel W. Waite.....................Worcester, Mass.
WDAU Slocum & Kilborn...............New Bedford, Mass.
WDAV Muskogee Daily Phoenix.........Muskogee, Okla.
WDAX First National Bank ....Centerville, Iowa
WDAY Kenneth M. Hance ....Fargo, N. D.
WEAA Fallain & Lathrop ....Flint, Mich.
WEAB Standard Radio Equipment Co..Fort Dodge, Iowa
WEAC Baines Electric Service Co......Terre Haute, Ind.
WEAD Northwest Kansas Radio Sup. Co..Atwood, Kans.
WEAE Virginia Polytechnic Institute....Blacksburg, Va.
*WEAF Western Electric Co.................New York, N. Y.
WEAG Nichols-Hineline-Bassett ....Edgewood, R. I.

WEAH Wichita Board of Trade & Landers Radio Co., Wichita, Kans.
WEAI Cornell University ....Ithaca, N. Y.
WEAJ University of South Dakota..Vermillion, S. Dak.
WEAK Julius B. Abercrombie...........St. Joseph, Mo.
WEAM Borough of North Plainfield, North Plainfield, N. J.
WEAN Shepard Company ....Providence, R. I.
WEAO Ohio State University ....Columbus, Ohio
WEAP Mobile Radio Co., Inc...............Mobile, Ala.
WEAQ Y. M. C. A. ....Berlin, N. H.
WEAR Baltimore Am. & News Pub. Co..Baltimore, Md.
WEAS Hecht Company ....Washington, D. C.
WEAT John J. Fogarty.........................Tampa, Fla.
WEAU Davidson Brothers Co...........Sioux City, Iowa
WEAV Sheridan Electric Service Co.....Rushville, Nebr.
WEAW Arrow Radio Laboratories..........Anderson, Ind.
WEAX T. J. M. Daly.................Little Rock, Ark.
WEAY Will Horwitz, Jr. ....Houston, Tex.
WEAZ Donald Redmond ....Waterloo, Iowa,
*WFAA A. H. Belo & Co.......................Dallas, Tex.
WFAB Carl F. Woese ....Syracuse, N. Y.
WFAC Superior Radio Co. ....Superior, Mich.
WFAD Watson, Weldon Motor Supply Co..Salina, Kans.
WFAF Henry C. Spratley..........Poughkeepsie, N. Y.
WFAG Radio Engineering Laboratory...Waterford, N. Y.
WFAH Electrical Supply Co. ....Port Arthur, Tex.
WFAJ Hi-Grade Wireless Instrument Co., Asheville, N. C.
WFAM Times Publishing Co. ....St. Cloud, Minn.
WFAN Hutchinson Elec. Service Co....Hutchinson, Minn.
WFAQ Missouri Wesleyan College and Cameron Radio Company......Cameron, Mo.
WFAR Hall & Stubbs ....Sanford, Me.
WFAS United Radio Corporation.......Fort Wayne, Ind.
WFAT Daily Argus Leader...........Sioux Falls, S. D.
WFAU Edwin C. Lewis, Inc...............Boston, Mass
WFAV University nf Nebraska............Lincoln, Nebr.
WFAW Miami Daily Metropolis.............Miami, Fla.
WFAY Daniels Radio Supply Co.....Independence, Kans.
WFAZ South Carolina Radio Shop......Charleston, S. C.
WGAB QRV Radio Co. ....Houston, Tex.
WGAO Orpheum Radio Stores Co.........Brooklyn, N. Y.
WGAD Spanish Am. Schl. of Telegraphy, Ensonada, P. R.
WGAH New Haven Elec. Co...........New Haven, Conn.
WGAJ W. H. Glass ....Shenandoah, Iowa
WGAK Macon Electric Co.....................Macon, Ga.
WGAL Lancaster Elec. Supply & Const. Co., Lancaster, Pa.
WGAM Orangeburg Radio Equipment Co., Orangeburg, S. C.
WGAN Cecil E. Lloyd....................Pensacola, Fla.
WGAQ W. G. Patterson.................Shreveport, La.
WGAR Southern American..............Fort Smith, Ga.
WGAS Ray-di-co Organization ....Chicago, Ill.
WGAT American Legion, Dept. of Nebr., Lincoln, Nebr.
WGAU Marcus G. Lnmb......................Wooster, Ohio
WGAW Ernest C. Albright..................Altoona, Pa.
WGAX Radio Electric Co., Washington Courthouse, Ohio
WGAY North Western Radio Co..........Madison, Wisc.
WGAZ South Bend Tribune...........South Bend, Ind.
WHAA State University of Iowa.........Iowa City, Ia.
WHAB Clark W. Thompson.............Galveston, Tex.
WHAC Cole Brothers Elec. Co............Waterloo, Iowa
WHAD Marquette University...........Milwaukee, Wisc.
WHAE Automotive Electric Service Co., Sioux City, Ia.
WHAF Radio Electric Co................Pittsburgh, Pa.
WHAG University of Cincinnati........Cincinnati, Ohio
WHAH J. T. Griffin...........................Joplin, Mo.
WHAI Radio Equipment & Mfg. Co....Davenport, Iowa
WHAK Roberts Hardware Co.........Clarksburg, W. Va.
WHAL Lansing Capitol News............Lansing, Mich.
WHAM School of Music, Rochester Univ., Rochester, N. Y.
WHAO F. A. Hill...........................Savannah, Ga.
WHAP Dewey L. Otta........................Decatur, Ill.
WHAQ Semmes Motor Co...........Washington, D. C.
WHAR Paramount Radio & Elec. Co. Atlantic City, N. J.
WHAS Courier Journal & Louisville Times, Louisville, Ky.
WHAV Wilmington Elec. & Supply Co., Wilmington, Del.
WHAW Pierce Electric Co....................Tampa, Fla.
WHAX Huntington Press..............Huntington, Ind.
*WHAZ Rensselaer Polytechnic Institute.....Troy, N. Y.
WIAA Waupaca Civic & Commerce Assn., Waupaca, Wis.
WIAB Joslyn Automobile Co.............Rockford, Ill.
WIAO Ocean City Yacht Club.........Ocean City, N. J.
WIAE Mrs. Robt. E. Zimmerman..........Vinton, Ia.
WIAF Gustav A. DeCortin...........New Orleans, La.
WIAH Continental Radio Mfg. Co...........Newton, Ia.
WIAI Heers Stores Co..................Springfield, Mo.
WIAJ Fox River Valley Radio Supply Co., Neenah, Wisc.
WIAK The Stockman Journal...............Omaha, Nebr.
WIAP J. A. Rudy & Sons................Paducah, Ky.
WIAQ Chronicle Publishing Co...........Marion, Ind.
WIAS Burlington Hawkeye-Home Elec. Co., Burlington, Ia.
WIAT Leon T. Noel ....Tarkio, Mo.
WIAU American Sec. & Sav. Bank........Le Mars, Ia.
WIAV New York Radio Laboratories..Binghamton, N. Y.
WIAW Saginaw Radio & Elec. Co.........Saginaw, Mich.
WIAX Capital Radio Co..................Lincoln, Nebr.
WIAY Woodward & Lothrop..........Washington, D. C.
WIAZ Electric Supply Sales Co.............Miami, Fla.
WJAB American Radio Co..............Lincoln, Nebr.
WJAC Rodoll Co. ....Joplin, Mo.
WJAD Jackson's Radio Eng. Lab...........Waco, Tex.
WJAE Texas Radio Syndicate........San Antonio, Tex.
WJAG Huse Publishing Co..............Norfolk, Nebr.
WJAH Central Park Amusement Co.......Rockford, Ill.
WJAJ Y. M. C. A. ....Dayton, Ohio
WJAK White Radio Laboratory..........Stockdale, Ohio
WJAL Victor Radio Corporation..........Portland, Me.
WJAM D. M. Perham...................Cedar Rapids, Ia.
WJAN Peoria Star & Peoria Radio Sales Co..Peoria, Ill.
WJAP Kelly-Duluth Co....................Duluth, Minn.
WJAR The Outlet Co. ....Providence, R. I.
WJAS Pittsburgh Radio Supply House, Pittsburgh, Pa.
WJAX The Union Trust Co............Cleveland, Ohio
WJAZ Chicago Radio Laboratory...........Chicago, Ill.
WKAA H. F. Paar & Republican Times, Cedar Rapids, Ia.
WKAC Star Publishing Co...............Lincoln, Nebr.
WKAD Charles Loof.............East Providence, R. I.
WKAF W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.
WKAG Edwin T. Bruce, M.D..........Louisville, Ky.
WKAH Planet Radio Co.........West Palm Beach, Fla.
WKAK Okfuskee County News............Okemah, Okla.
WKAL Gray & Gray ....Orange, Tex.
WKAM Adam Breede, Hastings Daily Tribune, Hastings, Nebr.
WKAN Alabama Radio Mfg. Co.......Montgomery, Ala.
WKAP Flint, Dutee Wilcox ....Cranston, R. I.
WKAQ Radio Corporation of Porto Rico, San Juan, P. R.
WKAR Michigan Agri. College....East Lansing, Mich.
WKAS L. E. Lines Music Co...........Springfield, Mo.
WKAV Laconia Radio Club.............Laconia, N. H.
WKAW Turner Cycle Co.....................Beloit, Wisc.
WKAX Wm. A. MacFarlane.............Bridgeport, Conn.
WKAY Brenau College.....................Janesville, Ga.
WLAC North Carolina State College.....Raleigh, N. C.
WLAD Arvanette Radio Supply Co.......Hastings, Nebr.
WLAF Johnson Radio Co.................Lincoln, Nebr.
WLAG Cutting & Washington Radio Corp. Minneapolis, Minn.
WLAH Samuel Woodworth ....Syracuse, N. Y.
WLAJ Waco Electrical Supply Co.............Waco, Tex.
WLAK Vermont Farm Mach. Co.......Bellows Falls, Vt.
WLAL Tulsa Radio Co.......................Tulsa, Okla.
WLAM Morrow Radio Co..............Springfield, O.
WLAN Putnam Hardware Co..............Houlton, Me.
WLAO Anthracite Radio Shop...........Scranton, Pa.
WLAP W. V. Jordon.....................Louisville, Ky.
WLAQ A. E. Schilling....................Kalamazoo, Mich.
WLAR Mickel Music Co...............Marshalltown, Iowa
WLAS Hutchinson Grain Radio Co.....Hutchinson, Kans.
WLAT Radio and Specialty Co. ....Burlington, Iowa
WLAV Electric Shop, Inc...............Pensacola, Fla.
WLAW New York Police Dept.....New York City, N. Y.
WLAX Greencastle Community Broadcasting Station, Greencastle, Ind.
WLAY Northern Commercial Co. of Alaska Fairbanks, Alaska
WLAZ Hutton & Jones Elec. Co............Warren, Ohio
WMAB Radio Supply Co............Oklahoma City, Okla.
WMAC F. Edward Page......Fernwood, Cazenovia, N. Y.
WMAF Round Hills Radio Corp........Dartmouth, Mass.
WMAG Tucker Electric Co. ....Liberal, Kans.
WMAH General Supply Co. ....Lincoln, Nebr.
WMAJ Drovers Telegram Co..........Kansas City, Mo.
WMAK Norton Laboratories ....Lockport, N. Y.
WMAL Trenton Hardware Co............Trenton, N. J.
WMAM Beaumont Radio Equipment Co., Beaumont, Tex.
WMAN Broad Street Baptist Church......Columbus, Ohio
WMAP Utility Battery Service.............Easton, Pa.
WMAQ The Chicago Daily News............Chicago, Ill.
WMAR Waterloo Electrical Supply Co.....Waterloo, Iowa
WMAT Paramount Radio Corporation.......Duluth, Minn.
WMAV Alabama Polytechnic Institute.......Auburn, Ala.
WMAW Wahpeton Elec. Co...............Wahpeton, N. D.
WMAX K. & K. Radio Supply Co....Ann Harbor, Mich.
WMAY Kingshighway Presby. Church......St. Louis, Mo.
WMAZ Mercer University ....Macon, Ga.
WNAB Park City Daily News.......Bowling Green, Ky.
WNAO Shepard Stores.......................Boston, Mass.
WNAO Oklahoma Radio Eng. Co.........Norman, Okla.
WNAF Enid Radio Distributing Co.........Enid, Okla.
WNAG Rathert Radio & Electric Co..........Cresco, Iowa
WNAH Manhattan Radio Supply Co....Manhattan, Kans.
WNAJ Benson Co. ....Chicago, Ill.
WNAL R. J. Rockwell........................Omaha, Nebr.
WNAM Ideal Apparatus Co.............Evansville, Ind.
WNAN Syracuse Radio Tele. Co.........Syracuse, N. Y.
WNAP Wittenberg College ....Springfield, Ohio
WNAQ Charleston Radio Elec. Co......Charleston, S. C.
WNAR C. C. Rhodes........................Butler, Mo.
WNAS Texas Radio Corporation and Austin Statesman, Austin, Tex.
WNAT Lenning Bros. Co.............Philadelphia, Pa.
WNAV People's Tel. & Tel. Co.........Knoxville, Tenn.
WNAW Henry Kunzmann ....Fortress Monroe, Va.
WNAX Dakota Radio Apparatus Co......Yankton, S. D.
WNAY Ship Owners' Radio Service.......Baltimore, Md.
WOAA Dr. Walter Hardy................Ardmore, Okla.
WOAB Valley Radio ....Grand Forks, N. D.
WOAC Maus Radio Co.........................Lima, Ohio
WOAD Friday Battery & Elec. Co......Sigourney, Iowa
WOAE Midland College...............Fremont, Nebr.
WOAF Tyler Commercial College..............Tyler, Tex.
WOAG Apollo Theatre ....Belvidere, Ill.
WOAH Palmetto Radio Corp............Charleston, S. C.
WOAI Southern Equipment Co........San Antonio, Tex.
WOAJ Ervin's Electrical Co...............Parsons, Kans.
WOAK Collins Hardware Co. ....Frankfort, Ky.
WOAL Woods, Wm. E. ....Webster Grove, Mo.
WOAN James D. Vaughan ....Lawrenceburg, Tenn.
WOAQ Portsmouth Radio Ass'n. ....Portsmouth, Va.
WOAR Lundskow, Henry P. ....Kenosha, Wisc.
WOAV Penna. National Guard.................Erie, Pa.
WOAZ Penick Hughes Co. ....Stanford, Texas
WPAA Anderson & Webster Electric Co......Waco, Nebr
WPAB Pennsylvania State College....State College, Pa.
WPAC Donaldson Radio Co. ....Omulgee, Okla.
WPAD Wieboldt & Co. ....Chicago, Ill.
WPAF Peterson's Radio Co........Council Bluffs, Iowa
WPAG Central Radio Co., Inc. ....Independence, Mo.
WPAL Superior Radio & Tel. Equipt. Co., Colnmbus, Ohio
WPAM Awerbach & Guettel ....Topeka, Kans.
WPAN Levy Bros. Dry Goods Co.........Houston, Tex.
WQAA Horace A. Beale, Jr............Parkesburg, Pa.
WQAP American Radio Co..............Lincoln, Nebr.
WQAQ West Texas Radio Co...............Abilene, Tex.
WRAA Rice Institute ....Houston, Texas
WRAR Jacob C. Thomas............David City, Nebr.
WRAU Amarillo Daily News..............Amarillo, Tex
WRAY Radio Sales Corporation..........Scranton, Pa.
WSAJ Grove City College ....Grove City, Pa.
WSAS State of Nebraska...............Lincoln, Nebr.
WSAV Clifford W. Vick, Radio Construction Co., Houston, Tex
WTAC Penn Traffic Co. ....Johnstown, Pa.
WTAU Ruegy Battery & Elec. Co.....Tecumseh, Nebr.
WTAW Agricultural & Mechanical College of Texas, College Station, Tex.
WWAC Sanger Brothers ....Waco, Tex.
WWAH General Supply Co................Lincoln, Nebr.
WWAX Werman Brothers ....Laredo, Tex.

Canadian Broadcasting Stations

CFAC Radio Corporation of Calgary, Ltd., Calgary, Alberta
CFCA Star Publishing and Printing Co., Toronto, Ontario
CFCB Marconi Wireless Telegraph Co. 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
CFYC Victor Wentworth Odlum........Vancouver, B. C.
CFZC Canadian Westinghouse Co., Ltd...Montreal, Quebec
CHBC The Albertan Publishing Co., Calgary, Alberta
CHCA Radio Corporation of Vancouver, Ltd., Vancouver, B. C.
CHCB Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario
CHCC Canadian Westinghouse Co., Ltd., Edmonton, Alberta
CHCF Radio Corporation of Winnipeg, Ltd., Winnipeg, Manitoba
CHCQ The Western Radio Co., Ltd., Calgary, Alberta
CHCS London Radio Shoppe..............London, Ontario
CHCZ The Globe Printing Co.............Toronto, Ontario
CHCX B. L. Silver.....................Montreal, Quebec
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, Ontari
CJCI McLean, Holt & Co., Ltd., St. John, New Brunswi
CJCN Simons Agnew & Co..............Toronto, Ontari
CJCS Eastern Telephone and Telegraph Co., Ltd. Halifax, Nova Scoti
CJOY Edmund Taylor ....Calgary, Albert
CJGC London Free Press Printing Co., Ltd., London, Ontari
CJNC Tribune Newspaper Co., Ltd., Winnipeg, Manit
CJSC The Evening Telegram...........Toronto, Ontari
CKAC La Presse Publishing Co.........Montreal, Queb
CKCB T. Eaton Co., Ltd...........Winnipeg, Manit
CKCD Vancouver Daily Province.........Vancouver, B. C
CKCE Canadian Independent Telephone Co., Ltd., Toronto, Ontari
CKCK Leader Publishing Co., Ltd., of Regina, Regina, Saskatche
CKCR Jones Electric Radio Co., St. John, New Brunsw
CKCS The Bell Telephone Co. of Canada, Montreal, Queb
CKCZ Canadian Westinghouse Co., Ltd., Toronto, Ont
CKKC Radio Equipment and Supply Co., Toronto, Ont
CKOC The Wentworth Radio Supply Co., Hamilton, Ont
CKQO Radio Supply Co. of London.......London, Ont
CKZC Salton Radio Engineering Co., Winnipeg, Mani

World Wide Wireless

Expansion for Canadian Marconi

VANCOUVER, B. C., is to be linked with the rest of the world by radio, the Marconi Wireless Telegraph Co. of Canada having applied for a license to erect a powerful station there at a cost of $2,000,000. The new station will use continuous wave transmitters. Other stations will be erected at Winnipeg, Toronto and Montreal, making a chain across Canada capable of handling traffic within the Dominion, with the United States, and with other countries. An expenditure of about $5,000,000 will be required for the new system, which will represent a considerable expansion of the present Marconi net in Canada, which works with American and European stations daily.

Radio Again Carries Load

THE break in the single trans-Pacific cable late in November resulted in an immediate increase of the traffic through the stations of the Radio Corporation of America on the Pacific Coast and in Honolulu, and again demonstrated, as has been done before, the great service of which radio is capable. For a considerable period, until the cable was repaired, radio was the sole means of communication with Japan, and the most direct method of reaching China. The latter, however, was not entirely shut off from telegraphic communication with the rest of the world, being reached also by cables from London, which roundabout route, however, entails considerable delay. The Philippines, Dutch East Indies and Guam likewise were severed from cable communication with the United States when the cable broke, and likewise were served by radio operated at new heights of efficiency.

Importance of Naval Radio

"AERONAUTICS and the radio telephone are perhaps the most marvelous developments of a marvelous age," said Rear Admiral Wm. A. Moffett, Chief of the Naval Bureau of Aeronautics, speaking over the radio phone from NAA, Arlington, recently. Admiral R. E. Coontz, Navy Chief of Operations, who also broadcast a speech, said that among its activities the Navy Communication Service handled three and three-quarter million words by radio for the American Merchant Marine in the past year.

"During the winter months," he said, "the Naval Communication Service handles on an average of 30 SOS distress calls per month, or one a day." The value of this service to the American public as a whole, and to shipping interests in particular, cannot be overestimated, he insisted.

He also mentioned the development of the radio compass or direction finder, and stated that the Navy has established stations equipped with this apparatus at various points along both coasts of the United States near the entrance to harbors. When a ship is approaching one of these harbors in a dense fog and is uncertain of her position, all that is necessary for her now to do is to ask two or more radio compass stations for her bearing, he explained.

This is the radio room of the S. S. Kamoi, fuel ship of the Japanese Navy. The ship has what has been termed the "most elaborate radio equipment of any ship afloat." There are three transmitters and three receivers

Radio Exports Increase

AMERICAN exports of radio apparatus during the month of October totaled $207,535 and weighed 114,309 pounds, according to figures compiled by the Department of Commerce. The value of these radio shipments was as follows: England, $70,391; Quebec and Ontario, $35,728; Angentine, $32,092; Brazil, $27,072, and Japan, $11,299, the balance going to twenty other countries.

Extends Range of Coast Defense Gunnery

EXTENSION of the range of coast defense guns is the newest service performed by radio. Experiments with a new use of the radio compass, recently carried out by the U. S. Army and Navy, has indicated, so unofficial reports state, that radio will enlarge the effective range of the big guns. Heretofore, the giant cannon on the American coasts have been limited in range to the limit of visibility at sea, which was about 25 miles under the best conditions. The guns can shoot twice that distance, but as the target cannot be seen further than that, their extra range is useless.

However, it has been found that if an airplane flies directly over a ship at sea, at the same time sending a series of radio signals, radio compass stations on shore will be able to spot the exact location of the plane, and therefore of the ship.

Will Consider Radio Standards

STANDARDIZATION of radio apparatus is to be considered by a conference called by the U. S. Bureau of Standards for January 12, 1923, in New York City. The need for standardization has been seen by many radio interests, and the coming conference will consider (1) whether a formulation of standards for radio apparatus and service shall be made; (2) if so, what general classes of apparatus or service should be included, and (3), what procedure shall be recommended for carrying out the conclusions reached.

If the conference decides that radio standards should be formulated, it is expected that they will be prepared with special consideration of the wide range of interests concerned, and that these standards may be adopted, with the approval of the American Engineering Standards Committee, as national standards.

The call for the conference was issued by the Bureau at the specific request of the Institute of Radio Engineers, National Radio Chamber of Commerce, Associated Manufacturers of Electrical Supplies, American Radio Relay League, Radio Corporation of America, and National Retail and Dry Goods Association.

Radio Reports Crops of World

PLANS for world-wide distribution of crop reports by radio, drafted by the United States Department of Agriculture, have been placed in effect, using reports from representatives of the Department abroad. A recent message from the Berlin representative was received in Washington and relayed throughout the country in less than five minutes from the time the news left Germany. In return, dispatches on American crops are transmitted weekly by the U. S. Navy stations to the International Institute of Agriculture at Rome and to other agricultural centers abroad.

Italian Traffic Is Relayed

SUSPENSION of direct radio communication with Italy has resulted in wireless traffic with that country going over new circuits. It is not expected that the new routes will be used after the new high power station, now being constructed near Rome, is put in operation. During the temporary suspension of direct radio communication, radio traffic from Italy for North and South America is being handled via the high-power stations of Germany, France and England, according to statements of the Ministry of Posts and Telegraphs at Rome. Full-rate and deferred messages and press telegrams may be sent via Nauen Transradio and Radio-France, and full rate and deferred messages via London Marconi.

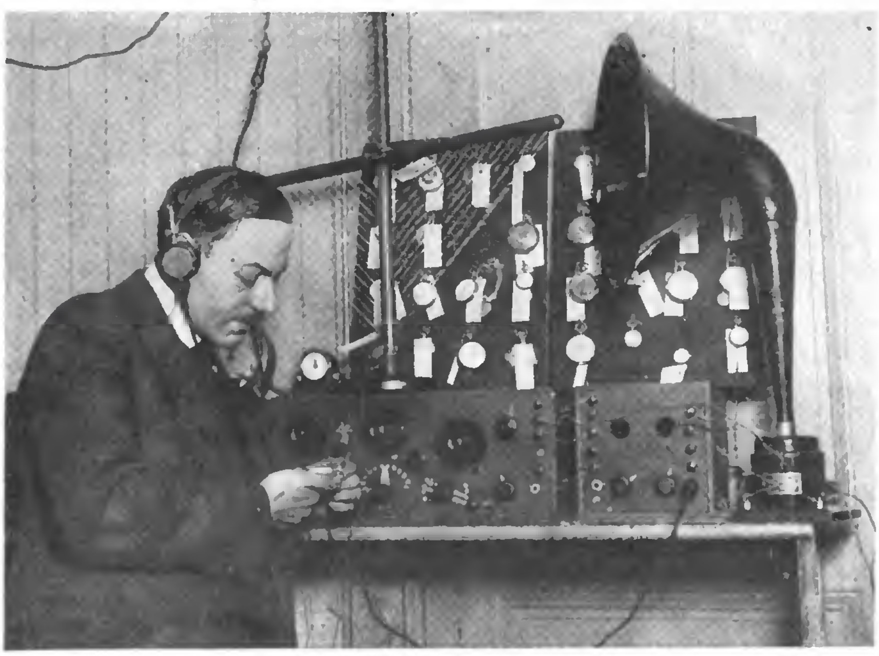
Messages sent via Nauen are transmitted by radio from Rome and relayed at Nauen. Traffic handled by France or England is sent by land wires from Italy and thence by radio. Messages via France or Germany will carry a rate of 20 centimes gold less than the cable rate, in the case of full-rate telegrams. Via London, the same messages would be ten centimes gold less than the cable rate. Deferred dispatches will be charged half the above rates. Press reports may be sent via France or Germany at the same rate as deferred messages, it is reported, but will not be handled via London.

Airplane Piloted by Radio

EXPERIMENTS by French engineers have demonstrated that it is quite feasible to guide airplanes by means of radio waves, without the presence of a pilot in the machine. The first such flight, made without a person on board the airplane, took place on November 25 at Paris. A 300-horsepower Voisin plane took off from the field alone, circled above it for several hours, and then descended. Its every movement was directed by engineers Demarcay, Bouche and Percheron, operating a special radio transmitter located in a hut on the outskirts of the flying field.

Big Station for Miami

CONSTRUCTION of a large radio station at Miami, Fla., is planned by the Tropical Radio Telegraph Co., which is a subsidiary of the United Fruit Co. The new station will handle traffic between the United States and stations in Central and South America and the West Indies, acting as a relay point. Towers 437 feet high are to be erected for the transmitter.



Simon Rimler, an American jeweler, has followed the precedent of his French brother craftsmen in installing a radio receiver for the purpose of securing the correct time by means of time signals. He listens to time signals from Arlington

Wireless for Canadian Woods

PLANS are being completed for a chain of wireless stations extending right into the Arctic Circle in Canada, linking together the most distant posts, and enabling Canadian officials to communicate with each other instantly, instead of by the old method of sled-carried mails. The new wireless chain will be operated by the Dominion Government. Stations are to be operated at Forts Smith, Resolution, Simpson, Norman and McPherson on the Mackenzie, and one at Dawson City.

Want Radio on All Aircraft

THAT eventually all aircraft engaged in public transport, both planes and dirigibles, must carry wireless apparatus, just as do sea craft, has been adopted as a general principle of the International Commission for Aerial Navigation, it is learned. At present only aircraft carrying ten or more persons are required to be so equipped, but it is planned to make wireless equipment compulsory on all aircraft carrying fewer than ten persons and flying more than 100 miles over land without landing or more than 15 miles over the sea.

WWAA Is General Call

THE general call signal WWAA has been assigned to all vessels whose radio equipment is operated by the Radio Corporation of America, which will be able to use the call when it desires to reach any and all of its ships within calling distance. The call will be used by coastal and ship stations desiring to get in touch with any other RCA station, and any RCA ship operator hearing WWAA should answer. The general call also will be used in broadcasting messages to all RCA vessels.

Offers Course in Radio Receiving

FOLLOWING the remarkable success of a special course for radio salesmen and amateurs generally, offered for the first time last Spring by the Radio Institute of America, New York City, the Radio Institute in San Francisco has started a similar course. It is intended to meet the needs of the average salesman, enabling him to explain radio operation to prospects, and give sound instructions in installation and operation. In addition to salesmen, a number of amateurs have taken the course in order to become thoroughly posted on all phases of radio receiving work. Both day and night classes are offered, and if it is desired, instruction in code can be taken.

The Radio Corporation's New President

By S. R. Winters

Gen. Harbord, Broadcasting

BECAUSE of the type of vision required to cope with problems for which there is no precedent, it is traditional with radio that the important executives of the industry must be seasoned men. In the high places are to be found no favorites of fortune, but veterans whose years of able service have brought them up from the lowest rung.

And now to this newest epoch-making art comes a new leader, one who has achieved the high office of President of the Radio Corporation of America — pivot, center and motive force of the radio that is visioned in its familiar slogan, "world-wide wireless."

What manner of man is he?

Let it be said, first of all, a veteran, tried and proven in the greatest tasks of administrative capacity. Again, one who has carved out his own career, in the broadest sense of the term.

For a rise from a private in the U. S. Army to a Major General and Deputy Chief of Staff within a period of 33 years, is the epitome of the career of James G. Harbord, who, on January 1, 1923, becomes President of the Radio Corporation of America.

At the active age of 56 years, he begins another cycle of service, in which the scene shifts from the arena of supreme achievement in military affairs to the leadership of the biggest commercial enterprise of its kind in the world.

James Guthrie Harbord was born at Bloomington, Ill., on March 21, 1866, from which state he later moved with his parents to Kansas, where his mother now resides. He was educated in the common schools of his adopted State and the Kansas State Agricultural College, receiving from the latter institution the degree of Bachelor of Science and Master of Science. Here, in this middle-western college where military training in the form of drills supplements the major subject of agriculture, James Harbord became imbued with the desire to become a soldier. So fervent was this yearning that the fact that another boy was given the only appointment from his Congressional district to the Military Academy at West Point, did not swerve him from his course. When 23 years old, though equipped with a collegiate education, he enlisted as a private in the United States Army.

From 1889 to 1891, he served successively in the ranks of private, corporal, sergeant, and quartermaster sergeant of the Fourth Infantry. By sheer force of merit he climbed to his present position of Deputy Chief of Staff and at the time of his retirement was the only Major General in the United States Army who had risen from the ranks.

In leaving Washington, General Harbord leaves behind him an enduring admiration in hundreds of hearts, one of the substantial forms of which is a life-size portrait. For the painting of this about 600 officers of the Marine Corps subscribed to a fund. The finished portrait will be presented to the Army and Navy Club, in Washington, "As a testimonial of the high esteem in which Major General James Guthrie Harbord is held by officers of the Marine Corps."

The writer visited the Washington studio of Richard S. Meryman, the artist who was engaged by the Marines. Here on the top floor of an old-fashioned, three-story office building, in a back room, as the artist was faithfully putting the final touches to his subject, he was asked, "What is your impression of General Harbord as a character study?" His reply, given promptly and in a sincere tone of voice, was, "He looks the soldier." The subject of the artist's brush is shown wearing his trench coat on which appears the insignia of the Second Division. In the background, is painted the hunting lodge or pavilion at Belleau Wood, which tower-like structure served as an important observation post in the terrific fighting in this area during the recent world conflict.

Nor is the admiration of the Marine Corps for their commanding officer at Belleau Wood and Château-Thierry restricted to the paint and brush, as enduring an expression of esteem as this portrait may be. Estimates of General Harbord from the Marine Corps are freely voiced, appraising his qualities in superlative terms. "His retirement is not only a loss to the Army but to the entire military service," said Major M. E. Shearer of the Marine Corps, in an interview with this writer. "His retirement is a distinct loss and he goes on the retired list with the best wishes of his old Fourth Brigade. We always looked upon him as a good Marine. The Army loses as fine an officer as it ever had." Another Marine officer told me, "Every Marine officer will agree with me that he was one of the finest generals that we served under in France." Still another Marine officer, a Major General and one of the leading officers of the Marine Corps, added: "General Harbord has the love, esteem, and regard of the Marine Brigade. This regard continues throughout the Marine Corps."

The newly-elected President of the Radio Corporation of America is married, having been wedded to Miss Emma Yeatman Ovenshine of Washington, D. C., a daughter of General Samuel Ovenshine, many years ago. They have no children.

Foremost among his recreational pursuits is horseback riding. Arising early each morning, he is off in the open, astride his famous mount, by 6:30, and for one or two hours he travels at a lively pace. Rain, snow, or other forms of stormy weather do not deter him from his morning ride, since he is an outspoken advocate of exercise in the out-of-doors in some form.

If his leisure hours permit, when at his Fort Myer home, he may be seen wandering through his flower garden or ransacking his extensive library of works on military affairs. He is an admirer of flowers and each Fall, in company with a crew of workers, he may be seen throwing safeguards around them for protection during the Winter, while in the Spring he assists in transplanting them. He is an intensive reader, exploring the pages of military histories of all countries with the earnestness of a student. Fraternally he is a Thirty-Second Degree Mason.

In appearance, James Guthrie Harbord is marked by his soldierly bearing. He weighs about 165 pounds, and is compactly built. Baldness parts his hair, taking a liberal strip in the center thereof. His eyes are piercing, and yet within them, "windows of the soul" that they are, gleams a kindliness that the rough tactics of war have not dimmed. He dispatches business with surprising swiftness. In fact, one of his associates said, "He gives a quicker decision than any person I know—and, he is usually right." His motto is appropriately expressed in the injunction "Work while you work, and play while you play." He enters into his morning exercises as a horseman with the thrills of a man much younger than one of his years. This recreation over, however, it has been his custom to come into Washington by automobile, arriving at the office by nine o'clock or earlier. His subordinates say that he works according to a system, knows what he wants done, and is not given to erratic performances. The gruffness characteristic of so many Army officials is not his.

The activities of General Harbord in Washington, as well as the new ones which he assumes on January first, are largely administrative. As Deputy Chief of Staff he had under his supervision more than one hundred officers of the General Staff in Washington. In addition to his routine work, he received about thirty callers a day. Somebody, in describing the democracy of General Harbord, said that he would receive a corporal that he knew with the cordiality extended to General Pershing. If we are to judge the future by the past (and one of our great Presidents said this was the only reliable criterion) Major General James Guthrie Harbord will carry with him to the Presidency of the Radio Corporation of America the vision and administrative capacity that will link nations into bonds of fellowship by means of radio and demonstrate in industry the leadership he has unmistakably displayed in military affairs.

Secretary of War John W. Weeks in approving the application for retirement of General Harbord said: "His retirement is a loss to the active forces of the Army which cannot be adequately expressed. We have not had in our military service or in our Government service in any capacity a man of higher qualities or one who has inspired in others a greater degree of confidence. The business he will enter is in its infancy, and it will offer full scope for his abilities. That he will prove himself a great leader in industry and commercial affairs seems as certain to me as his great leadership in military activities. I have an acute sense of personal loss in his going. His ability and loyalty have been of vital importance to me in administering the affairs of the War Department."

Some estimate of the man's capacity, too, may be gleaned from the appreciation of his war-time achievements, as recorded by Col. Frederick Palmer, official observer with the American Army in France, and famous war correspondent. The account of General Harbord's achievements is contained in an important series of articles on the men who had made victory possible, the introduction to which states, in effect, that there were many minor bureau chiefs in the United States who were better known than the men of General Pershing's staff, without whom success would have been impossible, no matter how hard the bureaucrats dug their spurs into their revolving chairs. It was Harbord, then a Major, that Pershing took to France as his first Chief of Staff, the same Major whom Theodore Roosevelt had chosen for the same office with his proposed volunteer division, and it was the same man whom Palmer, veteran war correspondent and judge of men, chose to talk about first. Says Palmer, in *Collier's:*

"It was evident to anyone who talked with him for half an hour that the high, broad forehead held more than he had learned in the barracks and drill grounds; and evident, too, that he made no fuss over his work, which probably accounts for the fact that he had time, or made the time, for gaining an education of the kind that schools do not supply. He had read much. He had a capacious memory. It was noticeable that anything he wrote officially was not only brief, but it was in good English." Which, among other things, made Palmer wonder why a man of this type had gone into the Army as a private, until he saw him "in command of troops and understood that he went into the army (instead of going to college and entering a profession) because he was first of all by nature a soldier."

Through all the harassing first eight months of the A. E. F., Harbord was Pershing's right-hand man. It was not long before everybody realized that Harbord, who had been an excellent chief of staff at an army post, was capable of expanding to be the chief of staff of a great and growing army. You could depend upon him for "Yes," or "No," without any additional verbiage. Once a matter reached Harbord you had action. He could be tart as well as brief. "That has as much tact as a sledge hammer," he said on one occasion when a draft of a communication which had an international aspect was submitted to him. Again, "Eight pages of this; I suppose that if I go through it all I will find something in it, otherwise why should a man have taken the trouble to write so much?"

Without a few such men as Harbord, who had a large supply of brain cells which they had kept sufficiently exercised in time of peace to be ready for business in war, Pershing could never have mastered his problem.

After the period of organization of the A. E. F. was over, and we were

James Guthrie Harbord, who enters civilian life to take over leadership of the commercial organization that forms the pivot, center and motive force of world-wide wireless sending our divisions into battle, Pershing gave Harbord that which every officer desires, a place at the head of combat troops. "I am going to send Harbord out to troops," said Pershing, "but I will have him back." It was understood then that the task of Chief of Staff awaited his return from the front.

It was then that Pershing did a remarkable thing, one which was criticised somewhat harshly by those who did not know Harbord as Pershing knew him. Harbord was put at the head of the Marine Brigade of the Second Division, May 6, 1918.

Now, the Marines are a proud organization, and they no more consider themselves a part of the regular army than they consider themselves a part of the Forest Service. They are not only Marines, but they do not hesitate to inform the world on all occasions that they are. Nobody is good enough to command the Marines except a Marine, and they wanted a Marine to succeed their own General Doyer, who had been invalided home, where he later died. Considering the feeling between them and the regulars, who thought that there should not be two distinct infantry organizations in the American Army, the appointment of Harbord seemed at the time to be dubious policy. But Pershing knew his man, and he knew the Marines. Harbord had a diplomatic as well as military mission to accomplish when he took his new command, but in a week the Marines were calling him a Marine. They had put their globe and anchor insignia on his collar. Soon some regulars were jocularly complaining that Harbord had deserted them.

When his brigade was rushed into position against the German offensive along the Paris-Château-Thierry road he did not rest on the defensive, but immediately took the offensive in Belleau Wood, where for the first time we met the Germans in the shock of open warfare. All France, all the world was watching us to see how we fought; the fate of nations rested with us. Says Palmer: "I was at his headquarters frequently during this period, and he was directing the battle in the same calm way that he looked after the paper work in the Chief of Staff's office—always 'all there,' ready to concentrate instantly on another subject and then return instantly to the one in hand. His record of this action is characteristic. Every order given and received, every report and every telephone message were down in proper sequence. At the end of each 24 hours' action he made an elucidating comment in which he was big enough to admit such mistakes as had been made—which all great leaders have said is one of the first qualifications of leadership."

Another war correspondent, now the radio editor of a leading daily newspaper, has given a vivid picture of Harbord that goes far to explain his instant popularity among the Marines. The correspondent managed to get to Harbord's headquarters during the Belleau Wood offensive, and was discussing his dispatches with Harbord.

"Don't forget that half of the Second Division is made up of Marines," said the general, standing bareheaded outside his headquarters as shells were dropping all around. "And there never were braver men on earth."

After turning the tide in July in "as fierce a six weeks of fighting as any division has had in American history," he was called to headquarters.

"Harbord, I am going to send you down to straighten things out in the S. O. S.," said Pershing. So Harbord had to give up a walloping fine fighting division just as our army was beginning to fight on a large scale. The command of the Service of Supply including ports, debarkations, warehouses, shops, hospitals, camps and construction, represented a responsibility second only to that assumed by Pershing himself. That a master hand was badly needed here will be remembered by all who were in the A. E. F. in the early days, and had to beg, borrow, buy or steal equipment and supplies from the French and British while huge stores were accumulating in vast dumps and warehouses where they did no one any good.

The different branches of the S. O. S. were working at cross purposes. Organization, there seemed to be none. But soon Harbord's personality became known throughout the S. O. S. Tours, the headquarters, saw him only a few days a week, the rest of the time being spent in the various ports and depots. A co-ordinated and responsive organization was quickly built up. The S. O. S. developed pride in its work. Reserve officers who in private could not find words to express their opinion of "narrow-minded, superannuated regulars," did not include Harbord. There was one well-known reserve officer of high rank who had sworn that they would never get him into the army again even if the Germans invaded America, but he changed his mind after he had worked under Harbord.

Throughout the Argonne battle, when America was putting forth every effort to end the war quickly, the S. O. S. responded efficiently to all calls from the front, which was a great accomplishment, as all know who went through those weeks of constant movement at ever increasing distances from the rail heads.

JAMES G. HARBORD

SOLDIER

Enlisted January 10, 1889, in Company A, 4th Infantry, and served as an enlisted man in Washington Territory and Idaho. Held grades of Private, Corporal, Sergeant, Co. A., and of Quartermaster Sergeant, 4th Infantry.

Promoted second lieutenant, July 31, 1891, as numher one of the class appointed from the ranks that year. Assigned to 5th Cavalry and served in Indian Territory, Kansas and Texas. Distinguished graduate, Infantry and Cavalry School, 1895.

Major in Second U. S. Volunteer Cavalry, the Torrey Rough Riders, raised in the Rocky Mountain States, in 1898.

Promoted First Lieutenant 10th Cavalry, July 1, 1898, and served in Alahama, Texas and Cuba. Adjutant General Departments of Santiago and Puerto Principe, and Eastern Cuba, under General Leonard Wood, as Military Governor, April, 1899, to May, 1901.

Promoted Captain 11th Cavalry February 2, 1901, and served in Virginia and the Philippines. For eight months in 1901 was Assistant Chief of the Division of Insular Affairs, of which General Clarence R. Edwards was Chief, in the office of Secretary of War Root.

Arrived in Philippines March, 1902. Served as cavalry officer until August, 1903, when appointed Colonel and Assistant Chief of Philippine Constabulary hy Governor Taft, on recommendation of Major General Leonard Wood, then Governor of the Moro Province in the Philippines. Served as Chief of the Moro Constabulary, and of Southern and Central Luzon, and acted as Chief of Phillppine Constabulary, terminating service with the Philippine Government under the operation of the "Manchu Law," on January 1, 1914.

Served as Captain and Major 1st Cavalry in California and Arisona January, 1914, to September, 1916.

Attended War College, Class of 1917.

Selected hy Colonel Roosevelt as a Brigade Commander in the Division which he hoped to be permitted to raise for the World War.

Promoted Lieutenant Colonel May 15, 1917. Accompanied General Pershing to France as Chief of Staff and served as such during period of organization of the American Expeditionary Forces, and until May 6, 1918, heing promoted Brigadier General National Army, August, 1917.

Assigned to Marine Brigade of Second Division May 6, 1918, and commanded it in the Verdun Sector and during the fighting in the Bois de Belleau and at Bouresches, during the stand of the Second Division near Château-Thierry, which stopped the German advance on Paris in June, 1918.

Promoted Major General National Army and assigned to Second Division, July 14, and commanded it during the Soissons Offensive, in the hattles of July 18 and 19.

Assigned to command Services of Supply on July 29, 1918, and served in that capacity until May, 1919.

Reappointed Chief of Staff, A. E. F., May 25, 1919, and served as such until August when sent by the President to the Near East as Chief of the American Military Mission to Armenia.

Arrived in United States Novemher 11, 1919, and assigned to Second Division and has since commanded it at Camp Travis, Texas. Deputy Chief of Staff since June 30, 1921. Promoted Brigadier General, Regular Army, November 30, 1918; Major General Septemher 8, 1919.

Retired December 29, 1922.

Only Major General "from the ranks" on the active list at the time of his retirement.

General Harhord has received the following decorations:

Distinguished Service Medal, U. S. Army.
Distinguished Service Medal, U. S. Navy.
Knight Commander, St. Michael and St. George, Great Britain.
Commander, Legion of Honor, France.
Grand Officer, Order of the Crown of Belgium.
Commander, Order of St. Morris and St. Lazarus, Italy.
Grand Officer, Prince Danilo, Montenegro.
La Solidaridad, Panama.

Harbord had had to give up his fighting troops, but "he made the S. O. S. a fighting army in the rear," a job which "in civil life would have been considered worth a million a year." He was jack of all trades in the business of winning the war, and master of them all, as he proved at G. H. Q., at the front, and in the S. O. S.

General Harbord's most noteworthy accomplishment immediately after the Armistice was the taking of an American Mission to the Near East, to investigate the advisability of the acceptance of a mandate over Armenia by the United States. This mission was appointed by President Wilson during the Peace Conference, and made a thorough study of conditions during a six-weeks' intensive tour. Following his instructions strictly, which were to report on conditions for the information of the American commissioners in Paris, General Harbord wrote a scholarly study of economic, political and racial conditions in Armenia, Turkey, Anatolia, Roumelia and Transcaucasia. The report made no effort to recommend or discountenance the undertaking of the mandate by the United States, leaving the decision on that subject to the proper authorities. For their guidance, however, General Harbord wrote a voluminous and illuminating volume, and included estimates of time, men, supplies, money, and indispensable conditions without which an American mandate would not be successful. The report was referred to the Foreign Relations Committee of the Senate and consisted of 13 bound volumes, the first one the report proper, and the others the findings of the experts who accompanied the general.

Later, in a series of articles, which attracted much attention a little over two years ago, General Harbord made this admirably compact yet comprehensive analysis:

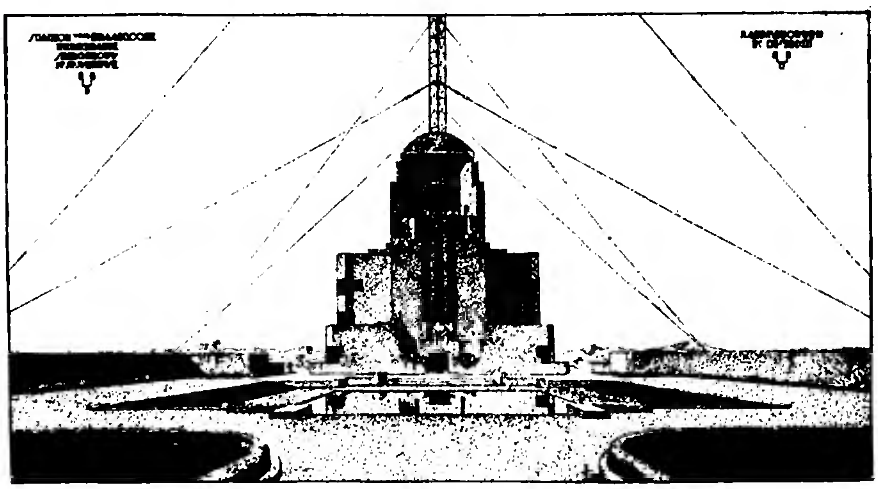
"The outstanding feature of the political situation in Transcaucasia was the intensity of racial hatreds, threatening violence and creating separatist tendencies, certain, if unchecked, to induce economic ruin and to leave various parts of the region in medieval isolation and anarchy. The racial antipathies are increased by the religious fanaticism of both Moslems and Christians, which manifests itself in massacres and causes Moslems of pure Georgian blood to side with Turkey against their Christian kinsmen. Russia encouraged these tendencies in order to divide and rule, and since the collapse of the Empire, they have been inflamed by local politicians for their own ends, and have been aggravated by conflicting interests and territorial disputes."

That is perhaps one of the best examples that can be given of the General's cogent conciseness, and to those who can "know" a man from his writings it will paint an admirable picture.

As one old soldier who had served under him in the cavalry said: "I knew when he was a captain that he had brains." That is perhaps the best possible characterization of General Harbord, President of the Radio Corporation of America.

New Japanese Radio Paper

JAPAN has a new radio magazine, called "Radio" and published by the Tokio Invention Laboratory, 9 Minami-Konyacho Kiobashi-Ku, Tokio. The first number, which has just arrived in this country, is well printed, in Japanese characters, of course, and contains reproductions of congratulatory letters written to the publisher by K. Kaneko, a privy councillor; R. Mayeda, Minister of Communications; U. Noda, former Minister of Communications, and F. Hamaji, a famous Japanese lawyer. The articles include general and technical studies of various forms of receivers.



This imposing pile of rather typical German architecture is the new radio station at Kootwyk, Holland, which will form another link in the chain of world wide wireless stations

Radio Replaced Wires Cut by the Turks

WHEN the Turk threatened the Dardanelles and southeastern Europe generally, radio had a new opportunity to demonstrate its practicability and speed. The situation in the Near East resulted in considerable disarrangement of the wire lines of communication, both on land and under the sea. Some lines, of course, went down under the Turkish onslaught, while those that were left were deluged with such a mass of messages as to prevent quick communication with the scene of activities. The United States Department of State found it necessary to have practically instant communication with its consuls and representatives in such cities as Smyrna, but found cables and European telegraph lines hopeless.

An appeal to the Navy to know just what its radio facilities could offer was made. The reply of the Naval communication was, "Our line of communication to the Embassy at Constantinople through our naval radio net is established and in official use today. We can communicate with Admiral Bristol within a few minutes."

Although the Navy is able to send messages to the Near East with great speed, a number of relays are necessary. When a dispatch for American officials in the Near East is filed in the Navy Department, when Navy radio is used, it is transmitted by the radio station at Annapolis, copied by a French station which sends it by land wire to the office of the American communication service in Paris, which relays it to Coblenz. In Coblenz the message is again relayed to Vienna and at Vienna a naval radio station transmits it to the United States radio station at Constantinople. Once at Constantinople the message is almost at its destination, the next step being to put it on land wires, trust it to couriers, or send it via radio to ships cruising in Near Eastern waters. Although this route seems complicated, it is in reality very simple as its operation is standardized and only a few minutes are required to put a message through from one end to the other.

Australian Station

CONSTRUCTION work has started on the wireless station near Melbourne, Australia, that is to be powerful enough to work directly with England. About two years will be necessary for the completion of the project. Powerful continuous wave transmitters will be installed which are expected to make possible the transmission of signals direct to London, 12,000 miles distant, during the greater part of the day and night.

Reporting Weather by Radio

By J. Farrell

"WE will now read the daily weather report, as furnished by the United States Weather Bureau. For the Northwest, rain on Thursday, with fresh north to northwest winds, followed by clear and cooler Friday, with north winds. Light to heavy frost Friday night. For Illinois, Indiana and Ohio, showers Thursday, light north west winds, Friday cloudy, probably light frost Friday night."

This forecast, read over the radio telephone to hundreds of thousands of city, town and farm dwellers, is the final radio link in a vital chain of weather reports, many other links in which now are forged by radio.

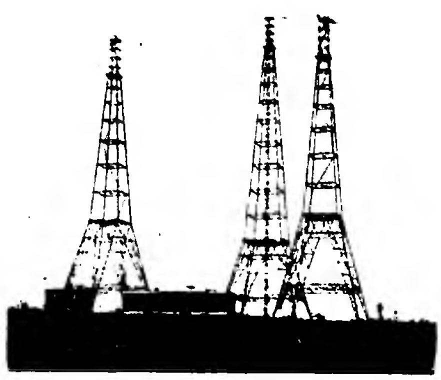
The radio telephone broadcast report is the end for which all the others were created; it places the vital information as to the weather before the country.

Your supply of fruits and vegetables; of meats, wool and cotton—of almost everything that you eat or wear—is affected by the prompt dispatch of weather forecasts to farmers, shippers and transportation agencies. Forewarned of an approaching storm, frost or twister, farmers are enabled to save millions of tons of food products that otherwise would be lost. By the use of radio, aviators in flight are kept informed of atmospheric conditions on high. Mariners on the seas out of sight of land are advised what

Kite for supporting radio antenna from plane

kind of weather to expect. Flood and other warnings dispatched to inland communities prevent loss of human life and property.

The United States Weather Bureau was the first Federal agency to experiment with radio and to use it for a meteorological purpose. The Bureau early recognized the possibilities of radio in receiving and broadcasting weather forecasts for the benefit of agriculture, commerce and navigation, and in 1902 employed Prof. R. A. Fessenden, even then a renowned radio expert, to conduct radio investigations. Much radio equipment was designed, particularly radio receiving sets, and the first storm warning by wireless was dispatched during that same year. Today, morning, evening and special weather reports and forecasts are broadcast from more than 120 radio stations throughout the country.



Arlington towers, U. S. Naval radio station

About 35 of these are Navy stations on the Atlantic, Pacific and Gulf Coasts, and on the Great Lakes. Eighty inland stations operated by newspapers, agricultural colleges, and other public and private agencies disseminate the reports throughout the land.

In 1904 the Bureau began the regular broadcasting of weather forecasts and storm warnings to naval vessels at sea. An interdepartmental board to consider the entire question of wireless in the service of the national government was then appointed by President Roosevelt. By unanimous agreement, approved by the President, the wireless apparatus of the Weather Bureau was turned over to the Navy Department with the understanding that it would be used to broadcast weather reports furnished by the Weather Bureau.

By the system subsequently worked out, observations of the wind and weather, air pressure and temperature, clouds, humidity and rainfall during the preceding 12 hours are made morning and night at 200 Federal weather stations in the United States. Within five minutes after the instruments are read in the different observation posts, the telegraph wires to Washington and to each of the other 199 stations are humming with the reports. In each office the information is charted as fast as it comes in so that by the time the last message is received a complete picture of the weather throughout the country is available at each office.

Supplemented by weather reports from vessels at sea, from stations in the West Indies, the Caribbean Sea, Central America, Canada, Alaska, Bermuda, the Azores and from a few places in Europe and Asia, weather forecasters are then prepared to tell what the weather is going to be the next day, and for a week to come. Twice-daily forecasts are made by district forecasters at Washington, Chicago, Denver, New Orleans and San Francisco. The morning forecasts cover probable conditions for the next 36 hours, the evening reports cover the ensuing two days. Special reports are issued whenever emergencies arise.

This news is dispatched to 1,600 distributing points, thence disseminated by mail, telegraph, telephone and radio. The reports reach nearly 100,000 addresses by mail, and are available to more than 7,000,000 rural telephone subscribers within one hour after the time of issue. The number of people reached by radio cannot be estimated, but the messages are "in the air" everywhere, pulsating to be taken down, and every day more of them are copied by new radio fans, either directly from the code, or when re-broadcast by radio telephone.

Operating room of the Navy radio station, Pensacola, Fla.

As yet, the most highly developed part of the work is the receipt and dispatch of storm warnings for marine purposes. Radio is indispensible in this field. A comparatively few years ago, before the use of radio, mariners out of sight of land had to depend upon their own observations for weather forecasts. Ships unwittingly rushed into the jaws of storms, and were gulped out of sight. Nowadays, vessels are guided by the advice of a weather forecasting agency whose forecasts year in and year out are 88.4 per cent. accurate. Few ships are without radio apparatus, and an elaborate system of reporting and relaying observations of weather conditions on the high seas has been developed.

Last October the Bureau's stations on the Gulf Coast spotted a hurricane 500 miles southwest of Cuba, and driving toward Florida. For five days the Bureau watched the storm as it moved first westerly, and then recurved in a northward and eastward direction. By wireless, ships in the vicinity were warned and constantly informed of the onrushing cataclysm; vessels put back to port or changed their course. Only one ship was lost, and that because its wireless apparatus was out of order. As the storm approached Florida, warnings were broadcast over the land so that property could be protected and movable goods placed above the line of flood waters.

Twenty Navy radio stations along the Atlantic Coast from Maine to Florida, and along the Gulf Coast, broadcast weather forecasts for marine purposes. These stations also send out synopses of general weather conditions for the entire country and contiguous oceans. Forecasts for ocean zones, showing the probable wind and weather, storm centers and the direction of the storm are dispatched. Similar service is conducted at five stations on the Pacific Coast from Dutch Harbor, Alaska, to San Pedro, California. There is also a broadcast station at Honolulu. On the Great Lakes, stations at Alpena, Mich., Buffalo, Chicago, Cleveland, and Duluth broadcast weather reports, forecasts, and warnings for that region.

In foggy weather treacherous currents in the Great Lakes often drive

Radio warnings of impending floods prevent loss of life and property

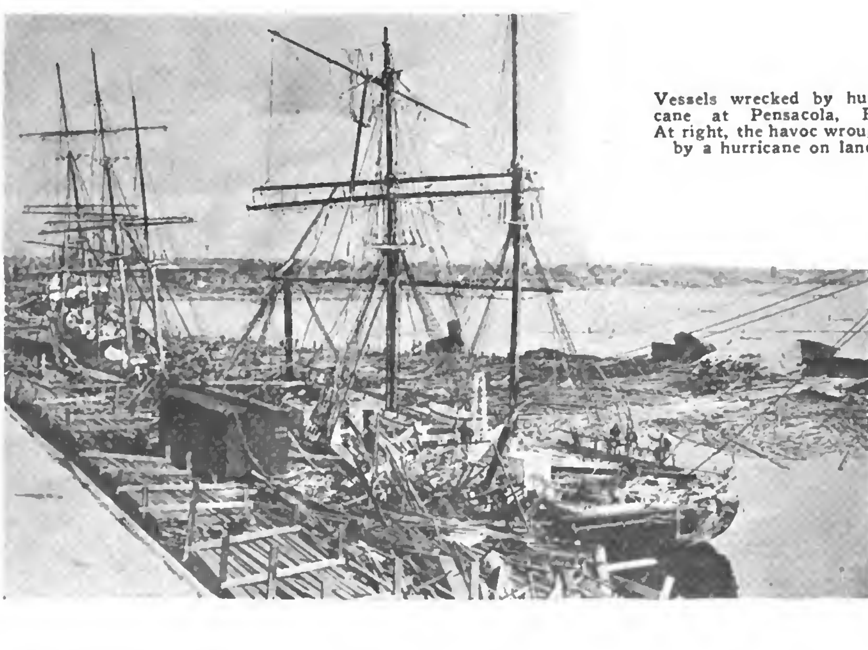
vessels 15 miles off their course in an hour. In stormy weather the ships seek protection among small groups of islands. The display of storm warnings in every port and harbor of any considerable size, supplemented by radio, make possible a service of tremendous value to marine interests. Sailings of vessels in ocean and lake traffic are largely regulated by these warnings.

For land service the 80 broadcasting stations are located principally in the corn and wheat belts; the live-stock producing sections; the great fruit sections of California, Oregon and Washington, and the cotton belt. A complete list of the stations would read like a gazeteer. The more important stations are at Atlanta, Ft. Worth, Dallas, Wichita, Kansas City, St. Louis, Madison, Dayton, Columbus, Detroit, Rochester, Buffalo, Mobile, New Orleans, Jacksonville, Raleigh, and Charlotte.

Reports of rainfall and highest and lowest temperatures during the preceding 24 hours are telegraphed each morning during the growing season from 187 special telegraph stations and broadcast by telegraph, telephone and radio throughout the 16 grain producing states. Daily bulletins giving detailed weather information for the immediate district and a general summary of the weather over the entire country are also sent out. Similar service is provided in the 11 principal cotton states, reports being received each morning from about 200 different points.

Cold waves, heavy snows, high winds and storms locally known as blizzards are a constant menace to the live stock industry in the Western range states, and a special service whereby warnings of sudden changes are broadcast by telephone, telegraph and radio throughout the territory has been perfected. This enables the cattle and sheep men to arrange to graze stock near shelter, or in a direction from shelter so that the stock will drift toward shelter when the anticipated wind arrives. In early shearing and lambing districts shearing is delayed, and newly shorn sheep and ewes with young lambs are kept near suitable shelter, when cold rains are expected.

A recent development of the service is the broadcasting of weather reports in connection with spraying. To protect apples from scab and other fungous diseases the spray must be applied before a spell of rainy weather if it is to be effective. In New York State alone raising apples is a $12,000,000 industry, and the importance of protecting it is great. Spraying specialties at Rochester cooperate with the weather forecasters, and a complete system for the immediate distribution of weather forecasts has been inaugurated so that practically every fruit grower in six or seven counties can at once start a



Vessels wrecked by hurricane at Pensacola, Fla. At right, the havoc wrought by a hurricane on land

campaign against fruit diseases. Fruit growers in other sections of the country such as in the Yakima Valley of Washington where damage by codling moth totalled $2,000,000 in 1918, are requesting similar service.

This service has resulted in saving $1,000,000 a year in the Pomona District of Southern California by enabling orchardists to place heaters in the orchards before cold storms arrive.

The flood warning system is of long standing in the large river valleys. It is not unusual to predict river heights in the lower Mississippi Valley to within a few tenths of a foot, several weeks in advance. Flood warnings enable farmers to drive out stock, merchants to protect merchandise, and people generally to remove to places of safety. Frequently in flooded or other devastated areas radio provides the only means of communication with other sections of the country.

As this is written, the Weather Bureau has announced further expansion of its radio service. On Wednesdays, from April to October, inclusive, a summary of weather conditions as they affected crops during the preceding weeks is to be broadcast from Washington and Chicago.

Radio broadcast warnings of approaching frosts makes it practicable to use artificial heaters in fruit groves

At Washington the naval arc radio station at Arlington with a wave length of 5,950 meters is to be used; at Chicago, the naval arc station at Great Lakes with a wave length range of 4,900 meters. These reports will go out at 10.15 and 10.30 a. m. respectively. Special warnings of storms, cold waves, frosts, and other conditions will also be issued each afternoon at 5 p. m. The States comprised in the Washington district are the New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland, District of Columbia, Virginia, North and South Carolina, Georgia, Florida, Alabama, Tennessee, Kentucky, West Virginia and Ohio; and those in the Chicago district are Illinois, Indiana, Michigan, Missouri, Minnesota, Iowa, North and South Dakota, Nebraska, Kansas, Montana and Wyoming. It is expected that the forecasts will be picked up by local radio stations in the various states and re-broadcast by radio telephone.

Where Billions Mean Nothing—in a Vacuum Tube

Infinitesimal Electrons and Unthinkably Tiny Molecules and Atoms Responsible for Success of Detector and Amplifier Tubes—Some Astounding Figures

By John Mills
Western Electric Co.

This article gives our readers some idea as to the enormous number and infinitesimal size of the electrons which are so important in radio communication. It is prepared at the request of the Editor by John Mills, of the Western Electric Company, whose ability to present striking and accurate pictures of electronic phenomena is well known to readers of his book, "Within the Atom."

WHEN your vacuum tube is all nicely adjusted, just what is going on inside it? There is a small filament which is carrying a heating current from the A battery of perhaps 1.2 amperes. That means there is a stream of electrons through the filament, from one end to the other, of about seven billion, billion electrons each and every second. That's a mere matter of 7,000,000,000,000,000,000 tiny electrons each second passing through a wire with a cross section of about 24 millionths of a square inch.

They come from the negative plate of the A battery. If you are using a storage battery you can figure for yourself that every time the sulphuric acid in the storage cell forms a molecule of lead sulphate on the negative plate two electrons start off for a trip through the filament. In each cell of the storage battery then, molecules of lead sulphate are forming at the rate of about twenty-five thousand billion, billion each hour that the filament is excited.

The same electrons which start from the negative plate of the battery are not necessarily the ones that get back to the positive plate. Perhaps most of them do. Anyway there is just the same number reaching the positive plate each second as leave the negative plate. Some of the original electrons which left the lead plate (the negative) may have been diverted in their travel through the filament and got outside to behave as free electrons in the vacuum tube. If they did, there is an equal number of electrons from the connecting wires and the filament which have taken their places in the procession.

The copper connecting wires through which the procession progresses are formed by tiny atoms of copper. Each one of these atoms is a most amazing system with an almost infinitesimal center or nucleus and twenty-nine electrons clustered around it.

How the atoms of the filament are formed depends, of course, on its construction. If it is tungsten each atom has seventy-four electrons in a cluster around a nucleus which is different, but perhaps not much larger than that of the copper atom.

Nobody knows just how these electrons are arranged about the nucleus, but these numbers are known to be correct. It is also known that the size of the electron is very small as compared to the distance which separates it from its neighboring electrons or from the nucleus. The distances within the atom from one electron to another are so large as compared to the size of the electron that each atom is a miniature solar system. There is plenty of room between neighboring, but not nearby, electrons for the electrons of the main procession to pass along.

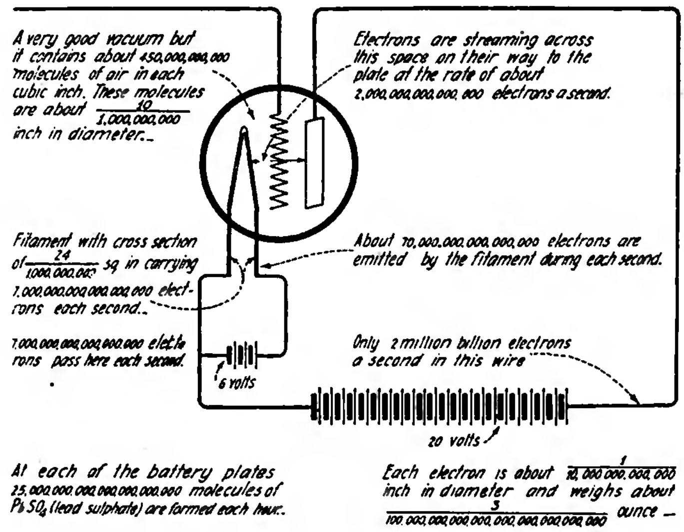
Not all the electrons which cluster around the nucleus of a copper atom or a tungsten atom are stay-at-homes; some of them like to join the procession and they do. In fact, they form quite a part of it. That means there are always some nuclei without their proper number of electrons in a group around them. These bereaved nuclei are always stopping some other members of the procession to fill the places of their wandering electrons which joined the parade.

Although there is lots of room the individual members of the procession stream along at such a rate that there has to be some dodging. And the dodging is done both by the stay-at-home electrons and the nuclei to which they belong, and also by the fast-moving electrons which are on the march. There are two results. One is that the atoms get pretty much disturbed; they have to move faster; that is why the filament gets hot. The other result is that some of the electrons in the stream get diverted from the straight and narrow way of the filament and go off into the vacuum which surrounds it.

How many do? That depends upon the magnitude of the stream, that is, upon the number of amperes through the filament, and upon the kind of atoms and molecules of which the filament is formed. For the same amount of disturbance in the filament there are more emitted electrons from the so-called oxide-coated filaments.

There will be about so many electrons emitted each second from the filament. If the plate is made sufficiently positive they are urged across to it as fast as they get loose from the filament. The number of them which then move to the plate each second is the so-called saturation current for that temperature of the filament. The tube is, of course, always operated with a much smaller plate voltage so that the grid can have some effect.

The grid, you remember, is strategically placed between the filament and the plate, so what it has to say to the emitted electrons has a great influence on their future careers. If it calls them on there is a much increased plate current, and if it warns them back, there is a reduced current in the plate circuit.



Suppose you have a vacuum tube like the Western Electric VT-1 and are operating with a plate voltage of 20 volts and no voltage on the grid. There will be emitted each second from the filament about 70 million billion electrons. Of these, the plate calls to itself 2 million billion. The rest of them flit around in the tube just missing collisions with each other; and each second there is just this number getting back inside the filament and going on with their proper duties, either surrounding some nucleus or taking a part in the parade.

Of course, that space into which these electrons have escaped from the filament is not a simon pure vacuum—it's the best that can be made with the pumps at the disposal of the tube manufacturer. When he started to evacuate the tube there were perhaps 450 billion billion molecules of air in each cubic inch of the tube. He pumped, and froze with liquid air, and heated the filament, and bombarded the plate; and when it was all over he had left perhaps about one billionth as many molecules in each cubic inch, that is, 450,000,000,000 molecules.

That is quite a number, but each one of them is only about ten billionths of an inch when measured from the outermost electron on one side of the nucleus to the outermost on the other side. There are so few (!) of them *relatively* that each molecule can go about four-tenths of a mile before it has to dodge another, although it will have to dodge back, that is, be reflected from the glass walls many times in such a travel.

The few electrons, which are emitted by the filament and drawn across to the plate, aren't likely to collide with many of these air molecules, so the operation of the tube depends only upon the electrons themselves.

That's what happens in a vacuum tube. And it is easy to see that it would be pretty hard to represent in a picture. Suppose the whole thing was magnified until the electrons were visible, then just one snap shot with a camera of a thousandth second exposure would show about a billion times more electrons trying to get across each infinitesimal cross section of the filament than there are people in Greater New York. It wouldn't be fair to the retoucher to attempt a picture like that, so the figures of the diagram will have to summarize what happens in a vacuum tube.

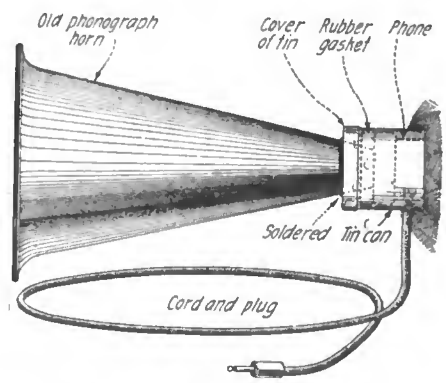
An Improvised Loud-Speaker

By Dr. Arthur R. Garvey

I ENCLOSE a sketch of a loud speaker which meets all practical needs of those not owning the more expensive types, and this loud speaker, although efficient, may be constructed in fifteen minutes by anyone handy with a small blow pipe and snips.

The parts necessary are an old phonograph horn which may be picked up at any second hand store for a song; a large baking powder tin with cover; a rubber gasket which may be cut out of an old automobile tire and a small soldering torch with some soft solder.

The cover of the can should be soldered to the end of the horn and if the hole to admit the horn in the cover of the can is cut reasonably accurate, the soldering will only take a few minutes. The can itself should be cut down so that the receiver will fit snug with the use of a rubber gasket between it and the cover of the can. This gasket will also prevent any tinny noises which would otherwise be present. Cut a small hole in the can to admit the receiver cord and the loud speaker will be finished, although a coat of paint for the can and horn will improve its appearance.



A useful home-made radio loud speaker

I am using a Baldwin type C unit and am getting wonderful results with a two-stage audio frequency set. Amateurs must remember, however, with this loud speaker or any other, the results are only proportional to the set in back of it.

Radio May Direct Rescuers in Mine Emergencies

Tests of Bureau of Mines Show Promising Results—Transmission and Reception Possible Through the Earth

By G. E. Mitchell

A WHISTLE blows long and frantically in a little coal mining town in Pennsylvania. With their hearts full of dread, the women and children hurry to the pit house. Those whose men are safe above ground rejoice while they give of their sympathy to those whose loved ones are still in the mine. Rescue parties are organized. A fall of rock, an explosion, a fire, any one of a score of accidents may have taken place below. Many miners may already be dead, and the lives of others hang in the balance.

Cross-bar rigging to insure safety to miners engaged in working loose strata—the dangers of which may be further guarded against by use of radio

What can be done? What is the most effective move? Intelligent and swift emergency work depends on accurate knowledge of conditions underground and that is just what the nature of the catastrophe renders impossible. One can tell only approximately the exact situation, how many men are entombed, where they are, and how best to rescue them. Telephone wires are down, and walls of rock or of flame keep back all rescuers.

What can radio do in such emergencies? Can it afford communication underground as it does through the air? To determine the possibilities, the United States Bureau of Mines recently conducted radio tests in its experimental mine at Bruceton, Pa. While not as yet conclusive, the tests seem to indicate that it should be possible to use radio equipment within coal mines for communication within the mine, and with the surface of the ground.

These preliminary experiments, made in co-operation with the Westinghouse Electric & Manufacturing Company, while failing to develop any practical method of using wireless waves for underground communication, nevertheless indicate clearly that electromagnetic waves may be made to travel through solid strata. In the Bruceton experiments, signals were heard distinctly through fifty feet of coal strata, although the audibility fell off rapidly as this distance was increased. The absorption or loss of intensity with distance is very great for the short wave lengths, 200 to 300 meters, used in these tests. Longer wave lengths are known to suffer less absorption and may possibly be found practically effective under certain conditions.

The preliminary experiments consisted first in receiving signals from without the mine by means of a receiver located inside the mine, and second, both sending and receiving messages underground through the strata. It was found that with a receiving instrument set at a point 100 feet under-

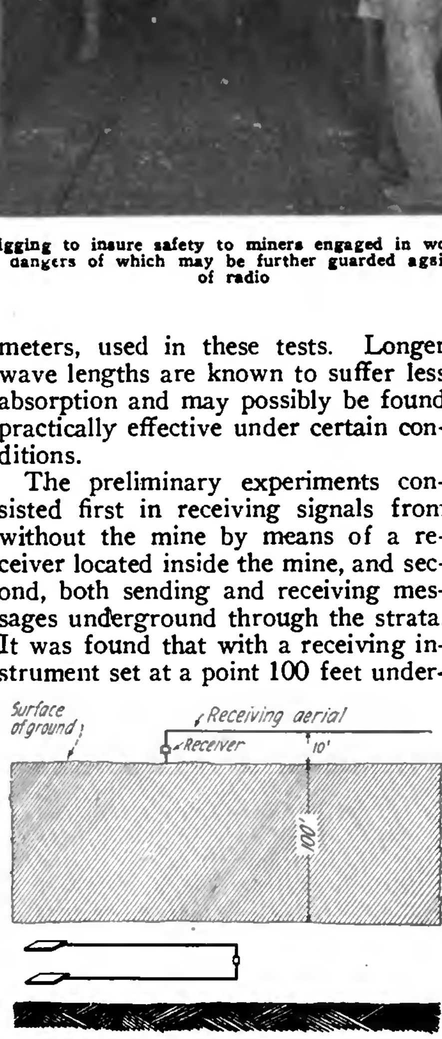


Figure 1—Relative position of transmitting and receiving apparatus for some of the tests

ground, signals from KDKA station, East Pittsburgh, Pa., could be heard distinctly. Station KDKA is at a distance of about 18 miles from the experimental mine. About 50 feet from the receiving station used in this test was a 6-inch bore-hole from the surface, lined with iron pipe and containing electric light wires which extended therefrom throughout the mine. The presence of these wires evidently assisted greatly in the reception, for when the receiving set was carried to another point in the mine removed from wires and tracks the signals were barely audible through 50 feet of cover. The fact that signals were detected, however, even though faintly, is sufficient evidence of transmission through the ground to encourage further experimenting.

In sending waves underground a transmitter was used in such a manner as to send out continuous waves of 200 to 300 meters long. On account of limited time no attempt was made to modify the apparatus in such a manner as to produce waves of greater length. Such additional experiments are much to be desired. In all the experiments the vertical antenna was found to give the better results. The horizontal antenna gave practically no reception. A loop of a single turn was used with fair results.

The strata at the Experimental mine lies almost horizontal. The direction of strata may have some influence on the transmission of radio waves, but the present experiments give no conclusive evidence on this point. No doubt the degree of wetness of the strata also influences the transmission of radio waves. The Experimental mine is a comparatively dry mine, but the overburden is damp and a small stream of water is continually flowing from the mine.

A more detailed description of some of the experiments follows:

1. Vertical Oscillator—The sending antenna consisted of two wires, each 50 feet long, stretched horizontally in opposite directions from the instrument and supported by dry sticks about 5 feet above the floor. Ground connection was made by a copper lead to the track in the floor of the drift. At a distance of 320 feet signals were weak.

In all tests open entries led from the transmitting to the receiving station, but one or more right-angle turns always intervened. In general, the ground connection was found to be a minor factor in the reception of signals. Merely laying a few feet of rubber insulated wire on the floor of the drift made satisfactory grounding by virtue of its condenser effect. With no vertical component in the receiving antenna no signals could be received at all.

2. Horizontal Oscillator with Horizontal Transmission—The nature of the sending antenna was radically changed. The two branches of the antenna were so connected to the instrument that oscillation would take place from one branch to the other, the apparatus thus being analogous to a Hertz oscillator. The ground connection was removed. This arrangement gave a radiation of the electric field in the horizontal plane as horizontal lines of force, whereas in the preceding series, the electric lines of force were vertical, being radiated by the vertical portion of the antenna. The receiving antenna consisted of two branches, each about 50 feet long. At a point 100 feet directly down the entry from the sending instrument the signals were strong when the receiving antenna extended horizontally from the instrument in opposite directions and in a direction perpendicular to the direction of the sending instrument. At a distance of 100 feet laterally from the sending instrument with coal walls intervening, signals were very faint. These statements are true whether the receiving antennae were held at the top of the entries, in the center or on the ground.

3. Ground Waves—Two galvanized iron sheets about 7 feet by 5 feet were attached to the antenna wires of the sending instrument, and grounded as well as could be done by leveling the moist ground and laying the metal sheets flat upon it. No radiation could be obtained by this arrangement because of the high resistance of the earth part of the circuit. One plate was then elevated about six inches upon dry sticks. This resulted in a sufficient decrease in the resistance to permit the oscillator to operate. At a distance of 140 feet the receiving antennae were grounded by attaching the tips to iron rods which were driven about one foot into the floor of the entry. Faint signals were heard.

4. Vertical Oscillator with Condenser Plates—The galvanized iron plates used in the preceding experiments were placed 5½ feet apart, one directly above the other, the planes of the plates being horizontal. Each plate was supported on fairly dry sticks of wood so that fair insulation was obtained. The distance of the plates from the sending instrument was about 40 feet. The antenna current was one ampere. At 140 feet a short receiving antenna with one end elevated and the other to ground gave no appreciable depression in plate current. A 50-foot antenna in a direction approximately at right angles to the direction of the sending instrument gave audible signals. The receiving instrument was then taken outside the mine to a point about 750 feet from the sending instrument. (See figure 1.) The antenna was hoisted to a nearby flagpole. Signals could be detected. The receiving instrument was taken to a point on the surface directly above the sending instrument, the distance between the two being about 100 feet. With a 50-foot antenna stretched in opposite directions, signals could be heard. At a point on the surface 250 feet away the signals still could be heard. Signals on 360-meter wave-length from Station KDKA were heard very strongly.

5. Horizontal Oscillator with Vertical Transmission—The top plate of the sending antenna was left in place, but the bottom plate was removed to a point on the opposite side of the instrument and about 50 feet distant and there supported in a horizontal plane on dry sticks on a level with the other plate. This arrangement, like that in experiment 2, is virtually a Hertz oscillator. Reception was attempted on the surface and signals could be heard faintly.

6. High Frequency Transmission by Wires—The plates were removed from the sending antennae and the antennae wires were attached by loops of electrician's tape parallel to the electric light wires for about 50 feet and parallel to the telephone wires for another 50 feet. Outside the mine, 750 feet away, a very loose coupling to either the light wires or to the telephone wires gave the signals with great intensity.

When Lightning Flashes Nearby

A Study of What Electrical Storms Mean to the Radio Antenna

By H. M. Towne

> EDITOR'S NOTE—*During the past summer more radio antennas were exposed to lightning than ever before, yet the newspapers failed to record the epidemic of fires that the ignorant had predicted. An antenna does not increase the lightning hazard but on the contrary may even reduce it; this is well known in a general way. Herewith is printed an illuminating analysis of the conditions bringing about this highly satisfactory result, an analysis that is the result of several years' study of the effects of lightning on power transmission lines, and lately, of lightning-induced static discharges in radio antennas.*

THE relation of the radio antenna to lightning or severe atmospheric discharges is well worthy of a little thought. This is particularly true in view of the more or less popular hallucination that an elevated outdoor radio antenna will "draw" or "attract" lightning. Such impressions may have deterred enthusiasts from installing radio receiving sets and certainly have excited causeless fear in the minds of many radio fans and given rise to occasional objections from neighbors.

I have heard of two landlords who refused to allow their tenants to join the throng of radio novices, claiming that the conventional aerial wires or antenna would seriously endanger their real estate.

With the exception of brief descriptive advertisements for protective devices, and publication of the Fire Underwriters' rules, little has been published on this subject. While it may not be altogether as interesting as the super-regenerative circuit, it is one which should be more generally and better understood by the radio enthusiast, if not the public at large.

Let us consider what happens on the antenna wire during the lightning storm. We will assume an average single No. 14 B&S wire antenna, say 150 feet long including lead-in, 35 feet high, and insulated by 50,000-volt insulators, and we will also assume a thunder storm such as is common during July and August, in most any of our central or eastern states. The antenna begins to feel the effect of the storm when it is still a long way off. Readjustments of electric charges in clouds and lightning flashes even two hundred to four hundred miles away will cause feeble pulsations of electric current in the antenna wire. These current pulsations are the cause of the unpleasant noises from the radio receiving set, which, in the parlance of the fan, are referred to as "static."

These currents which flow between the antenna wire and ground are caused by electro-static and electro-magnetic induction produced by the lightning flashes and shifting of cloud charges. It is for the major part an electro-static phenomenon, which may be quite complex because of unequal charges at different areas of the cloud and because of unsymmetrical equalization of charges after a lightning flash. An idea of the effect, however, can be had by considering the storm just approaching the vicinity of the antenna. The storm front is usually the region of the most severe lightning and consequently the clouds in the front of the storm must usually carry the more severe charges.

The condition is shown in figure 1. The clouds are, say, 3,000 feet above the earth and the front cloud has a charge of say 3,000,000 volts to ground. This creates an electro-static field between cloud and earth and this field extends far out beyond the area directly under the cloud. The intensity of the field, however, diminishes as the distance increases from the cloud-covered area. The curved lines represent the electro-static lines of force in the air dielectric between cloud and earth.

The cloud and earth represent plates of a mammoth condenser. The plates are separated 3,000 feet, and at the potential difference of 3,000,000 volts, there exists a potential gradient of 1,000 volts per foot in the air dielectric between cloud and earth. The antenna is nearly directly under the cloud and is in the region of the most intense electro-static field. The antenna is elevated 35 feet above ground and being in an electro-static field having a voltage gradient of 1,000 volts per foot, will have a potential to ground of 35,000 volts. This exists, however, as a bound charge, that is, the charge is not free to move or be discharged while the field of the cloud remains constant.

Now assume that a lightning flash occurs from this charged cloud, to another cloud or perhaps to earth. This will either shift the charge some distance to another cloud or the charge will be entirely dissipated in discharge to earth. This shifting or vanishing of the cloud charge takes place with the speed of the flash itself and just so quickly the bound charge on the antenna is set free, and will tend to neutralize by discharging through the lead-in wire and to ground.

Let us consider the possible amount of electric energy which can in this manner be induced on the antenna. If the antenna is suspended to grounded supports the maximum voltage which we can consider may ever be discharged to earth through the lead-in wire is the arc-over voltage of the antenna insulators. We previously as-

A typical lightning discharge

sumed these to be 50 K.V. The energy will be equal to $\frac{C E^2}{2}$ where C is the electro-static capacity of the antenna in farads. The capacitance of the antenna as previously dimensioned would be about .26 milli-mfds. and substituting this with the voltage E of 50,000 volts the equation becomes

$$\text{energy} = \frac{.26 \times 10^{-9} \times 50000^2}{2}$$

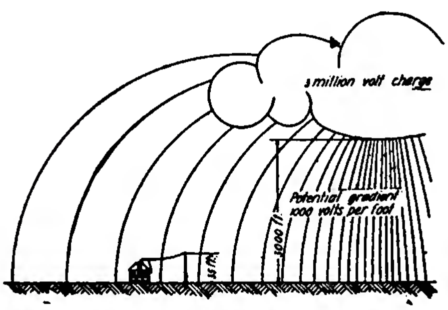


Figure 1—Diagram illustrating conditions of a thunderstorm

$$= \frac{.26 \times 10^{-9} \times 2.5 \times 10^9}{2}$$

$= .325$ joules

or .325 watt seconds.

This is really a less significant value of energy than the figures would indicate at sight. Such an amount of energy would light a 40-watt lamp for only $\frac{8}{1,000}$ of a second. It would raise a one-pound weight about 3 inches. If put in terms of heat energy it would be equivalent to the heat from .00015 grain of coal. Despite these insignificant energy equivalents, if we consider the time element of the induced charge, which is about 10 micro seconds $\left(\frac{10}{1,000,000} \text{ sec.}\right)$ the value of .325 watt seconds represents a power expenditure of 32.5 kw.

It may be of interest to see what the current value would be if such an induced charge were discharged from the antenna. To compute this we should know the inductance of the antenna. Its natural wave length would be about 185 meters and the corresponding natural frequency would be 1,620,000 cycles. Substituting this value and our capacitance value in the equation for distributed inductance and capacity which is—

$$f = \frac{1}{4\sqrt{LC}}$$

we can calculate L to be .09 milli-henry. The amount of electro-static energy will be equal to the electro-magnetic energy, or

$$.325 \text{ joules} = \frac{L I^2}{2}$$

and from this we find that I must be 85 amperes current.

The electro-magnetic induced effects on an antenna are produced by the current in the lightning flashes. Dr. Steinmetz has calculated the current of a lightning flash to be of the order of 10,000 amperes. There is, therefore, a magnetic field of considerable intensity surrounding the flash, similar to the field that surrounds a wire which is carrying current. Owing to the rapidity of the flash the field builds up and collapses in a very short interval of time, probably $\frac{1}{100,000}$ of a second. Thus, a circuit sufficiently within this rapidly changing electro-magnetic field will have a voltage induced on it. Probably the greatest effects of this nature would be produced by cloud to cloud flashes and especially when the flash is parallel to the antenna.

The writer has made a few observations of the induced effects during storms. When the storm gets within about 5 miles there may be sufficient voltage induced on the antenna to spark over a small air gap inserted between lead-in and ground and to cause an unpleasant shock to be had if the lead-in is touched while one is in contact with the ground wire or other earthed object.

These voltages were, of course, of momentary duration, probably corresponding to the time element of the lightning flashes. As the edge of the storm clouds get nearly over the antenna, the condition seems to change and the charge on the antenna seems continuous.

A small glass comparison vacuum gap which had a spark-potential of 500 volts was connected between the antenna lead-in and ground, and it discharged continuously, though the discharge was only a hair-like spark and was only visible when close up to the gap. This small continuous discharge was intermittently flashing up to a bright bluish green spark coincident with lightning flashes. In a recent storm this continuous discharge lasted about ten minutes and it stopped when the rain began to fall. Probably the first rain on the antenna insulators lowered the insulation resistance sufficiently to permit the charge to leak over the insulators instead of leaking off across the gap as before the rain. The antenna, however, continued to discharge coincident with flashes and I counted 78 discharges during a storm lasting locally about 45 minutes. In one instance during observations, a rather near-by lightning flash caused a 1⅛-inch air gap to spark over, representing about 30,000 volts.

Having discussed the induced effects, let us consider the worst condition, which is that of a direct stroke of lightning on the antenna. Such occurrences are very rare, considering the large number of antennas and the number of storms that occur. In about ten years of interest in this subject the writer has known of only about six cases of direct strokes, and these were mostly cases which involved antenna at an unusual height above the ground.

With the usual small antenna as is commonly erected for receiving purposes the probability of direct stroke is quite insignificant, though this depends to some extent on the nature of the surrounding country.

The average antenna used for reception of radio broadcasting presents no more of a lightning hazard than the electric light or telephone wires which enter your house, and surely no one will associate these with an invitation for lightning stroke. On the other hand, if lightning is destined to strike your house, whether there is an antenna there or not, the presence of an antenna with proper protective device will be a protection rather than a hazard, for it will serve as a lightning rod and divert the flash to ground which might otherwise go through the roof and cause fire.

I do not want to convey the impression that a house with a radio antenna is immune from damage by lightning nor that there is not the possibility that any antenna may be the target for a lightning stroke. Indeed, there is always the possibility of anything being struck when there is lightning, but it happens rather rarely.

With the average installation the probability of your property being struck is not much different whether the antenna is present or not. The fallacy of the antenna drawing or attracting lightning will become apparent to most anyone after a little reasoning.


Figure 3—Effective lightning arrester installation

On account of the induced charges which are so prevalent and also in view of the possibility, even though remote, of a direct stroke, it is necessary to connect a lightning arrester or protector between the antenna lead-in wire and ground wire for the purpose of carrying lightning discharges or less violent induced discharges to the ground with minimum chance of damage to the receiving set, building or operator. This protective device forms a shunt path for the discharges to ground and prevents the induced voltages from discharging through the radio receiving set with the attending danger of starting a fire.

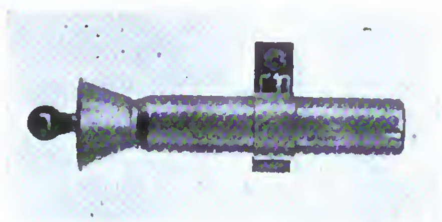


Figure 2—RCA vacuum type of lightning arrester

The protective device should be installed in accordance with rules set forth by the National Board of Fire Underwriters, and the device itself should have the approval of the underwriters. The writer is using the protective device shown in the accompanying photograph figure 2. This protector is made by the Radio Corporation of America and is designated as their Model UQ-1310. It consists of a 3/64-inch gap enclosed in a vacuum chamber and having two terminals for connection to the antenna and ground wire, and is installed as shown in figure 3. It will be noted that a flat copper strip is installed in addition to the usual copper wire for ground connection from protector to water and sewer pipes which are just inside the cellar window.

It is desirable to have the ground wire as short and direct as possible and of low electrical resistance, and it should preferably be carried outside the building to the earth connection. This last, however, is not always possible in the case of apartment houses, when the ground wire must be carried inside to the nearest water or steam pipe. This protector can be installed either indoors or outdoors, but the outside installation is to be preferred.

The charges on the antenna are discharged through the protector to the ground wire and thus prevented from entering the radio receiving set in the house. I have observed that the protector begins to discharge when the voltage of the antenna charge reaches about 350 volts. This insures a very good degree of protection. The protector has an insulation resistance of over 500 million ohms so that there can be no losses to ground of received radio signal energy.

To test this protector for the most extreme duty it might have to perform, which is discharging the current of a direct stroke of lightning, the protector was subjected to several discharges from Dr. Steinmetz's lightning generator at the General Electric Company's laboratory. This artificial lightning involved discharge current of 10-000 amperes at 120,000 volts, each discharge lasting about $\frac{16}{1,000,000}$ of a second. These values of current and duration of discharge compare well with the accepted figures for actual lightning. Spark-potential and insulation resistance tests together with internal examination following the lightning tests showed no measurable deterioration or damage to the protector which indicate the substantial construction of this little and yet important device. This protector affords practically the same degree of protection as the direct grounding of the antenna through a lightning switch and has the advantage of being automatic and requiring no manual manipulation.

In conclusion we can dismiss any impressions that the usual radio antenna is a lightning hazard to life or property, provided a good protector and suitable ground wire are effectively installed and the ground wire permanently connected to a low-resistance earth connection.

Factors Affecting the Range of Radio Transmission

By B. R. Cummings

Radio Engineer, General Electric Co.

ONE of the questions almost invariably asked by people who see or speak of a radio transmitter is "how far will it send?" This question is entirely justifiable and the following brief review of the factors affecting the range of radio transmitters has been prepared in an effort to explain the hesitancy which is frequently shown by radio engineers in claiming any specific range for a radio transmitter.

It has become standard practice with companies who build radio transmitting equipment to very carefully specify the conditions under which any guaranteed ranges can be made and even then it is seldom that a conservative company will guarantee transmission at all times.

In the first place a radio transmitter will transmit several times as far at night as in daylight; it will transmit farther on a dark night than on a moonlight night. This is due to the fact that the sunlight and moonlight cause an ionization of the atmosphere which results in much greater losses than occur when such ionization is not present. The greatest ranges are obtained when the atmosphere between the transmitting and receiving stations is most nearly a perfect insulator.

The range depends upon the nature of the territory lying between the transmitting and receiving stations, the greatest ranges for a given power usually being obtained over water. Any metal, particularly iron or steel, lying between the stations will cause a loss of signal strength. Such metal may either be in the form of artificial structures such as buildings or building framework, or may be in the form of ore deposits. Some sections of the country are noted for their poor location for radio reception, and the cause of this can usually be traced to this reason.

In many places it is possible to receive effectively from all directions but one and it is usually found that in this direction a metallic structure or a metal deposit is responsible for the lack of reception.

A radio station which can be depended upon for reliable communication through the winter months for a given range can only work effectively during the summer months over a fraction of this range, assuming that the power of the transmitter is not increased. This is not due to any diminution of signal strength, but to the percentage presence of so-called "static" disturbances during the summer months. Static disturbances, which result in cracking, hissing or grinding noises in the receiver head phones frequently sufficient to make this radio signal unintelligible, have been the subject of investigation and analysis for many years during which time many attempts have been made to determine their origin and means for preventing their detrimental effect on radio reception. While some very special receiving equipments and antenna systems have been devised to increase the ratio of signal strength to static strength (the so-called "signal-static ratio") the most positive way of overcoming static seems to lie in transmitting sufficient power to make the radio signals intelligible even in the presence of static. This was the procedure followed for example at the Lafayette Station in Bordeaux, France. which was built by the United States Navy Department during the war, for reliable communication in the event the trans-Atlantic cables were cut by the enemy. This station has a capacity of 1,200 kw. and its capacity was made large primarily to insure trans-Atlantic communication during the summer months when static is most prevalent.

The range which is accomplished depends also, of course, upon the type of receiving equipment which is used, and upon the ability of the operator to use his equipment to best advantage. A receiver with one or more stages of amplification will receive stations which cannot be heard without such amplification, although there is a limit to the extent to which amplification can be used. It does not serve, for example, to overcome static disturbances, because such disturbances are amplified to the same extent as the radio signal itself, leaving the signal static ratio the same, and therefore, not making the message any more intelligible.

The wave length at which transmission is carried on is also an important factor in the range which can be realized with a given power. Energy radiated at short wavelengths is absorbed to a much greater extent than energy at longer wavelengths, and for this reason very long wavelengths, comparatively, are usually used for a long distance, such as transoceanic communication.

The personal equation of the receiving operator is of importance. Signals which are quite readable to some operators are unintelligible to others.

The number of stations which work in close proximity to each other also decreases ranges which would otherwise be obtainable, for many signals which have sufficient strength to be easily interpreted are made unreadable by interference from other stations.

In general, therefore, in specifying the range of a radio transmitter, it is necessary to specify whether transmission will be carried on in daytime or at night; in winter or summer seasons; the type of receiver, and the amount of amplification which will be used; the nature of the country lying between the transmitting and receiving stations; whether or not uninterrupted communication is required or whether so-called "deferred service" is satisfactory; the wavelength upon which transmission will be carried on; the kind of transmission desired, that is, telephony, continuous wave telegraphy or interrupted continuous wave telegraphy; the vicinity in which the transmitter will be located with respect to other transmitters, and lastly, but by no means of least importance, whether or not the range specified, even after the foregoing conditions are known, shall be a conservative one or one which is the maximum which can be expected.

It is impossible, in a very brief discussion, to analyze more fully the various factors entering into range considerations which have been enumerated, but the mere mentioning of the existence of these factors should be sufficient to make all of us realize that a brief statement to the effect that a radio transmitter has a range of, say, five hundred miles, is practically meaningless.

This does not mean that reliable communication cannot be carried on over given distances, for a careful consideration of all conditions will permit satisfactory equipment being installed. Such equipment will frequently transmit distances far greater than the rated range of the set. For example, a transmitter manufactured by the General Electric Company which is rated, under definite conditions, at 175 miles, has recently communicated by telephone over a distance of 4,050 miles. This performance was, of course, the result of an unusual combination of favorable conditions.

In view of the foregoing, conditions should be considered before arriving at conclusions as to range.

Practical Reflex Amplification

Radio Frequency and Audio Frequency Amplification Obtained Within the Same Tube

By A. Ringel

THE past few months have witnessed the application of a comparatively little known circuit to practical radio receivers, namely the "reflex" amplifier. The essential feature of a reflex amplifier is the use of the same tube for both radio and audio frequency amplification.

This arrangement is not really new, being described by Bucher in "Vacuum Tubes in Wireless Communication," and by Stanley in "Principles of Wireless Telegraphy" (Volume II). It has been known to the English and French for quite some time,—but it has only recently been applied to amateur receiving sets. The reason for the delay may have been the absence of any short wave radio frequency transformers. Such a condition no longer exists, numbers of excellent transformers are now on the market and this no doubt has hastened the development of the reflex circuit.

Similar circuits have been used by the English amateurs, who employed plate tuning in order to obtain radio frequency amplification. In fact, one of these sets was described in a recent issue of THE WIRELESS AGE (August, 1922, page 74). For the benefit of readers of THE WIRELESS AGE, the writer has laid out a few reflex circuits which can be built by the average amateur. He has not tried all the hook-ups shown in the diagrams—but has experimented considerably with some of the essential circuits and has obtained promising results. From his tests he has learned a number of interesting things in regard to their behavior which will undoubtedly be of interest.

Generally, most of the radio frequency amplifying transformers work well from about 250 to 500 meters and are especially good for broadcasting reception. However, for amateur wave lengths, it is best to use plate circuit tuning. The latter is, of course, very critical in adjustment and is therefore recommended only to the more advanced experimenter—who is able to calibrate the condenser dials by the use of an external buzzer-driven wavemeter. Better still is the use of a buzzer modulated C-W wavemeter, since its tuning is much sharper. The amateur should therefore be guided by the above considerations in determining which sort of set to construct—whether he wishes to receive broadcasting exclusively—or 200 meters. Most of the circuits shown are intended for radiophone reception.

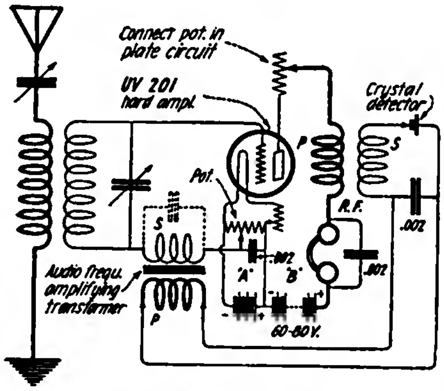


Figure 1—Simplest form of reflex circuit—single tube used for radio and audio frequency amplification with crystal detector for rectification

It is impossible to use more than two stages of audio frequency in a reflex amplifier, because the loud audio frequency signals tend to paralyze the tube as far as radio frequency amplification is concerned. In fact, a radio frequency amplifier will not amplify an already powerful signal—it merely amplifies signals which are too weak to operate the ordinary detector. While the reflex amplifier is not particularly wonderful on receiving local stuff, it will prove its worth on distant stations. If loud speaker operation is desired, an additional external stage of audio frequency amplification is required. Although another tube may be used as the detector, a crystal detector is perfectly practicable.

SIMPLE REFLEX CIRCUIT

Figure 1 illustrates a combination employing one amplifier tube and a crystal detector. The incoming radio frequency is applied to the grid and filament by means of the tuned circuit coupled to the antenna coil. It is amplified in the plate circuit and then applied to the crystal detector through an ordinary radio frequency amplifying transformer. The rectified signal, now audio frequency, is fed back again to the grid of the tube by means of an audio frequency amplifying transformer, amplified in the plate circuit, and received in the telephones. The tube thus functions both as radio and audio-frequency amplifier.

The reader may ask if the use of audio frequency coils in the radio frequency circuit does not in some way obstruct the passage of the radio frequency currents. A by-pass condenser of .002 microfarad capacity is connected across the primary of the radio-frequency transformer, and across the phones, and thus provides a low impedance path for the radio frequency. Usually, the distributed capacity of the secondary winding is sufficiently large in most audio frequency transformers, so that an additional condenser is unnecessary. In

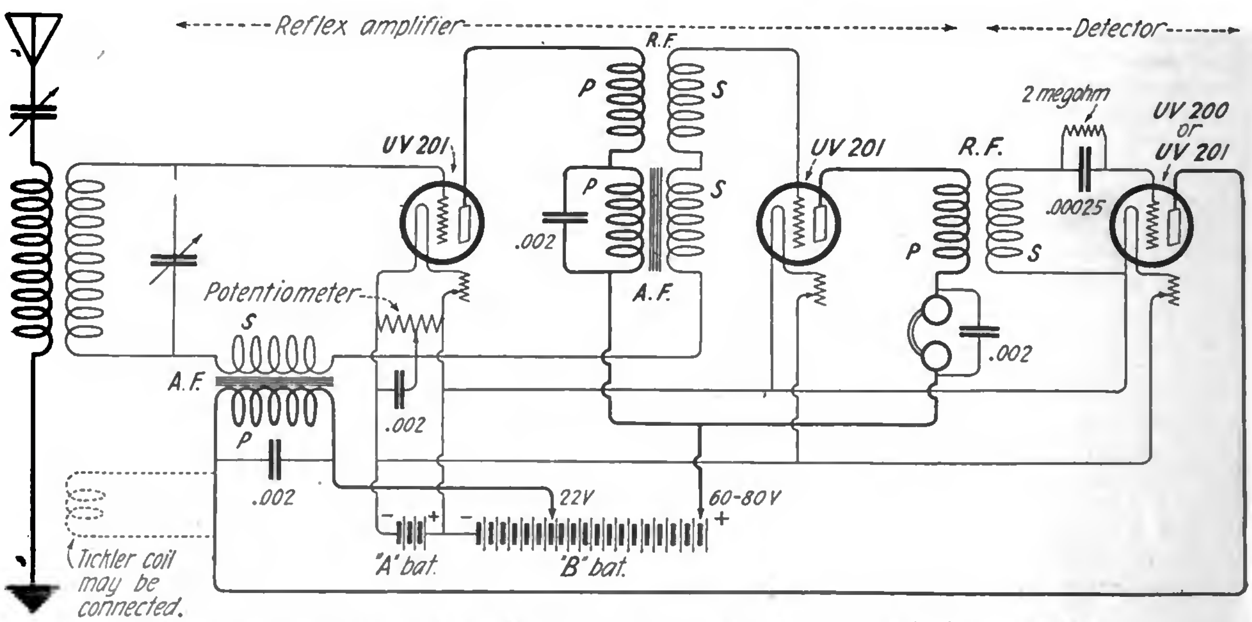


Figure 2—Two radio frequency stages, a tube detector and reflex back to two audio frequency stages

figure 1, this capacity is represented by the dotted lines across the secondary. Because of their comparatively low inductance, the radio frequency circuit elements do not obstruct the passage of the audio-frequency currents.

electrons from the filament, producing a fairly conductive path between grid and filament, and consequently a considerable amount of the audio frequency signal is absorbed by this shunt path. A better plan to stabilize the radio frequency amplifier

circuits well in mind, it is not difficult to develop the more elaborate hook-ups and to understand them. It is well to bear in mind that any tube can be used only for radio frequency and once for audio frequency amplification. Any attempt to use a

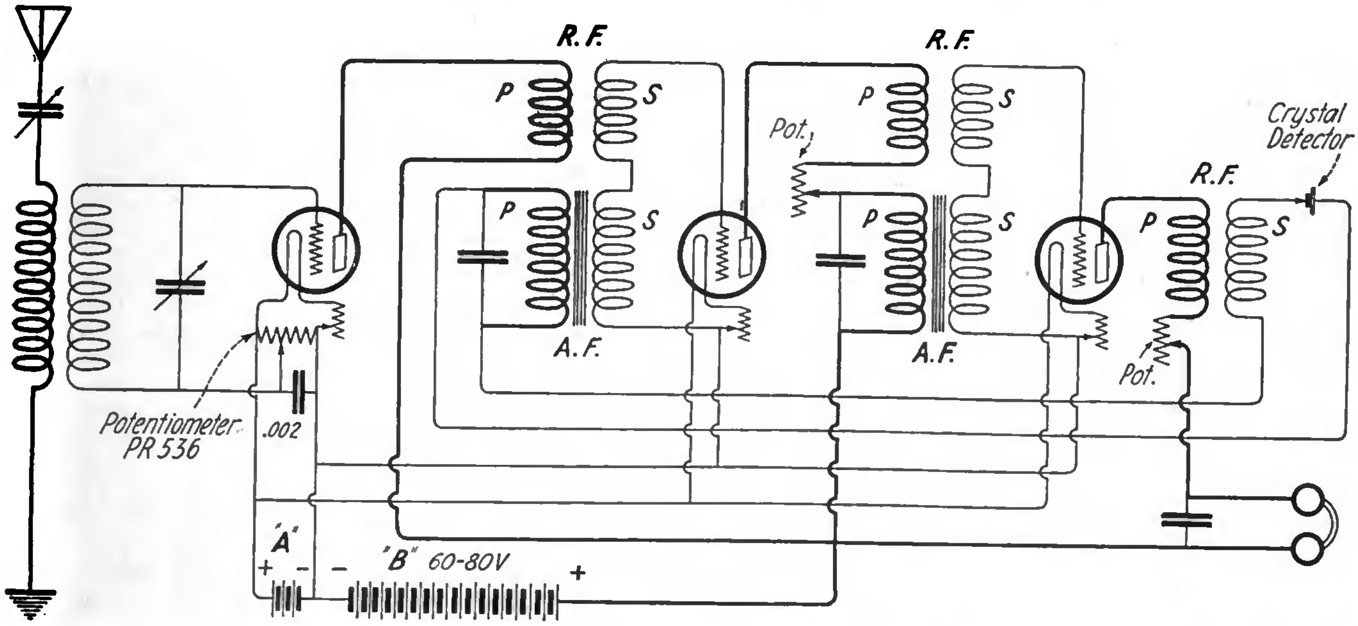


Figure 3—A three-tube reflex amplifier, containing three stages of r. f., crystal detector, and two stages a. f. amplification. Note use of resistances in plate circuit of last two tubes to prevent oscillation, instead of stabilizing potentiometer across the filaments as used in first tube

The adjustments in a set of this sort are the same as in an ordinary radio-frequency amplifier. The antenna and grid circuits are tuned in the customary manner to the desired station, and the stabilizing potentiometer adjusted for optimum signal. A good spot is then located on the crystal detector so that the intensity is loudest. Galena is probably best to use because it is the most sensitive, although it may not contain as many good spots as carborundum. The use of a potentiometer for completing the grid circuit is not very desirable, since it also affects the amount of audio frequency amplification. When the slider is in such a position as to make the grid positive, the grid draws and prevent oscillations would be to connect the potentiometer in series with the plate and primary of the radio frequency transformer. Oscillations are then stopped by this resistance. A 200-ohm potentiometer is quite sufficient for most radio frequency transformers, when used in the plate circuit, but one of 1,000 ohms resistance is desirable.

A vacuum tube may be used as a detector if so desired. In that case, the primary of the amplifying transformer is in the plate circuit of the detector, as in figure 2.

Multi-stage Reflex Circuit

With the elementary principles of reflex tube twice will cause either radio or audio-frequency oscillations.

Figure 2 shows a three-tube reflex amplifier. The first two tubes are reflex amplifiers, that is, contain two stages of radio and two stages of audio frequency amplification. The third is the detector. Regeneration back to the receiving circuit may be affected from the detector by inserting a tickler coil—as indicated by the dotted lines—in the plate circuit. Note that an A-battery potentiometer is used to stabilize the radio frequency amplifier.

All the apparatus is of standard make. The radio frequency transformers may be the Radio Corporation's model UV1714, and the

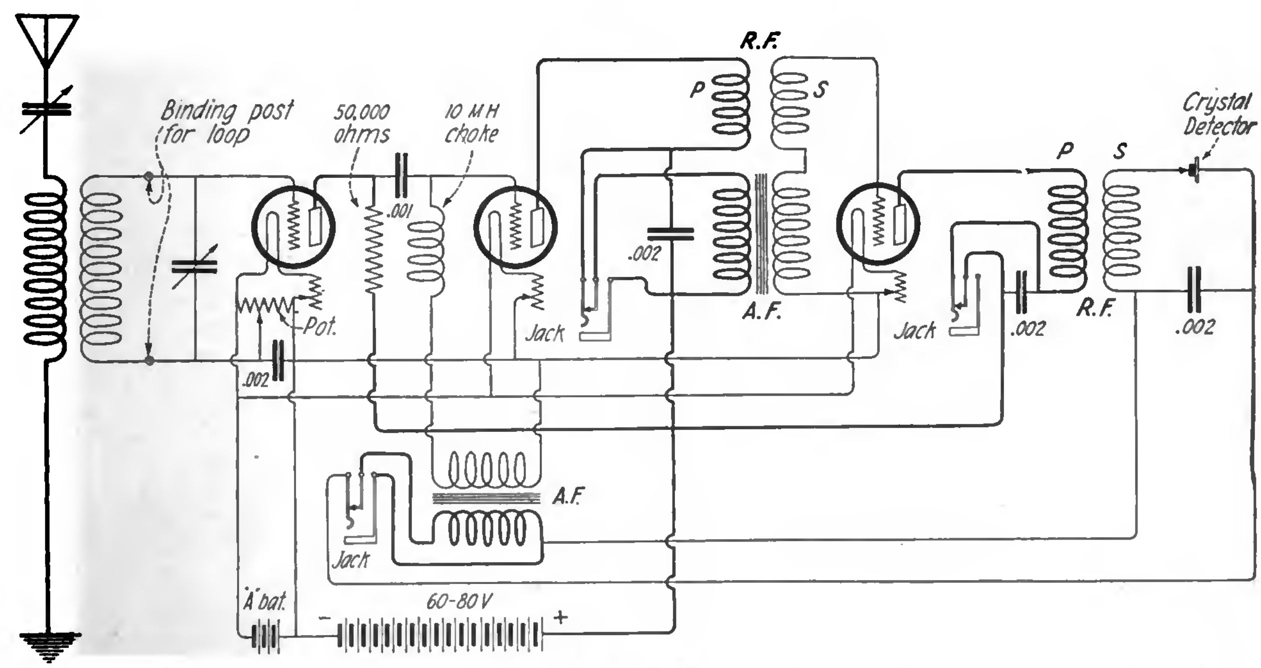


Figure 4—Circuit similar to that used in a commercial reflex amplifier. First r. f. stage is resistance coupled, then two transformer coupled r. f. stages with crystal detector and two stages of audio frequency. Jacks for phones or loud speaker on a. f. stages

audio frequency transformers model UV712. The latter is peculiarly suited for this purpose inasmuch as the secondary has a high distributed capacity which obviates the use of an additional blocking condenser across it. Hard amplifier tubes, such as UV201, or WD11—1½ volt filament—must be used in the reflex stages. An ordinary detector is satisfactory for the third tube, but a UV201 or a WD11 are also suitable.

Figure 3 illustrates a slightly different arrangement. Here, three tubes and a crystal detector are used. With this hook up, we get three stages of radio-frequency amplification, and two of audio-frequency amplification—the first radiotron is a radio frequency amplifier and the next two are reflex; the telephones are connected in the plate circuit of the third tube. The last A crystal detects, rectifies the radio frequency, and converts it to audio frequency—which is then fed back to the grid of the second tube by means of an audio frequency transformer. Similarly, another transformer is used to couple the audible signal to the third tube. The telephones or loud speaker may be connected to any desired stage by means of jacks.

An unusual feature in this circuit is the radio frequency choke coil which acts as a sort of grid leak for the resistance-coupled radio-frequency stage. If its inductance is of the order of 10 millihenries, the reactance would be of the order of 100,000 ohms at radio frequencies being received (about 1,000,000 cycles). At audio frequencies its reactance is quite low and hence does not impede the flow of audio denser between grid and plate of tubes is of 2 microfarads capacity. It should have this value since it must serve at audio frequencies as well as at radio frequencies. A choke coil of about 5 millihenries inductance should be provided in the lead running from the crystal detector to the first choke coil, in order to prevent any feed back of the radio-frequency signal. A 250-turn duolateral coil is satisfactory for this purpose, or else a coil of about 400 turns of No. 24 DSC wire on a spool 1 inch in diameter and 2 inches long.

The operation of this set is quite critical—every condenser should be retuned on changing wave length. Therefore it can be recommended only to more advanced amateurs who have the necessary patience and skill. In order to use this circuit for

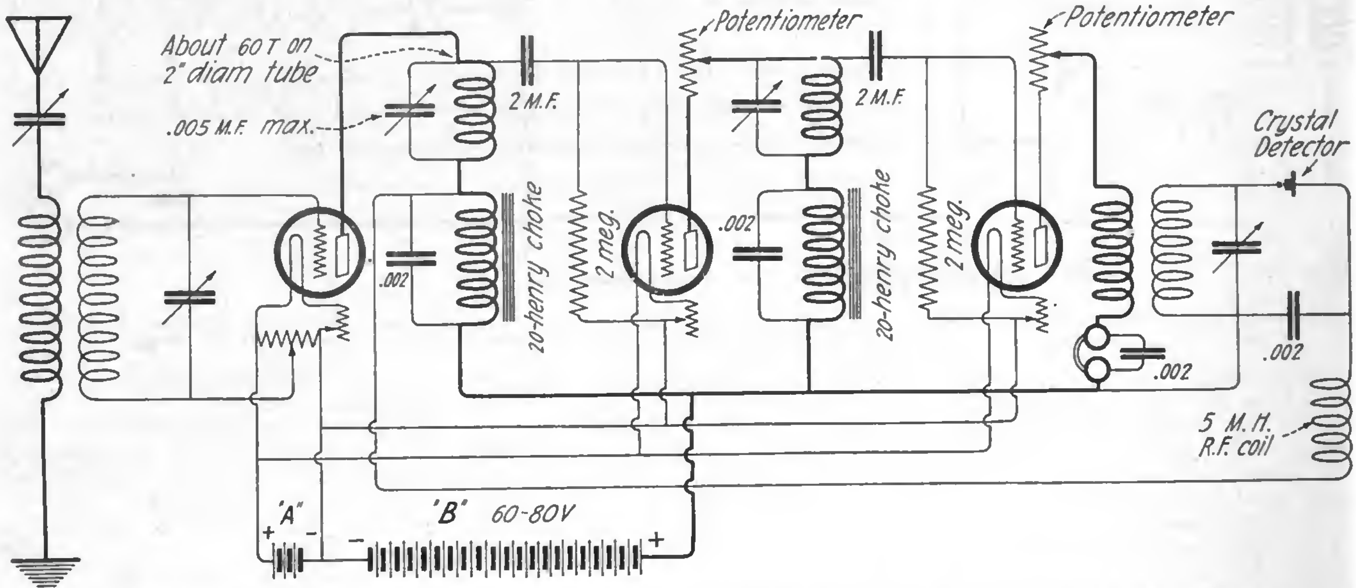


Figure 5—Reflex circuit using tuned plate circuit radio frequency amplifier and choke coils for audio frequency amplification—three stages r. f. and two stages a. f.—"Coto-coil" r. f. choke coils are suitable for use in place of the tuned circuit

radio frequency amplifier feeds the crystal detector and the rectified signal is relayed back to the grid of the second bulb through an audio frequency amplifying transformer. The first radio stage is stabilized by means of an A-battery potentiometer, and is quite satisfactory since there is no audio frequency present. The last two stages employ resistances in the plate circuits for this purpose. The only difference in operation between this circuit and that described before lies in the additional adjustment of the crystal detector and in the plate resistances. The increased intensity of received signal and the greater distance obtained, however, more than make up for these added adjustments. This circuit readily demonstrates the advantage in using a crystal detector, since now we have three stages of radio frequency amplification instead of two. Jacks may be connected across the audio frequency transformers so that the telephones may be used in any stage desired.

Wiring of a Commercial Type of Reflex Amplifier

The circuit shown in figure 4 is essentially that of a reflex amplifier now on the market, with some additional modifications added by the writer. The first tube is a resistance coupled radio frequency amplifier; the last two provide two additional transformer coupled radio frequency stages. frequency currents. An ordinary grid leak cannot be used here since it would seriously reduce the amount of audio frequency amplification. A stabilizer is used only on the first tube. If loop reception is desired, the receiving circuit is disconnected and a loop substituted across the terminals indicated in figure 4. Of course, all the tubes are hard amplifiers.

Reflex Circuit Using Choke Coil and Tuned Plate Amplifier

In all of the above described hook ups, ordinary radio frequency amplifying transformers are used. However, the more enterprising amateur may employ the tuned circuit type, wherein either the grid or the plate circuit is tuned by means of condensers connected across the coils.

Figure 5 illustrates a rather novel form of reflex amplifier, somewhat analagous to a choke-coil coupled amplifier. The general features are the same as in the hook ups described—the main difference being in the fact that there is no transformer coupling between amplifier stages. This circuit is suitable for radio frequency choke coils such as are manufactured by the Coto-Coil Company. In that case, no condensers are required for tuning. If ordinary coils and condensers are used, the coil should consist of about 60 turns of No. 24 DSC wire on a 2-inch tube. Note that the coupling con- C. W. reception, an external heterodyne oscillator should be provided.

Conclusion

The reflex amplifier is one of tremendous possibilities and it is surely worth while for the amateur to acquaint himself with it. The circuits are essentially the same as those in everyday use. There is nothing startlingly new or original. All the apparatus employed is of standard types readily obtainable on the market. The very fact that it saves the use of additional tubes is enough to make the amateur welcome it with open arms.

The Best Receiving Antenna

THE fundamental laws governing the best form of receiving antenna were worked out long ago, particularly (in popular form) by Dr. Austin of the United States Navy, and they are simple indeed. Here they are, expressed in non-technical language:

1. The higher the receiving antenna, the stronger the signal.
2. The "height" of an antenna is the distance above ground of its "middle point."
3. For any particular wave length, there is a best over-all length for the antenna.

(Continued on page 77)

Amateur Radio Activities in Australia

By J. S. Kemp

SINCE the first article of this series was originally written, amateur radio work in Australia has progressed considerably, and although the restrictions have not been lifted at the time of writing, there are signs from time to time which show that the efforts of the various organizations are beginning to have effect. During the month of July a conference was held by the representatives of each of the interested parties, to discuss the regulations now in force. It was suggested that in the future transmitting licenses be granted to bona-fide experimenters who had attained the age of 18 years, and who had passed a suitable examination, also that the annual license fee be reduced to $5. Although at the time nothing definite was arrived at it goes to show that the amateur is at last being recognized, and that his claims are being considered with less prejudice than before. Just recently a conference was held among the amateurs to discuss the best methods of putting their claims before the authorities. It was suggested that a central body be formed, consisting of delegates from each organization, and that this body be named the New South Wales Association of Radio Societies. The idea being that one powerful body would have a greater chance of obtaining a hearing, than if each organization sent a separate deputation, therefore it is most likely that these conferences will yield some results that will favor the amateurs generally.

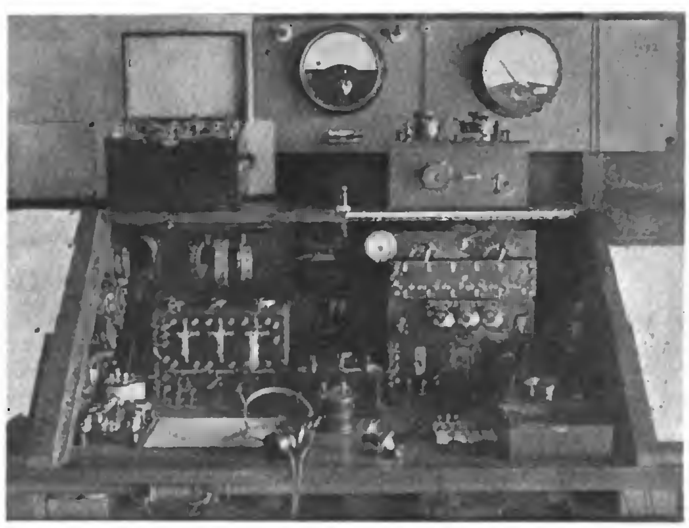
Organizations are springing up rapidly everywhere; to mention a few. The Military Radio Association of Sydney, and the Metropolitan Radio Club of Sydney. These two clubs are making rapid progress. Lectures, exhibitions, and various other activities are on the ambitious programs of these two organizations for this year. The latest and most up-to-date apparatus is to be installed as soon as sufficient funds are available. The Military Radio Association is a combination of military and civilian interests. It has the opportunity of developing into the foremost club in Australia, being unhampered to a certain extent by the usual hindrances of the general amateur organization. Recently this club reported for the first time in Australia, the Aerial Derby held in Sydney annually by the Australian Aero Club. A ½ kw. Marconi pack set was taken out to the flying ground, and an aerial rigged, and as the results were obtained they were transmitted immediately to the "Sydney Evening News" office and published. This stunt was very successful, and is a "feather in the cap" of this young organization. A dance was also held during the last month to raise funds for apparatus, and it was intended to transmit the music from C. D. Maclurcan's station seven miles distant, to be received, amplified and thrown into the hall with sufficient strength to dance to, but unfortunately that pest of radio work, atmospherics interfered to such an extent that the attempt had to be abandoned after all the previous tests had proved successful. The receiving instruments were kindly loaned for the occasion by the representative of the Magnavox Company of America, who also supplied an expert to handle them. Not to be outdone the Metropolitan Radio Club is organizing a radio exhibition to be held in the near future for the first time in the history of Australian amateur work, and it promises to be very successful.

Now a word about the oldest established Wireless Institute of Australia. This Institute was established in 1910, and enjoys the distinction of being the first body of its kind to be formed in the British Empire. It has branches in all the capital cities of Australia, and has a total membership of about 300 which is being rapidly added to each year. It is the official mouthpiece of the amateurs at present, and its views and decisions, are respected by all. Each of its branches has a transmitting station, from which news of interest to local amateurs is broadcasted regularly. Radiophone work has improved very much. The Government station at Melbourne radiates speech occasionally. C. D. Maclurcan of Sydney, and the Amalgamated Wireless, Ltd., of both Sydney and Melbourne, providing regular phone concerts much to the benefit of the amateur who now has more than spark signals to interest him.

C. D. Maclurcan is one of the foremost of the Australian amateurs doing much valuable work. He possesses something so rare at present in Australia, namely a transmitting license, and his station has created what is believed to be a world's record, the C. W. signals being heard 1,400, and telephone 1,100 miles, respectively, using only 8.1 watts power. Efficient and effective transmission with the minimum of power necessary over large distances is the aim of Mr. Maclurcan, and his experiments in this direction have been very successful. The transmitting set has been considerably improved since the last article was written by me. The ten Marconi V24's have been replaced by three "Radiotrons" five-watt power tubes, UV-202 and the circuit has been altered from the Heising or Shunt System—wherein five valves were used as oscillators, and five as modulators—to that of the grid control method, which uses all tubes in parallel as oscillators. The tubes are operated with the filament voltage reduced from 7.5 to 6, so that the total output of the three is really only equal to that of two tubes fully loaded to prolong the life of the tubes, which are unprocurable in Australia, in the event of a burnout. The filaments are heated by alternating current transformed from 240-volt A.C. mains, and the plate voltage is supplied by a 300 volt D.C. generator, belt driven by a ¼ h.p. induction motor. The input plate current is 30 milli-amperes, so that the power supplied to the plates is exactly nine watts. The aerial is of the sausage type, and consists of four No. 18 gauge copper wires equally spaced around 2½-foot wooden hoops, spaced fifteen feet apart. Each span is 100 feet, making a total effective top of 200 feet.

The end of each span is elevated by a 25-foot mast. The lead-in is taken from the center and consists of four No. 18 gauge wires on 12-inch hoops. The natural wavelength of the aerial is 325 meters, and the

Antenna system of experimental station of C. D. Maclurcan



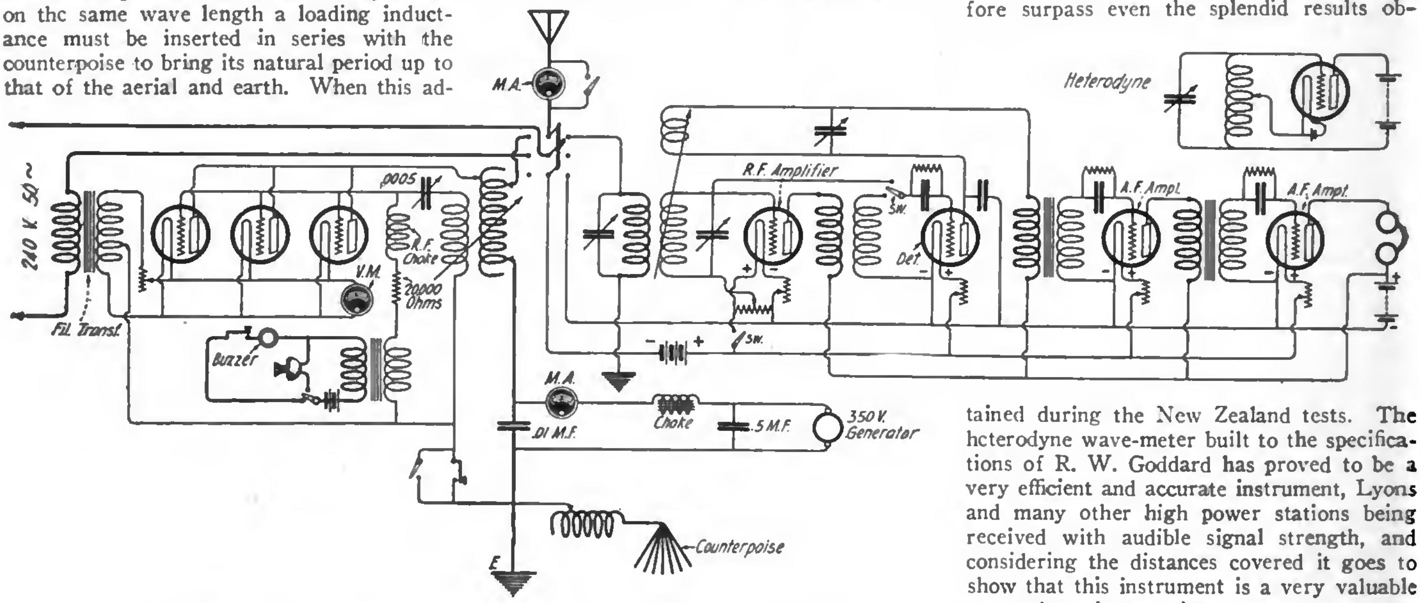
Receiving and transmitting sets used by Mr. Maclurcan

capacity to earth .001 mfd. The capacity to the counterpoise is .00066 mfd. A tuned counterpoise is used in conjunction with the water pipe earth. It will be noted that the capacity of the aerial to the counterpoise is .00066 mfd., while to earth it is .001 mfd. Therefore, it is apparent, that if both earth and counterpoise are to work in conjunction on the same wave length a loading inductance must be inserted in series with the counterpoise to bring its natural period up to that of the aerial and earth. When this adjustment is correctly made the radiation increases considerably due to the lowering of the ohmic resistance thus caused.

In this instance the radiation was increased from 600 milli-amperes to 900 milli-amperes. The counterpoise consists of four wires 220 feet long, and 4 feet apart, supported on three 12-feet spreaders—one on each of the three masts—and spread directly under the aerial about ten feet above the ground. The lead-in is taken from the center, all wires including the lead-in being well insulated. The respective heights of the three masts are, main mast 80 feet, and the two supporting masts 25 feet each.

The receiving set has been very much improved by the addition of a stage of radio-frequency amplification. The latter instrument using a V-24 valve, as transformer coupled to the detector valve, and with 100 volts on the plate gives a remarkable increase in signal strength. As an instance of the efficiency of this instrument, one evening certain signals could be copied twenty feet away from the phones, using a detector and two stages of audio-frequency amplification. When the radio-frequency amplifier was switched in, the increased signal strength enabled them to be read at a distance of 70 feet. Personally speaking I think a stage of radio-frequency is much more efficient as regards signal strength, than two stages of audio frequency and I would strongly advise the adoption of the same in all valve sets. A popular concert is broadcasted from this station every Sunday night from 7.30 P. M. to 9.30 P. M.

It is needless to say that these concerts are very much appreciated, and enjoyed by all who listen to them. During the recent tests with New Zealand, a distance of 1,400 miles, the telephony was received clearly, and the C. W. very loud on four consecutive nights. The power used varied between a minimum of 8.1 watts, and a maximum of 8.7 watts, the maximum antenna current being 1.1 amperes, and the minimum .46 ampere. The plate voltage varied between 270 volts and 280 volts. The filament voltage was kept constant at 6 volts. The receiving stations in these instances used only one tube—one aerial being only 15 feet high and 80 feet long—truly a remarkable performance for such low power. I have personally seen the letters of official verification, and therefore can state that these statements are not fairy tales. Such results speak volumes for the effective management of this station. It has been found by experiment that the grid control method is the most suitable for low power transmission. It has just come to my knowledge that C.W. signals from this station have been received 2,100 miles from Sydney using the same power, and I have personally seen the radio-telegram acknowledging the receipt of the messages. The ship station was using one expanse B valve and was 100 miles north of Darien Radio in the tropics at the time, a distance of about 2,000 miles, and although the signals were received at strength 6, they were rendered unreadable by fierce atmospherics. Signals from this station have just recently been received with readable strength during the day in Melbourne, a distance of about 600 miles, using a maximum power of 8.5 and minimum of 3.2 watts. The results of these tests therefore surpass even the splendid results obtained during the New Zealand tests. The heterodyne wave-meter built to the specifications of R. W. Goddard has proved to be a very efficient and accurate instrument, Lyons and many other high power stations being received with audible signal strength, and considering the distances covered it goes to show that this instrument is a very valuable one to have in a station.



Circuit diagram of the transmitting and receiving circuits used by Mr. Maclurcan

The prospects of the amateur have improved very much this year, and it is only hoped that they will continue to do so in the future. Our numbers are rapidly increasing, and as soon as the ridiculous restrictions now in force are removed, amateur radio work will go ahead with leaps and bounds. Even the local newspapers have been bitten by the "radio-bug." The "Evening News," of Sydney, now publishes a column or two every Saturday which contains valuable information for the amateur, and also gives the general public an inkling of the activities of the radio amateur. During the month of August the first Australian all-wireless weekly made its initial appearance containing much valuable news and information to amateurs, and all those interested in radio. Let them all come because we Australian amateurs need all the advertising it is possible to get. It may be of interest to the amateurs of America, and other countries to know that negotiations are proceeding for the erection of a high power station in Australia, capable of communicating with the rest of the world. The cost of erection, etc., will be in the neighborhood of $4,000,000. The Amalgamated Wireless Ltd. of Australia, holding 499,999 shares, and the Commonwealth Government of Australia 500,001 shares, making in all a total of 1,000,000 shares of which the Commonwealth holds a majority.

No Amateurs in Sweden

OWING to Government regulations in Sweden, nothing has been done so far to stimulate popular interest in amateur radio telephony, according to William L. Peck of the American consulate, Stockholm. The use of radio apparatus is controlled by the Royal Telegraph Board; private firms may use it under license, but they have not availed themselves of this right.

The single Swedish firm manufacturing radio apparatus and parts has supplied considerable quantities to the Swedish Government. The factory is comparatively small, but arrangements have been made for its expansion should circumstances warrant.

Swedish electrical dealers have for some time been trying to obtain modification of the regulation which forbids the use of radio apparatus by amateurs, but so far without results. Should its use by individuals be permitted there would be a good market for wireless goods in Sweden, owing to their interest in all things electrical, and the short distances between cities in Sweden and cities in neighboring countries.

40 Amateurs Heard in England

Stations in Six Districts Copied During the 1,200 Mile Preliminary Tests—Extensive Preparations Made by Amateurs of America, England and France for Two-way Work

DURING the 1,200 mile qualifying trials for the trans-Atlantic tests of amateur transmitting stations, conducted by the American Radio Relay League, more American amateur stations were heard in England than were heard during the entire tests of 1921.

The qualifying tests were held during the latter part of October and the first part of November, and up to the time the forms for this issue of THE WIRELESS AGE were closed, forty American amateur stations had been heard by English amateurs either during the preliminary tests or on subsequent Saturday nights. The fact that numbers of American stations were heard by the English on Saturday nights—Sunday mornings—does not mean that the air for long distance transmission was any better on that particular night than on any other night of the week, but simply that the English sat up all night in order to listen for American signals. The difference in time of five hours enters seriously into consideration, seriously so far as the English are concerned, their time being five hours ahead. It has been found that signals from American amateur stations are strongest in England between the hours of 2 and 3 a. m., G. M. T., corresponding to 9 and 10 p. m., New York time. During the time that Paul F. Godley was at Ardrossan, Scotland, in December, 1921, he reported that signals were always best at this particular time of the night, and it was not possible to hear any American stations before midnight.

Although the best radio conditions had not yet arrived at the time of the preliminary tests, English amateurs succeeded in copying, as before stated, over forty American stations. Obvious errors in the call letters of some of them reduced the actual verified list to forty and these stations are as follows:

The finals of the trans-Atlantic tests for this year were scheduled to take place between December 12th and December 21st, during which time all the amateurs who qualified in the preliminary tests were given a separate period of transmission with a definite code word in order to preclude any error in reception, and definitely fix the identity of the transmitting station. Over 325 stations qualified with a 1,200-mile overland record, and as it was not possible to give each one of these stations a separate period, as was done last year when only a few qualified, they were divided into classes, each class transmitting for fifteen minutes each night during the tests.

In the case of the American amateur stations which did not qualify with a 1,200-mile record, a free-for-all period was arranged also for fifteen minutes on each night, December 12th to 21st. In transmitting these stations will merely use the word "test," which is to be transmitted three times, then the call letters of the station transmitted three times, this procedure to be followed for fifteen minutes each night in accordance with the general plan as worked out by the American Radio Relay League.

A complete list of American stations heard in England during the final tests will be published in the February issue of THE WIRELESS AGE.

As transmitting across the Atlantic is now more or less an accepted fact due to the successful transmission of several American stations on a definitely arranged schedule, the great interest in these tests centered, of course, around the attempt of English and French stations to transmit to America during the period between December 22nd and December 31st, inclusive. Up to the time of these tests, no signal from an amateur station in Europe had ever been heard in the United States, and consequently thousands of American amateurs sat up night after night between the hours of 7 p. m. and 1 a. m., listening for signals from amateur stations in England and France. As this issue of THE WIRELESS AGE was practically complete and off the press before the conclusion of these tests it was not possible to give the results of them in this issue, but they will be given fully in the February issue.

The interest among American and English amateurs has been great and on both sides of the ocean untold effort and a great deal of money has been put into making two-way amateur communication across the Atlantic Ocean a regular service, and it is to be hoped therefore, that the efforts of the amateurs have been successful and that by the time this issue of THE WIRELESS AGE is ready for distribution to its readers, that the amateurs of two continents will have successfully exchanged greetings and messages of good-will and that the bond of friendship existing between them has been greatly strengthened as a result.

Up to the time of these tests there did not exist an amateur station in England of sufficient power to transmit short wave signals to America, but due to the enterprise of the Manchester Wireless Society which is affiliated with the Wireless Society of London, a special permit was secured from the postmaster general of Great Britain, which authorized the erection and operation of a 1 kw. tube station. And it is this station probably upon which the American amateurs are basing their hopes of two-way communication between the amateurs of Europe and America. At the time this issue went to press applications were pending with the postmaster general for permits for one or two additional tube stations of power sufficient to transmit to America on short waves, under favorable conditions, but the outcome of these additional undertakings is not known at this

1CX	R. S. MacArthur, 2 Cambridge Ter., Cambridge, Mass.
1ZE	I. Vermilya, 24 Allen St., Marion, Mass.
1AFB	N. H. Colby, New London, N. H.
1CMK	P. H. Bloom, 682 East St., Holyoke, Mass.
1XU	T. S. L. Kletcha, Stockbridge, Mass.
1AZW	H. Toumanjanian, 16 Finley Place, Newport, R. I.
1BDI	F. E. Handy, 414 H. H. Hall, Univ. of Me., Orono, Me.
1CDO	W. Brackett, 838 Middle St., Bath, Me.
2ZK	Cannon George Curtis, 183 Drake Ave., New Rochelle, N. Y.
2HJ	H. J. Basbrouck, 71 Elmont Ave., Port Chester, N. Y.
2AJL	K. Goomrigian, 199 Morris Ave., Summit, N. J.
2AIM	T. D. Haubner, 306 Lookout Ave., Hackensack, N. J.
2QR	H. H. Robinson, 13 Walnut St., Keyport, N. J.
2AGC	P. R. Neusch, 551 Delafield Ave., West New Brighton, N. Y.
2AWF	Elmer Wirsing, 33 Quail St., Albany, N. Y.
2AWL	R. S. Johnson, White St., Red Bank, N. J.
2LM	A. Davidson, 347 West 122d St., New York City.
2AHO	Wm. H. Derrick, 58 North 6th St., Newark, N. J.
2CPD	R. A. Donnelly, Crescent Ave., Birelle, N. J.
2EL	H. H. Carman, 217 Bedell St., Freeport, L. I.
2ZL	J. O. Smith, 3 Corona Ave., Valley Stream, L. I.
2CO	P. Cooper, 512 Sewall Ave., Asbury Park, N. J.
2FP	R. G. Barber, 52 Herriman Ave., Jamaica, N. Y.
3GB	O. B. French, 1717 South 55th St., Philadelphia, Pa.
4FT	D. McR. Parsley, Masonboro Sd., Wilmington, N. C.
5AD	F. C. Moore, 434 Hillary St., New Orleans, La.
5LV	R. E. Hanrick, Franklin St., Waco, Texas.
8ATU	J. K. Marcus, 87 Kelly St., Rochester, N. Y.
8AX	L. E. Larson, 68 Oliver St., No. Tonawanda, N. Y.
8BFM	C. J. Sonneberger, 919 Beardsley St., Akron, Ohio.
8BPL	S. J. Hutchinson, Jr., 1914 Delaware Ave., Swissvale, Pa.
8AFT	C. E. Helms, 727 Jay St., St. Marys, Ohio.
8AQO	J. E. Page, Fernwood Farm, Cazenovia, N. Y.
8XAK	Wittenberg College, Carnegie Science Hall, Springfield, Ohio.
8AJ	E. B. Redington, 12 Thomas St., Waverly, N. Y.
8OT	W. J. Wiseman, 436 Cherry Ave., N. E., Canton, Ohio.
9CTE	E. T. P. Niespodziany, 2118 West Kenwood St., South Bend, Ind.
9ZY	B. A. Ott, 241 South 17th St., LaCrosse, Wis.
9LG	D. F. Wood, 311 West Exchange St., Jerseyville, Ill.
9XE	W. H. Kirwan, Davenport, Iowa.

writing. The English amateurs, backed by the Wireless Society of London and other societies throughout England, are, however, sparing no effort and no expense to make the undertaking successful and practically the entire scientific fraternity of Europe is watching the effort to effect two-way communication and is hoping for the best.

The tests aroused great interest in France, surprisingly great in view of the fact that it was only this year that the French Government allowed amateur use of transmitting apparatus. The success of the tests of the year before, between the United States and England, stimulated the French amateurs, and in October a committee, the Commité Francais des Eissais Transatlantiques, was formed to co-ordinate the efforts of the French. The committee consists of Dr. Corret, president, member of the Société Francaise d'Etude de T. S. F., of the Amis de T. S. F., and of the Radio-Club de France; M. Hémardinquer, secretary; and Messieurs Deloy, Givelet, Jacquot, Le Mée, Roussel, Waddington, Quinet and Vagne, each one of whom are members of one or more of the three French radio organizations named above.

Besides transmitting several suggestions to England, the United States and among themselves, the French pledged themselves to secure the co-operation of a commercial transatlantic station in transmitting results of the tests. Last year the results of the tests were made instantly known through the great transmitters of New Brunswick and Carnarvon.

The French committee, realizing that their amateurs have not had the time to familiarize themselves with reception in the neighborhood of 200 meters, prepared a brochure containing technical details of short-wave apparatus, which is offered at a price of one franc, and is obtainable from the three French radio societies.

Still another step taken by the committee was the explanation of the situation to the French Administration of Posts, Telegraphs and Telephones, so that amateurs whose transmitting licenses had been dated to go in effect on January 1, 1923, would be able to transmit prior to that date, for the purpose of the tests. The committee, which has headquarters at 19 Boulevard de la Republique, Versailles, made available to all interested the full details of the hours and conditions of the tests.

Portable Transmitter in Winnipeg

Experimenter Uses 15-Watt Radio Telephone Transmitter on Moving Automobile and on Canoe—Louise Lovely Makes Speech Over the Motor Set

WINNIPEG recently succeeded in making itself heard all over Canada, directly and indirectly, by means of a radio telephone transmitting set installed in an automobile by L. V. Salton. The set operated successfully while the machine was in motion, which was in itself sufficiently novel to attract attention, while to make the feat even more prominent Louise Lovely, the well known motion picture star, who happened to be in the city, was persuaded to make the first speech over the set.

Reports from listeners show that Miss Lovely was heard at distances of 75 miles and over, and the news of the feat spread rapidly in Canadian wireless circles.

The transmitter used consisted of a 15-watt set of special design. Power was furnished by a 450-volt generator driven by the fan belt of the automobile engine, with an auxiliary set of B batteries, and an 8-volt storage battery for lighting the filament. The output from the generator was filtered by means of choke coils and condensers.

The greatest difficulty that had to be overcome was the matter of an efficient ground, without which sufficient radiation could not be obtained. Considerable experimentation was necessary in order to solve this problem, and the form finally taken by the antenna part of the outfit consisted of a double loop aerial, with the frame of the car as ground. This was in effect a multiple tuned antenna and counterpoise, and the radiation secured when the three parts of the antenna system were properly balanced was entirely adequate.

In addition to the transmitting equipment, the car also carried a compact regenerative receiver with two steps of audio frequency amplification, attached to a single telephone receiver unit, which was used as a loud speaker. The results of this equipment also were satisfactory, broadcast programs being distinctly heard in the interior of the sedan while the car was moving through noisy traffic in the streets of Winnipeg.

Encouraged by the successful work of this equipment in the automobile, Mr. Salton determined to make tests with it on his canoe, and again it proved possible to send and receive over considerable distances. In the canoe installation, however, it was necessary to use 350-volt B batteries in place of the generator, as obviously no power was available to run the latter.

For receiving, a simple crystal detector was sufficient, as the water in which the canoe floated presented a perfect ground.

L. V. Salton operating his radio transmitting and receiving station installed aboard a canoe. (At right) Louise Lovely, movie star, operating the set in an auto

Improving the Quality of a Receiving Set

By Ray Dio

REGARDLESS of what is being said about the single circuit tuner and its broad tuning—by those who are supporting their famous "fifty-knob" three-circuit receivers it must be said of those wise manufacturers who are making the single circuit tuner and dispensing with several knobs and dials that they are meeting the public demand. Who would buy a phonograph if it was necessary to turn ten knobs and dials before a record could be played? Very few, if any.

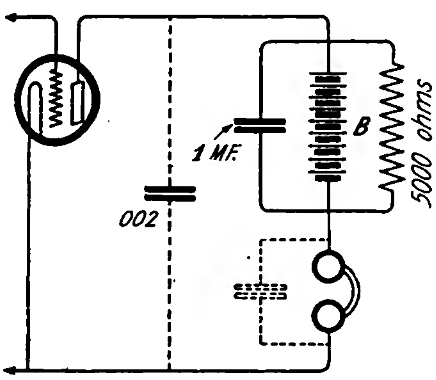


Figure1

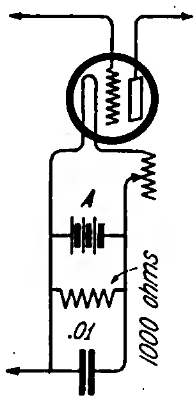


Figure2

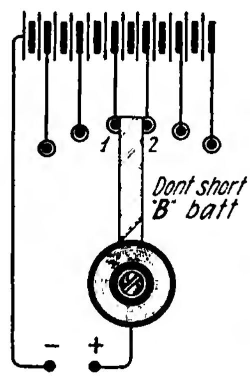


Figure3

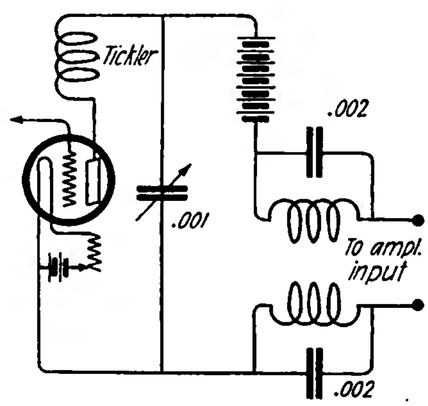


Figure4

"A" battery, "B" battery and radio frequency traps

A single-circuit tuner properly operated is as efficient as any other tuner that can be constructed and is much more simple in operation. No degree of efficiency is sacrificed in bringing about the simplicity of operation.

An amateur who wishes to sit up all night tuning in other amateurs hundreds of miles away, just for the glory of it, can probably do much better with sixty-five knobs on his tuner—but it is criminal to sell the novice or radiophone listener a receiver with a Coates safe combination. It is in most cases merely a temporary sale, as it will either land back on the shelf or the service required will eat up the profits.

"B" Battery Noises Eliminated

Much has been written regarding the noises originating in the "B" battery which races through the tubes in much the same fashion as static does. Many have blamed "static" for noises which could be heard with the same intensity with the antenna disconnected. Regardless of how well a "B" battery is constructed it will be noisy when it is fairly well run down and has been in use for a considerable length of time. This means that no matter what type of "B" battery you purchase if you use it "too" long you are bound to get "B" noises—unless a special type of circuit is employed.

"B" Battery Noise Trap

By referring to figure 1 you will note the plate circuit of an ordinary receiving circuit. Around the "B" battery shunt a one-microfarad condenser and a 5,000 ohm resistance unit, such as the RCA UP 1719.

The theory of operation is as follows: The battery noises must be caused by either a momentary decrease or increase in voltage. These fluctuations are to some extent similar to a quick succession of actual breaks (or opens) in the plate circuit. Now with the shunt circuit described these fluctuations are absorbed locally—in the immediate battery circuit comprising the condenser and the resistance unit. The .002 condenser of a good grade should always be shunted across the entire "B" battery circuit as shown by the dotted lines; i. e., from plate to filament.

"A" Battery Noises

Sounds funny, but it is the truth. I have traced these parasitic noises down very carefully in the last six months and have provided for every ailment of the telephone receiver. When the "A" battery is permitted to run down too low it gives off the same noises as the "B" battery does, with the exception that they seem to be more easily traced to the "A" battery, as they are not so erratic. These noises are probably generated in the same way that the "B" battery noises are and I have found that they can be suppressed to a considerable extent by applying the same absorbing circuit. This is shown in figure 2. A 1,000-ohm Ward-Leonard resistance unit is shunted across the storage "A" battery and a .01 mfd. condenser is also shunted to it. When a potentiometer is employed the 1,000-ohm resistance can be eliminated.

Phone Condenser

It is advisable to shunt a variable condenser across the telephone receivers having a capacity of .001. This is shown in figure 1 by the dotted lines around the telephone receivers proper. This provides a path for the radio-frequency currents.

Since current equals voltage divided by resistance; i. e., $I = \frac{E}{R}$, the current absorbed or wasted by the shunt resistance of 5,000 ohms around the 22-volt battery is practically negligible.

Figure5

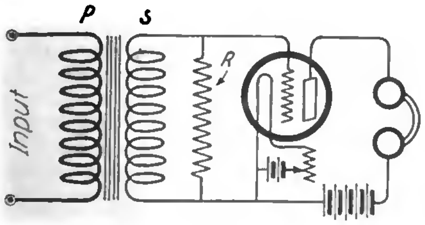


Figure6

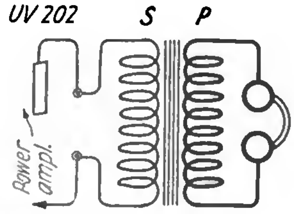


Figure7

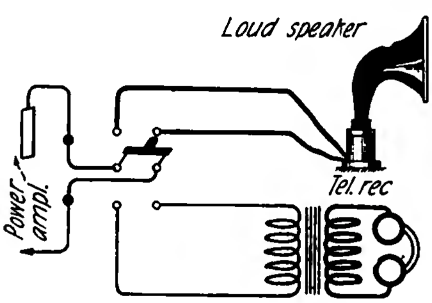


Figure8

Circuit arrangements to clear up distortion and improve signal audibility in radio reception

$$I = \frac{22}{5000} = .0044 \text{ amperes.}$$

In the case of the "A" battery—

$$I = \frac{6}{1000} = .006 \text{ amperes.}$$

In the case where the 300-ohm potentiometer is employed—

$$\frac{6}{300} = .02 \text{ amperes.}$$

The "A" battery, of course, could stand a much larger drain than this, however, it is not considered good practice to make the resistance value too small in the "B" battery circuit.

"B" BATTERIES

The average life of any good "B" (dry cell) battery is from six to twelve months, depending on the way the battery is handled by the user. Many experienced radio men short "B" batteries, as a flash test for voltage, and expect the battery to live its normal life. By short circuiting a "B" battery, where the capacity is low and the voltage high, a considerable portion of the total energy is wasted.

Again, in wiring up "B" batteries with switches and contact points so that any voltage can be cut in the circuit at will, many overlook the fact that this switching device shorts the "B" battery every time it is operated.

This is clearly shown in figure 3, where the switch points are shown mounted on the panel too close together and as the switch lever is moving from point number 1 to point number 2 a short occurs. This shorts the cells between those taps, and as they die prove a total resistance to the passage of current from the other cells in the battery unit.

RADIO FREQUENCY CHOKES TO INPUT OF AMPLIFIER

In order to prevent the radio frequency currents from entering the windings of the amplifier unit—regardless of the type—the radio frequency traps shown in figure 4 are suggested. On a cardboard tube four inches in diameter by four inches long wind one inch of number 28 single cotton covered wire one-half inch from the end. Then wind another inch of winding one inch from the first winding. This will be spaced one-half inch from the other edge. The windings should be connected so that they oppose each other and each one shunted by a .002 fixed condenser.

When this trap is inserted it is absolutely necessary to use a .001 variable condenser shunted across the plate and filament as shown in figure 4, to provide a good path for the radio-frequency currents. The trap provides a means of keeping the radio-frequency currents from having to pass through the primary of the audio-frequency transformer. Of course, they merely go through the capacity.

REDUCING STATIC AND OTHER ANNOYANCES

The General Electric Company has adopted a very effective method of reducing the static and extraneous noises common to many receiving circuits, either originating in the set itself or from some local generating source by shunting a 400,000-ohm resistance unit across the secondary of each amplifying transformer. While the audibility of the signals is slightly reduced, the lower frequency currents produced by static and other parasitic enemies of radio is reduced to a far greater extent than the signal. Connections are shown in figure 6.

TWO STAGES AUDIO FREQUENCY THE LIMIT

After the second stage of audio frequency amplification is constructed and added to the receiver the "bucket is full," so to speak, and a third stage will not result in greater amplification of signals as the amplifying tube will not stand the input—in other words—the amplifying tube cannot handle that amount of energy.

If it is desired to add another stage of audio frequency amplification, design a power amplifying circuit with the same hook-up throughout using a 5-watt transmitting tube in the third stage. The voltage should not be less than 120 on the plate at any time.

POWER AMPLIFIER FOR LOUD SPEAKERS

Telephone receivers of any design should never be connected in the plate circuit of a power amplifier. The telephones will undoubtedly be damaged. In most cases the telephone receivers become "open" in the windings and it is impossible to repair them.

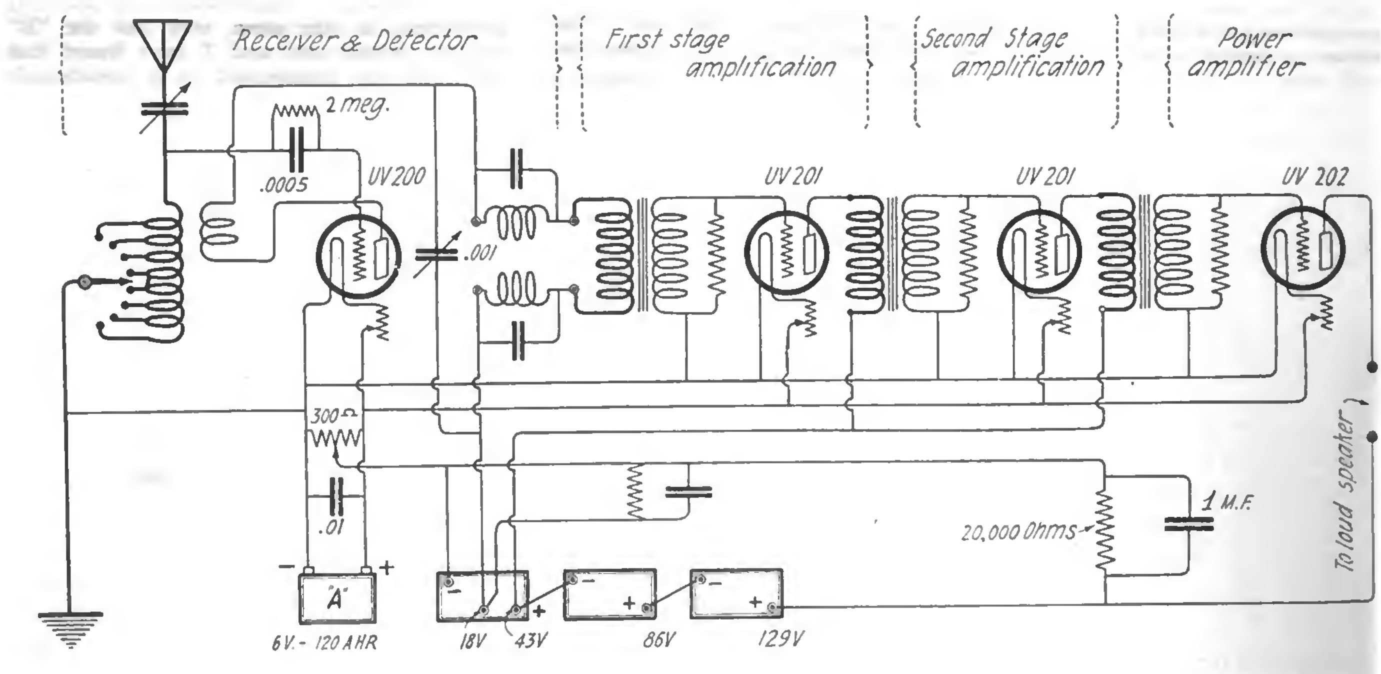


Figure 9

Circuit diagram, including various refinements, of a receiving set consisting of a detector and two-step a. f. amplifier with power amplifier added.

USING RECEIVERS WITH POWER AMPLIFIER

The author found that the telephone receivers could be used in the power amplifying circuit if the output of the amplifier was first connected to the secondary of an ordinary amplifying transformer and the primary to the telephone receivers. This acted as a step-down transformer and there was practically no loss of signal strength; however, reception is much clearer as the result of this practice and is strongly recommended when two stages of amplification are in use. See figure 7.

If connected as shown in figure 8 it is an easy matter to throw the set onto the telephone receivers or the loud speaker.

THE COMPLETE CIRCUIT

By first glancing at the complete circuit one will imagine that there will be a thousand and one dials and knobs on the receiver. However, every one of these additions is in the form of fixed units and it is not necessary to touch them after they are once installed in the receiving circuit.

Figure 9 gives the complete circuit where the ordinary signal circuit receiver is shown. A variable condenser (23-plate vernier) is in series with the primary of a variocoupler between the antenna and ground. The input of the receiver is taken directly from the primary of the variocoupler. The secondary or rotor of the vario-

(Continued on page 79)

Properties of Vacuum Tube Filaments and Means for Prolonging Tube Life

By Jesse Marsten

THE vacuum tube is the most perishable element in the radio set, whether it is receiver, transmitter, wave meter or what not. At the same time, unfortunately, it is one of the most expensive elements. It is therefore of particular interest to the amateur or experimenter to keep track of all safety measures advanced for the operation of tubes as it means dollars and cents to him.

The amateur who operates tubes desires to get the maximum possible output from them, whether in the form of signal audibility or radiation current. However, if he is a good amateur he will not take all he can for he soon finds that the extra output he gets is altogether out of proportion to the extra expense involved. He will therefore want to make the best compromise and endeavor to secure the maximum output consistent with reasonable cost.

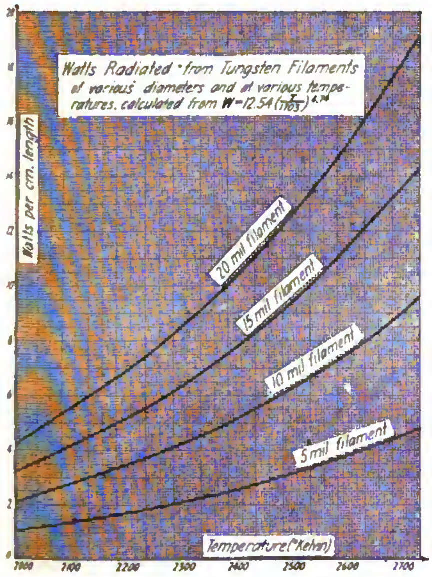


Figure 1—Graphs of radiated energy in watts from tungsten filaments of various diameters at various temperatures

The vulnerable point in most tubes is the filament and the cause of the failure of most tubes is excessive filament current. An understanding of the properties of tube filaments and a knowledge of some of the results obtained from an analysis of these properties leads to methods which will enable prolongation of the life of the tube. These properties will be discussed and illustrated by curves and methods of operation suggested.

The filaments of most vacuum tubes are constructed of tungsten wire. The manufacturers generally give the constants at which the tube is supposed to be worked. The filament constants are generally the terminal filament voltage and filament current. Thus the operating filaments of UV-202 tube, a 5-watt tube, are:

Filament terminal voltage: 7.5 volts.

Filament current: 2.35 amperes.

These actual working constants are chosen to give the maximum output at a filament temperature designed to give maximum life. This temperature is called the "safe" temperature.

The power expended in the filament goes toward heating it to incandescence, as a result of which there is an emission of negative electrons from the filament. The rate at which these electrons are emitted depends upon the temperature of the filament which in turn depends upon the power expended in heating the filament. The power expended in the filament, its temperature and the rate of electron emission are related to each other by definite laws graphically shown in figures 1 and 2.

Curve 1 shows the relationship between the amount of energy consumed by the filament and its temperature. This relationship is given by the Dushman Equation

$$W=12.54\left[\frac{T}{1703}\right]^{4.74}$$

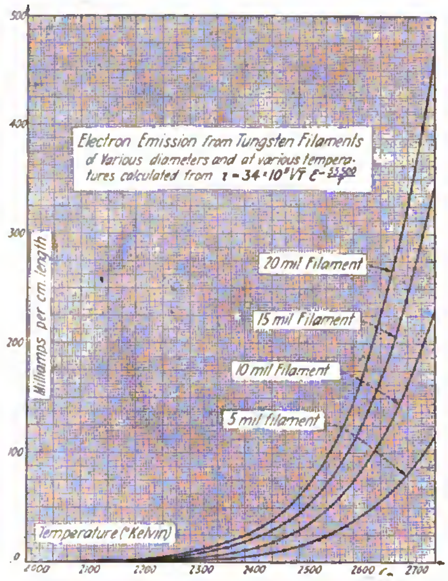


Figure 2—Graphs of electronic emission from tungsten filaments of various diameters at various temperatures

where W is the filament power in watts per centimeter length of filament and T is the absolute temperature of the filament in Kelvin degrees. Since a thick wire has more radiating surface than a thin one, it will obviously take more energy to raise a thick tungsten wire to a given temperature than a thin wire. Consequently the relationship between the variables here discussed will be represented by a series or family of curves showing this relationship for different sizes of wire.

Coming back again to figure 1 it is important to remember that as the thickness of the filament decreases the temperature of the filament rises for a given expenditure of energy.

In figure 2 the electron emission from the filament per centimeter length of the filament is shown for various temperatures. The relationship is given by Richardson's equation

$$i=34\times10^{9}\sqrt{T}\,\epsilon^{-\frac{55500}{T}}$$

where i is the electron emission in milliamperes per cm. length of filament, and T is the absolute temperature of the filament in Kelvin degrees. It will be observed that for a given temperature the emission increases with increase in the thickness of filament.

The operating temperatures to which filaments are heated range from 2,400 to 2,600 degrees. The heat generated at these temperatures is so great that the solid material of the filament vaporizes, and the dark deposit seen on the glass wall of lamps and tubes represents the tungsten which has been deposited as a result of vaporization. The rate at which vaporization of the filament takes place increases very rapidly with increase in temperature. Below about 2,450 degrees the slope of the curve is very small showing slight increases in evaporation with increase in temperature. However above 2,450 degrees the slope rises very rapidly showing large increase in vaporization with small increase in temperature. Now as a result of this vaporization material is taken away from the filament and hence the diameter of the filament wire decreases with time. Let us see how this vaporization and decrease in filament diameter affects the life of the filament.

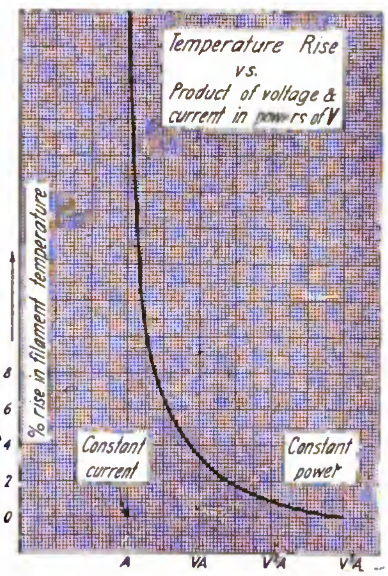


Figure 3—Graph showing temperature rise of filament resulting from constant current instead of constant voltage

The operating tube constants given above are such as to give an operating temperature called "safe" temperature. This "safe" temperature is such that if the filament is kept at that constant temperature its diameter will have been reduced by 10 per cent. at the end of 2,000 hours. When the filament diameter is reduced by that amount its life is said to be over. In other words the safe temperature of a filament is such as to limit the evaporation of the filament so that at the end of 2,000 hours its diameter has decreased by 10 per cent. This safe temperature depends on the size of the filament. Curve 4 shows the safe temperatures for different filament sizes.

Consider now the case of a 10-mil filament whose "safe" temperature is given by figure 4 as 2,481. From figure 1 we see that this temperature is secured when energy at the rate of 6 watts per cm. length is consumed in the filament. The rate of evaporation at this temperature is 3.3 grams per sq. cm. sec. At this temperature of 2,481 and the corresponding rate of evaporation the filament will have a life of 2,000 hours. To secure this temperature a definite amount of energy must be consumed in each centimer length of the filament. Assuming that the diameter of the filament remains constant at 10 mils—it actually gets smaller, of course, on account of vaporization—this energy is secured by a definite filament current which is proportional to the square root of the energy, since

$W = i^2 \times R$, and R remains constant.

Therefore $i < \sqrt{W}$

Suppose now that the expenditure of filament energy is increased by a small amount, say from 6 to 6.25 watts per cm. This means that the filament current required for this increase in energy is also increased, and since current is proportional to the square root of the energy, the increase in filament current will be given by

$$\frac{i_1}{i_2} = \sqrt{\frac{6.25}{6.00}} = 1.02 \text{ or } 2\ \% \text{ increase.}$$

In other words if the filament current is increased by the small amount of 2 per cent. the energy consumed in the filament will increase to 6.25 watts per cm. which will raise the filament temperature from 2,481 to 2,510 degrees. At this new temperature, which is only about 1 per cent higher than the safe temperature, the evaporation is found to be 5.6 grams per sq. cm. per sec. which is 70 per cent. greater than that at the safe temperature, which means a life reduction of the filament of 70 per cent. In other words, a small increase of 2 per cent. in filament current which would hardly be perceptible on an ammeter will result in a 70 per cent. reduction in the life of the tube!

The above figures definitely show that in the operation of tubes filament currents should most certainly not be increased above rated values. The above calculations were based on the assumption that the diameter of the filament wire remained constant. As a matter of fact it decreases due to regular evaporation. If the above conclusions hold for a constant filament thickness they must surely hold for a filament which decreases in thickness with age.

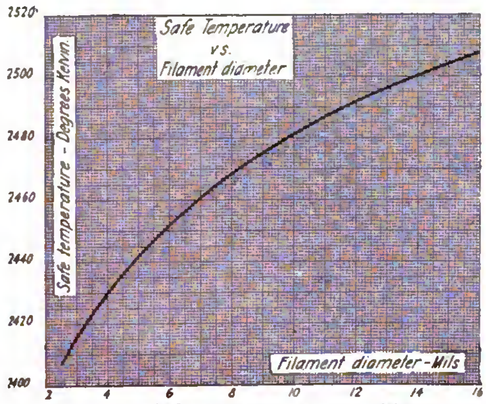


Figure 4—Safe temperatures for different filament sizes

Since the filament diameter decreases with age and since it is obviously out of the question to operate the filament with rising current, the question arises what is the best way to operate the filament? There are three possible ways:

1. To operate filament at constant current throughout its life.
2. To operate filament at constant power throughout its life.
3. To operate filament at constant voltage throughout its life.

Analysis of the above methods of operation leads to certain definite conclusions which are summarized in the curve of figure 3. This is a qualitative curve which shows the rise in temperature of the filament for various methods of operation. The ordinates show percentage rise in temperature, the abscissae show methods of operating filament, that is, what variables are held constant. Thus when the current is held constant (A constant) the temperature rises rapidly. When the power is held constant (VA constant) the temperature rises approximately 3 per cent. When the product of current and the cube of the voltage is held constant (V^3A constant) the temperature remains constant, there is no rise in temperature. When the voltage is held constant there is no rise in temperature, but there is a drop in temperature of about 2 per cent.

From this we see that to operate at either constant current or constant power means a rise in filament temperature and hence a considerable reduction in tube life. If we operate so that V^3A is constant we maintain constant temperature and therefore will realize the theoretical life of the tube, namely, 2,000 hours. However, since there are no meters which read this product, this method of operation is not practicable. If, however, the filament is operated so that constant voltage across its terminals is maintained, there will be a drop in temperature and hence the maximum possible life will be secured consistent with reasonable output and efficiency. It is therefore best to operate the tube at constant voltage, and to use a filament voltmeter rather than an ammeter.

The curve in figure 3 points out very conspicuously what a tremendous temperature rise is secured when the filament current is kept constant. Most amateurs operate their filaments this way, and the result is frequent renewals of tubes. Every method for preventing current increases should also be utilized. One of the commonest methods of current increase is secured by the addition of the plate current to filament. It is well known that if the negative of the plate voltage source is connected to the negative of the filament battery there will be an unequal distribution of current in the filament legs, the negative leg carrying larger current, and hence is more liable to burning out. In order to avoid this the negative of the plate battery should be connected to the positive of the filament battery. When using power tubes this unequal distribution of filament current can be avoided by the use of A. C. for the filament, when the negative of the plate battery is connected to the center tap of the filament transformer, hence both legs of the filament will carry the same current.

Shall We Continue the Prize Contests?

FOR the last three years The Wireless Age has been conducting a monthly prize contest, awarding prizes for the best article submitted on various subjects and phases of radio as specified in the prize contest announcement conditions each month. As practically every phase of radio has been covered in these announcements, it has become increasingly difficult of late to find subjects for these contests with which the readers of The Wireless Age are familiar enough to write articles.

Because of the falling off in the number of prize contest manuscripts received, we have reluctantly come to the conclusion that it is advisable to discontinue the monthly prize contests. This feature will be omitted, therefore, after the March issue, the subject for the prize contest for that issue having been announced in the December issue.

If readers are interested in having these prize contests continued, and will submit ideas or suggestions for them, we shall embrace every opportunity to conduct such contests whenever it seems probable that a suggestion is one which will meet with response on the part of our readers.

Any reader who is interested in future reinstatement of the prize contests on any subject is invited to send along suggestions; these will be acknowledged and appreciated, and will be adopted as a subject of prize contests in the future whenever in our opinion, such suggestions will interest our readers to an extent to warrant it.

—The Editor

EXPERIMENTERS' WORLD

Views of readers on subjects and specific problems they would like to have discussed in this department will be appreciated by the Editor

Wasteful Antenna Resistance and Its Reduction

By L. R. Felder

(First Prize $25.00)

MOST amateurs who have installed or are contemplating installing a transmitting outfit, spend practically all of their time designing and constructing the set itself, and developing the set to the highest point of efficiency and perfection. But when it comes to the antenna system they swing their wires in the easiest place, attach their ground lead to that good old stand-by, the external water pipe, and then expect that the post office will work overtime delivering letters to them from stations all over the country telling them how QSA their signals come in. It is about time they got wise to the fact that no matter how efficient their generating station may be, they cannot get any decent results by pumping juice into a radiating system that is full of leaks. Just as you've got to know how to design your power transformer to get all you can out of it, so you've also got to know how to design your antenna and ground system. And unless you understand just what determines the resistance and radiating powers of your antenna you will not be able to design the antenna system properly.

Now let us see just how we are able to reduce the resistance of the antenna and so increase the range of the transmitter. The resistance of an antenna is composed essentially of the following:

1. Ohmic resistance, namely of the antenna wires, ground and ground lead, lead-in wires, connection joints, etc.
2. Resistance due to imperfect dielectrics in the electric field surrounding the antenna.
3. Radiation resistance of the antenna.

The above three components add up to make the total antenna resistance. Of these three the first two components are wasteful, that is electrical energy is wasted in the form of heat due to them. The last component is the useful component, the greater this is the greater will the radiated energy be. Now most amateurs sweat blood trying to push the needle of their radiation ammeter off the scale. They cannot seem to get it into their craniums that it is not so much more current that they want as it is more radiated energy. Ten amperes in one antenna may not carry as far as five of these same amperes in another antenna. What good are the amateur's ten amperes if nine of them are wasted in the resistance of the first two components above mentioned while only one of these amperes is useful in radiating energy? What the amateur should first sweat over, therefore, is to reduce the first two components to the lowest minimum possible, and to increase the last component.

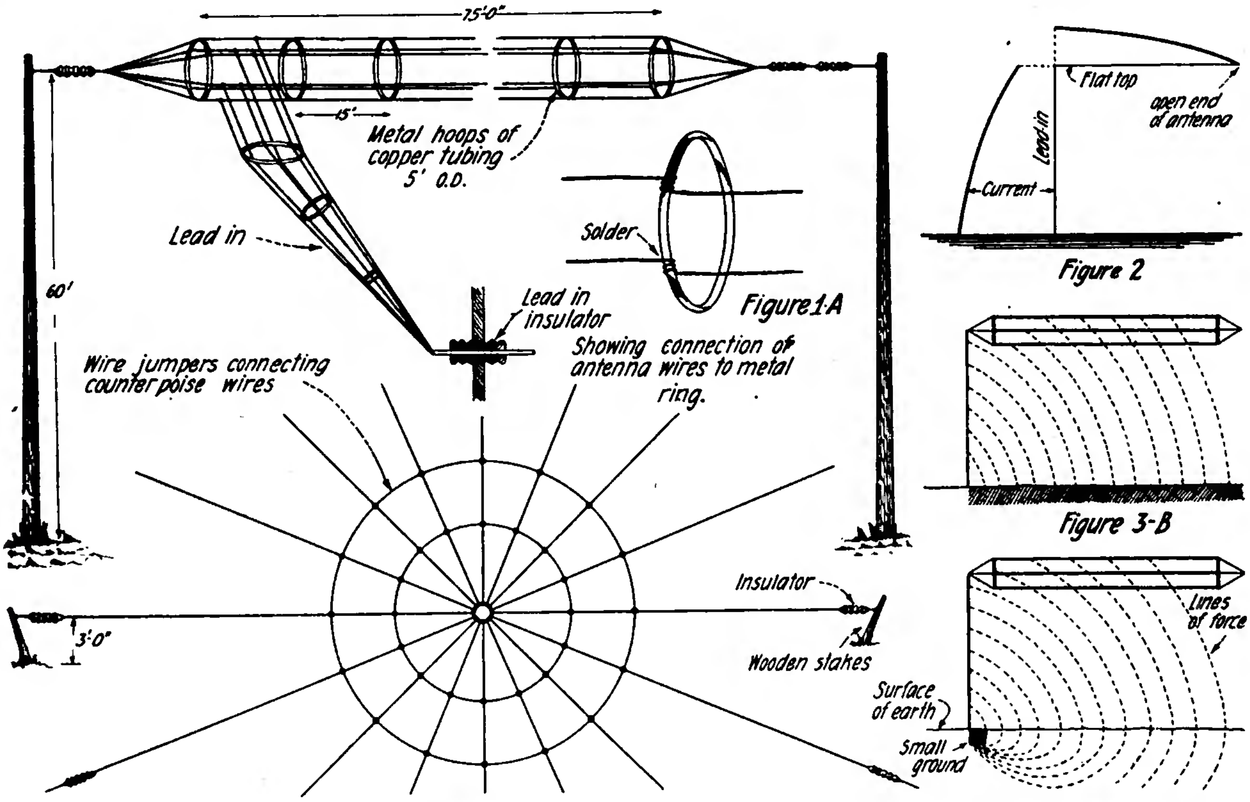


Figure 1—Six-wire cage antenna and counterpoise ground. Figure 2—Distribution of current along the antenna. Figure 3A—High current density and high resistance resulting from small ground. Figure 3B—Extended and uniform distribution of lines of force on large ground affords low resistance

The Ohmic Resistance of the Antenna

In the first place the antenna wires should have a maximum of surface because on account of the skin effect, the current travels on the surface of the wire. This can be secured by the use of large diameter wire or flat copper strip, but as these are rather inconvenient for antennas, stranded wire should be used, the best wire being seven strands of No. 18 phosphor bronze wire. This stranded wire has been found to be far superior to a solid conductor having the same surface area, as far as resistance of the wire goes at high frequencies.

Now when it comes to the particular disposition of these wires a very important factor enters, namely the so-called "edge effect" which is somewhat similar to the skin effect in conductors. When a flat top antenna is used having more than two conductors, as for example a four-wire inverted L, there are two outside conductors and two inside conductors, or more depending upon the number of turns. Just as in a solid wire the current tends to flow on the outside surface of the wire, so in the case of the antenna having multiple wires the current tends to crowd to the outside wires, thus the distribution of currents in the antenna wires is non-uniform, the outside wires carrying more than their share. As a result of the non-uniform current distribution the resistance of the antenna is increased. Consequently this form of antenna is not recommended. This effect can be avoided if the antenna is constructed so that all its wires are on the outside, and the only type of antenna in which this is possible is the cage antenna. All the wires, as shown in figure 1, are elements of a cylinder and are equally distant from the center, thus insuring uniform current distribution, hence lower resistance than the other types of antennas. For the same reason the lead-in of the antenna should also be of the cage type, but the writer has found the best form of lead-in to be of the particular cage type shown in figure 1, namely a tapering cage. This particular form of lead-in offers the lowest resistance of any type of lead-in, and secondly, which is just as important, offers a reduced capacity. For best results it is desirable that the antenna capacity be confined to the top portion of the antenna. Since the capacity of the cage type is directly proportional to the diameter of the cage it is apparent that the lead-in has its maximum capacity at the top and its minimum at the bottom which is what is wanted. This type of lead-in therefore offers both resistance and capacity advantages. As far as connection joints and splices go it need hardly be said that all joints should be thoroughly soldered. An unsoldered joint will corrode in time and may increase the antenna resistance by several ohms.

One of the most prolific sources of wasted energy is in the ground resistance, and this is largely due to poor design of the ground system. The importance of the ground will at once be evident when the amateur realizes that the current density is a maximum at the ground. The distribution of current in the antenna is generally of the form shown in figure 2, showing that at the ground it is a maximum. Since the heating effect is proportional to the product of resistance by the square of the current it is evident that this resistance should be a minimum. Now there is one important reason why most ground systems as built by amateurs have very high resistances; and that there is very little surface area to their grounds, as a result the total current is confined to small area, thus increasing the current density at that point and hence increasing the resistance to large values. In figure 3 (a) is shown the path which the electric lines of force from antenna to earth take. It will be seen that the lines of force from the antenna spread out a considerable distance over the earth, and that these lines of force travel to the ground through the earth. Now if a small ground is used as in figure 3 (a) the lines of force concentrate around this small ground, resulting in great current density in limited area, hence there is a great loss in heat. If, however, a large surface ground is utilized as shown in figure 3 (b) the lines of force are more uniformly distributed over this ground and there is smaller current density, resulting in less loss and lower resistance. It is therefore best to provide a ground covering a large area. Since the electric lines of force come from antenna to ground, the ground should be placed as far as possible directly under the antenna.

There is one type of ground system which yields a minimum resistance and which is preferable to the above type of direct ground, and this is the counterpoise ground. This is a system where either a large metal plate or a network of wires is placed over the ground and insulated from the ground as shown in figure 1. The direction of the electric lines of force is now as shown. The advantage of this type of ground is that the lines of force flow directly from antenna to counterpoise, and due to the large area presented by the counterpoise a more uniform distribution of current is obtained. This type of ground is often simpler to construct than a real good direct ground and should be given more attention by the amateur. Measurements taken on a certain particular antenna employing first a direct ground and then a counterpoise showed a reduction in antenna resistance from 10 ohms at 600 meters, to 4 ohms at 600 meters. There is such a tremendous saving in resistance by the use of the counterpoise that the large companies use this type of ground and have thereby been able to reduce their antenna resistance to such low values as 1 to 2 ohms.

In the actual construction of this counterpoise ground the following must be considered. In the first place the area of the counterpoise should be as large as possible, and should be as nearly as possible directly under the antenna, and should extend for some distance around the antenna. The writer has found that it is more convenient to employ a network of wires for the counterpoise rather than a solid sheet, as this is too expensive and cumbersome to handle. The counterpoise should be placed about 3 to 4 feet above the surface of the ground, and should be the same distance above the ground at all points. As many wires as possible should be used, but a good average number is about 20 wires. At frequent intervals these counterpoise wires should be connected together by jumpers as shown in figure 1. It must be well understood that the supports for the counterpoise wires must be well insulated from the ground and that if wood supports are used they should be well seasoned. Not only that, but on account of rain the wires should be insulated by means of good non-hydroscopic insulators. The wire leading to the counterpoise from the ground terminal on the transmitter should be composed of a few strips of wide copper strip, since the current is at its greatest value at the ground.

Resistance Due to Imperfect Dielectric

This factor in the resistance of the antenna is very largely overlooked by nearly all amateurs. The antenna is a very large condenser, one plate of which is the aerial proper, the other plate being the earth or counterpoise. Consequently for minimum resistance the dielectric of this condenser should be as perfect as possible. Much of the increase in antenna resistance is therefore due to the presence of material in the surrounding space around the antenna which are poor dielectrics. Thus trees, buildings, etc., are a great disadvantage. But often these cannot be done away with. A more prolific source of danger in this respect is found in the insulation often used by amateurs. They do not realize that an insulator for an antenna must fulfill two important functions: first it must insulate, and second it must be a good dielectric having low losses. They recognize the first but entirely lose sight of the second. A good insulator is not necessarily a good dielectric. They should use only standard recognized insulators for their antennas. A good many of the composition products now on the market have extremely poor dielectric qualities and should be avoided. Material such as electrose and glazed porcelain are satisfactory. Never use unglazed porcelain, fibre or wood as these absorb moisture.

In the construction of the cage antenna which has been here recommended rings should be employed along the length of the cage to attach the antenna wires to. It is not advisable to use any insulating material for these rings such as wood, fibre or any other insulating material for that matter, as the less insulating material you have in the electric field the less loss will there be. The writer uses metal rings of copper tubing to which the antenna wires are soldered.

Radiation Resistance of the Antenna

By following out the suggestions mentioned under the first two headings the wasteful resistance of the antenna may be reduced considerably and the output of your transmitter increased, in this way increasing your radiation. However, by proper design of the set a direct increase in the useful radiation resistance of the antenna may be secured. The radiation resistance of the antenna is directly proportional to the effective height of the antenna, that is the height of the center of capacity of the antenna. Thus by installing the antenna so that it is as high as possible you will secure an increase in the radiation resistance. One other point which most amateurs do not seem to be aware of. There is one particular wave length for each antenna at which the antenna will radiate best, i. e., at which the radiation resistance is a maximum. That wave length is the fundamental wave length of the antenna. At this wave length your antenna radiates most energy. It should therefore be the aim of amateurs to build their antennas so that the fundamental is as near 200 meters as possible. Of course, if the antenna has a natural wave length of 200 meters it must be loaded up with enough coil to permit coupling to the secondary, which immediately increases the wave length. This should be compensated for by means of a series condenser. All other things being equal an antenna which radiates at its fundamental will carry further than one which does not.

Figure 1 shows the details of the antenna as described herein which gives excellent results. A six-wire cage antenna is used, made of seven strands of No. 18 phosphor bronze wire. The length of the aerial cage is about 75 feet, the diameter of the cage being five feet. Every 15 feet a metal ring of copper tubing is used to attach the wires. The wires are wound around the metal ring twice and then soldered as shown in the detail. The lead-in is likewise a cage but tapered, with similar spacing rings, which are of reduced size on account of the taper. Electrose insulators are used at the end of the antenna and also for the lead-in. The counterpoise is supported by wooden stakes, but at each stake small electrose insulators are employed to keep the wires away from the stakes.

Finally a last word with reference again to the insulation employed on the antenna. A quarter of a million ohms resistance sounds very high and would seem to be all right for insulation. But in an admirable little article on "General Notes On Matters Radio," by S. Solomon, which appeared in the December, 1921, issue of THE WIRELESS AGE, a calculation was made which showed that this insulating was nothing. This calculation showed that if there was a leak which had a resistance of a quarter million ohms from antenna to ground at 1,000 meters it would be equivalent to introducing a series resistance in your antenna of about 5 ohms, which would cut down your radiation to a ridiculous figure. Insulation cannot be too strongly stressed and it is suggested that the insulation on existing stations be looked over and it will probably be found that improvements can be made.

Some Details Which Reduce Antenna Resistance

By Jerome Snyder

(Second Prize, $15.00)

THE importance of a real good antenna cannot be too strongly emphasized. A good antenna is half the reception problem solved. If people putting in stations would begin to realize that a poor antenna with a two-stage amplifying set may give no better results than a good antenna with a crystal set more effort would be put into the installation of the antenna than is otherwise done. A few small things well done will make a receiver worth ten times its cost.

The writer lives roughly about 10 miles from stations WEAR and WKC in Baltimore and has a Westinghouse Aeriola Jr. crystal set. At the time I bought the set I installed the following antenna on the roof of my house. A single wire 60 feet long of No. 14 copper-clad steel was stretched about 10 feet above the roof of the house which is a two-story affair. The wire was stretched diagonally across the roof, in this way I was able to secure about 15 to 20 more feet in length than I would be able to get otherwise. The lead-in was brought in at the rear end of the building, and my intention was to make the antenna and lead-in one continuous wire by continuing the antenna through the hook-eye of the end insulator as shown in figure 1. The wire was accidentally nicked and so a splice had to be made. The lead-in was brought down alongside the wall of the house to the set on the back porch as shown in figure 1. The ground connection was made to the cold water pipe which was about 20 feet in from the porch as shown in the sketch.

With these arrangements made and the set hooked up, I could barely hear the broadcasting from the stations mentioned. I could not blame the set as it was tried out by the dealer from whom the set was purchased and worked well. The broadcasting was audible, but the phones had to be pressed to the ears tightly. The moment two pairs of phones were put on in parallel no signals could be heard.

I called in help at this time and the following changes were suggested and then made. First the splice in the antenna lead was soldered and the joint covered with tin foil. In making the new splice the best connection joint is made by using the so-called "Western Union" joint, shown in figure 2. This joint not only gives the best electrical connection but also gives maximum strength at joint. Long porcelain cleats were now attached to the side of the house at equal intervals, so that there was at least a distance of six inches between the wall and the free end of the cleat. The lead-in was brought down via these cleats as shown in figure 1. The length of the ground lead was now shortened by the following substitution. The porch is about 10 feet above the ground. Directly under is an earth plot. A square piece of copper plate about two feet on a side was obtained and sweated on to a two-inch round bar about six or seven feet long. The copper plate was then sunk into the ground about five feet and connection made to the bar from the ground terminal of the set.

The results obtained with these changes were a revelation. The broadcasting now came in so loud that I could hear distinctly with the phones lifted off the ears. Furthermore two pairs of phones could now be attached in parallel and the broadcasting enjoyed by both listeners without straining at all. Shifting the ground lead back to the old water pipe gave fair results now, but about 25 per cent. lower than with the copper plate ground, showing that the extra length of ground lead probably added considerable resistance to the antenna. The fact that fair reception was now had with the old water pipe ground proves that considerable of the original trouble was due to the unsoldered joint and the lead-in touching the wall of the house.

It appears that the difference between poor reception and good reception is a difference between high antenna resistance and low antenna resistance and this is determined by such apparently small precautions as:

1. Condition of joints in the antenna. They should all be carefully soldered.

Correct method of splicing antenna wire

Figure 2

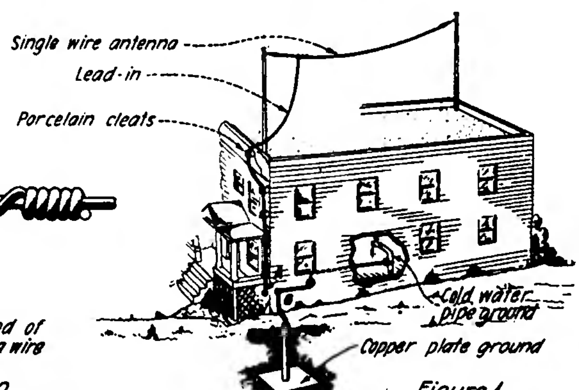


Figure 1

Correct installation of antenna system to reduce resistance and method of splicing wire

A poor soldering job is almost as bad as no solder at all. Be sure to have considerable surface of both wires making contact and get the solder sweated in all the open spaces between wires.

2. Antenna or lead-in touching parts of building. This introduces high resistance in the antenna circuit as the energy collected by the antenna leaks off to ground by way of the building. The lead-in must be kept a considerable distance away from the building wall, preferably by means of good insulators. Glazed porcelain will do.

3. Size or length of ground lead. The longer this is the more resistance is introduced in the antenna circuit, and the weaker will be the received signal. If you are near moist ground and are able to sink a fair sized copper plate into the earth this will give unprecedented results. Otherwise be sure to make the ground lead as short as possible.

Reduction of Antenna Resistance

By R. Emerson

(Third Prize, $10.00)

THIS is a method of reducing antenna resistance which is quite novel for a receiving station and by the results obtained in its application, I have been able to increase the sensitivity of my set considerably. The method can be very successfully used by those who live in locations where the soil is sandy and rocky and a good ground cannot be obtained. As this method requires the use of a counterpoise, it is not very practical although not impossible, for the city dweller, but can be applied to very great advantage by those who are not confined to a limited space. Again, as the city amateur can connect his ground to the water pipe system, this is as good a ground as could possibly be obtained, and if he follows the rules of erecting his antenna and bringing in his lead-in as far away from the building and metal conductors as possible, it is not essential to worry about antenna resistance. But as stated above, the man who lives in a section where no matter how he may make a ground connection, the results obtained are discouraging, then some method must be employed to overcome the high resistance of a poor ground.

My antenna is 100 feet long and 40 feet high. My ground connections originally were, first, the regular water pipe connection, and then a number of connections to conductors going into the earth. But the signals that were received were not of the strength that should have been obtained with a set that I am using. Although I had no way of measuring my antenna resistance, yet I surmised that it was very much higher than it ought to be because of not being able to operate my tickler coil to obtain proper regeneration.

My first change was to use a counterpoise which consisted of two wires, raised one foot above the ground, four feet apart and running parallel to the entire length of the antenna. The tickler coupling then became more effective and an increase in audibility was obtained of about four to six times that of any of my previous results.

In some of the high power transmitting stations, there is used a method that employs both the counterpoise and the ground to give a decrease in antenna resistance. My next move was to try this in my case although for receiving instead of transmitting and an increase in audibility was obtained of three times that when receiving with a counterpoise alone. The circuit for employing a combination of the counterpoise and ground is shown in figure 1. L is an inductance that has a value of about 200 microhenrics and can be a coil wound with 20 turns of litz wire on a 3-inch diameter bakelite form. Taps should be brought out at every turn as the adjustment for best results may be critical and may depend on a difference of one or two turns.

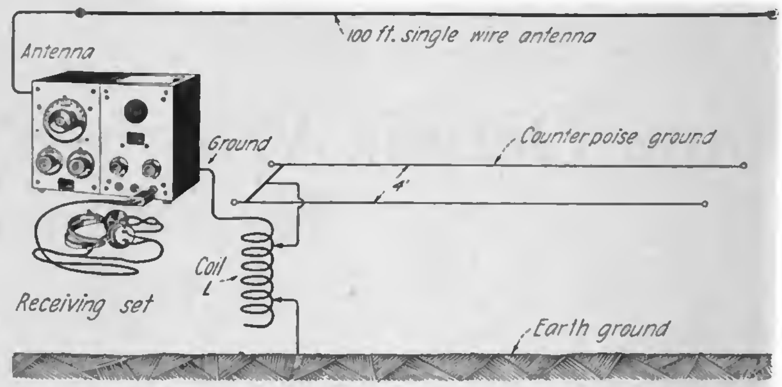


Figure 1—Combination of counterpoise and ground connected by a tapped coil to increase signal strength

The effect of this coil as used in this case, is to balance the phase relation of the currents in the counterpoise and ground and the result of this combination is an appreciable decrease in audibility.

The method for tuning is to first adjust the control elements in the receiving set for maximum signal and then regulate the number of turns in ground coil for loudest signal. Although this requires a little extra care in manipulation, the results obtained are well worth the effort.

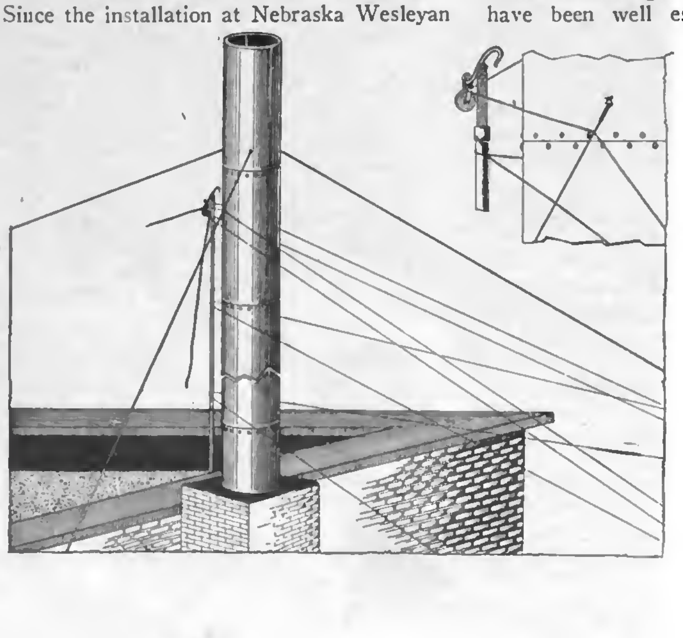
Notes on Antenna Construction

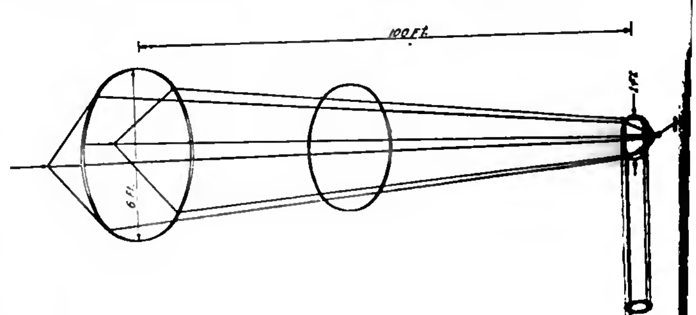
By J. C. Jensen
Dept. of Physics, Nebraska, Wesleyan University

RECENT literature, both text-books and journals, contain much material on the theory and practice connected with efficient radiation from an antenna. Since the installation at Nebraska Wesleyan University is unique in some respects, the details may be of interest to those who contemplate antenna erection.

Two facts regarding antenna construction have been well established. In the first place, the capacity depends on its length, height, and distance from the ground or other counterpoise. The wire acts as one conductor and the earth as the other, the

(Continued on page 78)





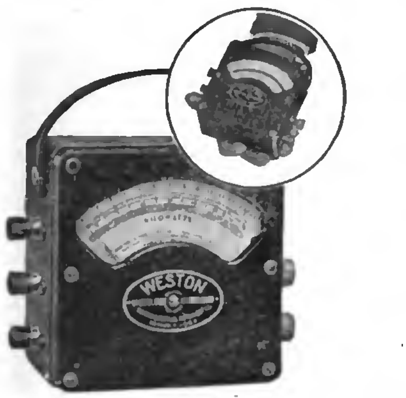
Constructional details of the cage antenna and details of the method of installation

NEW APPLIANCES AND DEVICES

"Weston, Jr." Line

THE Weston Electrical Instrument Co., announces a new and unique line of small portable instruments for use on alternating-current circuits known as the "Weston, Jr."

The group comprises wattmeters, voltmeters, ammeters and milliammeters which will undoubtedly fill a real need in the factory, the isolated power plant, the central station, or the laboratory of the educational institution for field testing, because they are very compact, light and reasonable in price. The new line will possess the same



Weston, Jr., Meter

commendable operating characteristics as are possessed by other well-known Weston products. Bulletin 2006 is available to all who may be interested in this new line of Weston instruments.

Bradleyometer

ANOTHER application of the compression resistance principle has been made by the Allen-Bradley Company, in the Bradleyometer, a new potentiometer embodying graphite discs operating under pressure. In placing the Bradleystat filament rheostat on the market, the Allen-Bradley Company has applied a principle they have been using for twenty years in the manufacture of rheostats and motor starters for industrial purposes. The smooth current control obtainable with this type of resistor was especially desirable for radio circuits, where the sensitive units require the finest of adjustment.

In the Bradleyometer this same idea has been utilized with the result that a potentiometer with all the desirable control characteristics of the Bradleystat rheostat is available.

Two columns of discs are assembled in the porcelain container, each column with a separate and independent pressure plug extending through the top cover plate. The pressure knob rotates through 180 degrees, and through a special shaped cam applies pressure to one column in one direction of rotation and to the other column in the other direction. As pressure is applied to one of the columns the pressure is released on the other.

The resistance of a column of the discs varies with the pressure, so that the action of the Bradleyometer is to decrease the re-

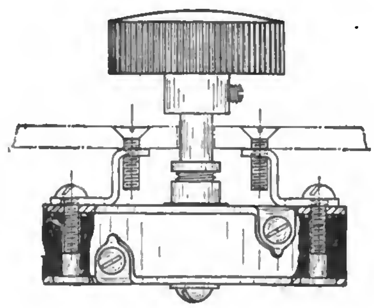
A novel potentiometer

sistance in one column and simultaneously increase the resistance in the other column. The total resistance of the two columns remains constant, as in any wire wound potentiometer, while a connection between the two columns serves the same purpose as the slider of a wire potentiometer.

The Bradleyometer controls the resistance gradually as the pressure is increased or decreased on the discs. This provides for an absolutely even balancing of the potential in the plate or grid circuits, wherever the Bradleyometer may be connected.

Resist-o-Meter

EMPLOYING the compression principle, the "Resist-O-Meter," manufactured by the Scholes Radio & Manufacturing Corpora-



New type of filament rheostat

tion, is a new departure in filament rheostats in that adjustments can be made without jumps or steps.

There is no metal frame to produce induction, nor iron to create magnetic action. Response is immediate without hesitancy or lag. The rheostat can be mounted on either side of panel, or laboratory bench.

A big feature of this rheostat is that the adjustable mounting brackets eliminate the necessity of drilling extra holes in the panel.

New Federal Apparatus for Radio frequency

THE great interest in radio frequency amplification on the part of broadcast listeners who are reaching out over more distant stations has prompted the Federal Telephone & Telegraph Company, to place upon the market two new radio frequency amplifier units, known as No. 55 and No. 56. No. 55 consists of two stages of radio frequency amplification while No. 56 contains one R. F. step and a detector. The company has been wise in not supplying these units with radio frequency transform-

One-step r. f. and detector receiving set

ers installed in them, as the majority of experimenters have their own ideas as to the design of transformers for radio frequency work.

These units are supplied complete except for the transformers, but with the standard No. 40 Federal R. F. transformer socket in place ready to receive the particular type of Federal transformer that the user wishes to insert. As the company's transformers are all interchangeable and as the mounting makes use of springs for contact, it is possible to substitute one transformer for another in a few seconds, thus making possible a quick change from one wave length to another. These radio frequency transformer units are standard in size and design with the company's other apparatus, with which they may be hooked up to form any desired combination of receiving apparatus.

For amateur work on wave lengths around 200 meters, the company offers its No. 29 R. F. transformer, which is given a wave length rating of between 175 and 300 meters. For broadcast reception, No. 30 has a range from 275 to 600 and the No. 31 may be used on wave lengths between 500 and 1,000 meters. These ranges are conservative, and it has been found possible to use the transformers on waves greater than those intended, with, however, some sacrifice in amplification. The transformers are carefully assembled in hard rubber shells and are supplied with a mounting block, carrying separate springs into which the transformer terminals may be slipped.

Soldered terminals are provided on the mounting block so that soldered connections may be made with the circuit while still making it possible to insert, remove and exchange transformers at will, by

Radio frequency transformer

merely pulling one transformer out of its spring socket and pushing another in.

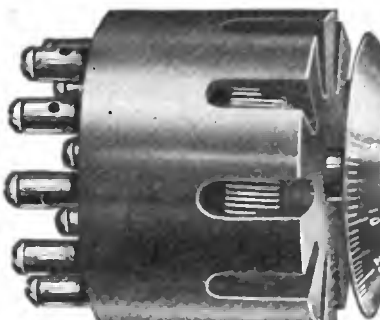
Purchasers of broadcast receiving apparatus in complete sets are finding in the shops two new receivers designed by the Federal company, known as No. 57 and No. 58, each of which are unusual in containing radio frequency amplification. This gives recognition to the fact that distance records for broadcast reception are interesting more and more radio fans. Each set contains a single stage of radio frequency, a detector and two stages of audio frequency. The No. 57 receiver is of the single circuit type and has been found to be exceedingly effective, not only on outdoor antennas but also on indoor loops. Three rheostats are provided to control the tube filaments and there is also an amplification control.

Two-circuit tuner with one-step r. f. detector and two steps a. f.

The No. 58 receiver is more selective than No. 57, being a two-circuit tuner. However, it does not present to the operator any more complications of tuning than does the single circuit type. The tuning circuit consists of an antenna inductance and a secondary inductance, the coupling between the two being variable and a condenser being provided for tuning the secondary circuit. Tuning of the antenna circuit is accomplished by an inductance switch. As the coupling between the two circuits is variable within very wide limits, the receiver can be adjusted to almost any desired degree of selectivity. The amplification system consists of one stage of R. F. detector and two stages A. F.

New Klosner Tube Controls

THE well known Klosner vernier rheostat, which is in use on thousands of receiving sets, has appeared in a new model, known as No. 200. The chief new feature is in the attachment of a dial instead of the knob and pointer found on the original model. This permits more accurate operation and obviates the necessity of placing a scale on the panel. The new type has the same design of resistance wire as the former one, and by its fine adjustment permits selection of the exact length of wire that passes the correct current for best reception. The rheostat is made of Condensite, resistance wire, and phosphor bronze contacts.

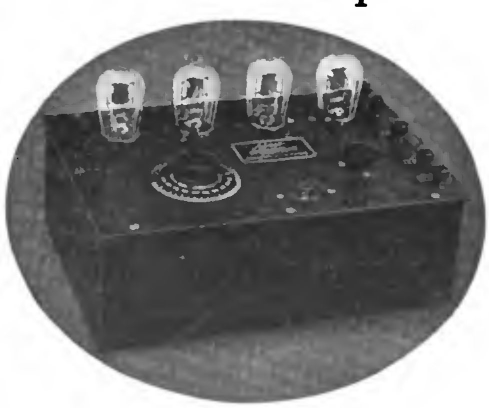


Klosner vernier rheostat and Amplitrol

The Klosner Improved Apparatus Co., has also developed a combined rheostat and filament control, by means of which it is possible to open and close amplifier circuits without using plugs, jacks, and outside switches. The Amplitrol, as it is called, not only governs the filament, but also switches the plate circuit on and off. The usual connectors in the amplifier tube circuits are attached to the binding posts of the Amplitrol instead of to jacks or switches. The device is made of Condensite, with exposed metal parts highly nickeled. Like the new model vernier rheostat, it is provided with a graduated dial.

Ware Receiver Has Simplified Control

A DEPARTURE from the conventional manner of mounting panels in a vertical position is to be found in the Ware type AD2 receiving set, in which the panel is horizontal. This may be considered by some to show an English influence, as most of the English apparatus is so constructed. The manufacturer, the Ware Radio Co., decided to adopt the design, however, after experimenting with vertical and horizontal panels. Its conclusion was that the horizontal position offered more convenience of operation than the vertical. As a matter of fact there was no particular need for seeking the ultimate in convenience, as the set already was simplified to one tuning control and a rheostat; the form of mounting is proof of the company's thorough-going policy.



Electrically, the receiver consists of a variable condenser for tuning a loop antenna, and sockets and radio-frequency transformers for four bulbs, one of which serves as a detector. Used with a small loop or coil antenna the receiver gives excellent results in picking up and amplifying concerts from far and near broadcasting stations. Its simplicity and effectiveness make it exceedingly attractive to the general and inexperienced public as well as to the experts, many of whom no doubt have experimented with the same circuit contained in this set.

The Best Receiving Antenna

(*Continued from page 62*)

In addition, a few other simple rules may be added, such as:

4. The antenna should be as far away as possible from other wires, particularly grounded ones.
5. If it is necessary to cross other wires, run as nearly as possible at right angles to these, and as far as you can above them.

With these rules in mind, the radio engineering department of the General Electric Co. has drawn up the following rules for the best installation of receiving antenna for 360 meters:

a. Use a single wire only.
b. Run the wire in the form of an inverted "L."
c. Keep both ends of the horizontal part of the "L" as high as you can. If one end can be made higher than the other, go ahead and do it.
d. Insulate the antenna well at all points where you support it.
e. Make the total length of your wire, from radio set to far end, not more than 180 feet long or less than 160 feet.
f. Keep the antenna wire as far away as you can from tin roofs, grounded wires, gutters, and the like. In any case, be sure to have the antenna *higher* than these.
g. Run the antenna at right angles to any power wires, and as near as you can at right angles to the telephone wires. If you have to choose between the two, pay most attention to the power wires.

Annual Convention of Kansas Radio League

AMATEUR radio enthusiasts, from all parts of Kansas and Oklahoma, assembled in Hutchinson, Kansas, Nov. 16 and 17, for the annual convention of the Kansas Radio League.

Mayor Gano, of Hutchinson, made the address of welcome. Wilbur Cooper, Jr., of Wichita, the representative of the United Electric Supply Company, responded to the address of welcome.

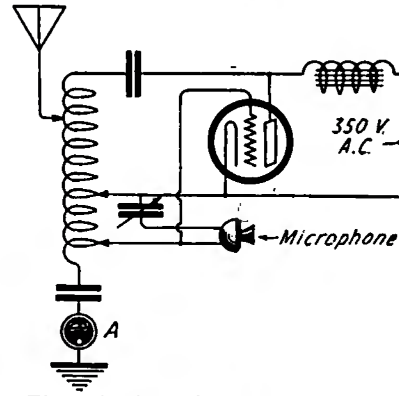
On the first night of the convention, a banquet was served the visiting delegates by the Chamber of Commerce.

After finishing the other business of the league, the following officers were elected: Wilbur Cooper, Jr., of Wichita, president; P. Harrison, of Lindsborg, vice-president; Albert McDermed, Hutchinson, secretary; C. Floorman, Wichita, treasurer; Rev. T. K. Bosworth, Hiawatha, chaplain; E. H. Beardmore, Glasco, Kansas, traffic manager; Eugene Randles, Hutchinson, publicity manager; Otto Taylor, Wichita, membership manager.

The following firms had exhibits at the hall: The Comer Electric Company, Hutchinson; the United Supply Company, of Wichita; the Bickel Auto Machine Shop and Supply Company, Alva, Oklahoma; the Donovan Electric Company, Hutchinson; the Electric Products Company, Kansas City, Mo.; the Central Radio Supply Company, Hutchinson, and the Chicago Radio Laboratory, Chicago.

Modulating an A. C. Set

MR. PAUL J. MILLER, 1133 Creedmoor avenue, Pittsburgh, Pa., 8AGX has had excellent results in modulating the output of a small transmitting set employing A.C. on both filaments and plates. The circuit, in detail, is shown as follows:



The voice is radiated a few meters above the carrier wave of the station. The modulation is reported as being of excellent quality with so little A.C. hum as to be practically negligible.

Notes on Antenna Construction

(*Continued from page 74*)

air between serving as dielectric. Secondly, in an antenna composed of a single wire with no capacity at the outer end, the current will be maximum at the transmitter and zero at the end, since the end contains no reservoir into and out of which the electrons constituting the current may surge. Since effective radiation demands the largest possible current in the top of the antenna, it has become common practice to construct the top of the inverted "L" or "T" antenna of four or more parallel wires to increase the capacity, and therefore the current in the outer portion of its length. This having been done, it is commonly assumed that the current in the main portion of the antenna, e. g., at the bend of the inverted "L," will be less than that at the transmitter only by an amount representing the resistance loss in the lead-in plus any dielectric and corona losses.

In order to get the maximum current in the flat top itself there should be more capacity at the outer end than is found for an equal distance in the lateral part and the capacity of the lead-in should be as small as possible. With a steel tower used for support on an inverted "L" aerial the steel will serve as a conductor or counterpoise and its proximity to the lead-in will greatly increase the relative capacity of the latter. In our case a steel smoke-stack 80 feet long and on a 20-foot brick pedestal, is used for support. As it is effectively grounded both by the guy wires and breeching, it is equivalent to having the lead-in within 10 feet of earth for a distance of 80 feet. In order to get a better distributed capacity under the conditions above stated the cage aerial shown in figure 1, was constructed. The hoops, which serve as spreaders, are made of No. 5, B&S gauge, galvanized iron wire, soldered to the seven strand copper cable at all joints. The hoop at the outer end contains two turns of wire, the others one. In addition to this cage aerial, another of two wires about 280 feet long has been in use, primarily for receiving. It is of the same height as the other and the lead-in is at about the same distance from the smoke-stack. Measurements made with a Leeds and Northrop Capacity Bridge and an alternating current of about 1,000 cycles give a capacity for the cage antenna of .000765 mfd., while that of the longer one is .001264 mfd. The fact that the lateral portion of the one is nearly three times as great as the other shows the relative value of the lead-in capacity to be large. Later the long antenna was cut in two, leaving a flat portion of 100 feet, and its capacity was found to be .00074 mfd.

The resistance of the cage antenna is low and its distributed capacity makes it very efficient for radiophone transmission.

Two years ago we were confronted with the problem of getting a pulley to the top of the smoke-stack, the cable passing over the pulley having broken in a storm. The stack then in use was 65 feet high above the 20-foot pedestal and had no ladder. Moreover, it had been recently painted and no falls left for climbing it again. In order to get 9YD into service once more with a minimum loss of time and expense, the scheme shown in figure 2, was employed. A hook wide enough to reach over the band at the top of the stack was fitted with a ring and a pulley through which the cable passed. The hook was tied to a piece of wood which dropped about a foot into a one-half inch gas pipe. The cable was used as a guy wire to hold the upper end of the pipe against the stack and more pipe and guy wires added as the hook was pushed upward. When the hook was at a point just above the top of the stack the pipe was twisted 90 degrees and slowly lowered until the hook was in place. The only slip in the proceedings was in not providing for an extra pair of guy wires for the upper joint of pipe. When the hook and cable were freed from the pipe, the latter bent sidewise and caused a collapse all the way down the line, but outside of a section or two of bent pipe no harm was done. On a long antenna attached to such a support as a steel tower or smoke-stack which sways more or less with the wind it has been found advantageous to connect a heavy coiled spring between the insulator and support at the outer end of the antenna. The spring takes up the strains due to wind and temperature changes, and renders less likely the breaking of the wire.

Improving the Quality of a Receiving Set

(*Continued from page* 68)

coupler is connected directly in the plate circuit of the UV200 detector tube as the "tickler" or "feed-back."

The grid condenser has a value of .0005 mfd., while the shunted grid leak has a value of 2 megohms (2,000,000 ohms). Across the "A" battery terminals is shunted the 300-ohm potentiometer and from its center tap the negative of the "B" battery supply returns to the circuit. A .01 mfd. condenser shunted across the "A" battery terminals completes the "A" battery noise trap. The ground connection returns to the negative side of the filament. A .001 mfd. variable condenser is shunted across the output of the receiver and offers plate tuning as well as a radio frequency by-pass.

The plate of the detector tube (UV200) is operated on 18 volts. The "B" battery noise trap is shunted across the 18-volt section comprising the 5,000-ohm resistance and the 1 mfd. condenser. Note that a separate trap is provided for the amplifier circuits. This trap is made up of a 20,000-ohm Ward-Leonard resistance unit and a 1-mfd. condenser — approximately 6 milli-amperes flowing through the resistance. Note that the amplifier "B" battery supply is taken off at the 44-volt terminal, while the plate supply of the power amplifier is at the 132-volt terminal. The radio frequency chokes prevent any of the radio frequency currents from entering and dissipating in the amplifier and by the aid of the .001 mfd. variable condenser the radio frequency by-pass is assured.

The shunted resistances to the secondary of the amplifying transformer windings have a value of 400,000 ohms each. However, 750,000-ohm units will eliminate much of the noise due to low frequency disturbances.

No attempt is made to design the panel or mounting for the set as it is believed that the majority of those interested will be those who have already built their sets and who are looking for improvements.

If you are aware of the maximum results you can obtain with your receiver kindly underrate it and permit your friends to appreciate the good music and concerts which are being sent out every night. Don't push the set to its limit—it won't stand up long. Squealing, howling, distortion and other disturbing elements are mainly due to the operator striving for quantity, without a proper regard for quality.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. All monthly lists of distant stations worked and heard which are received by the 10th of each month will be published in the next month's issue. For example, lists received by November 10th will be published in the December issue. Spark and C. W. stations should be arranged in separate groups.

2NE, A. H. SAXTON, 211 Claremont Ave., Jersey City, N. J. Single Tube. (Month of November.)

CW.—1atj, 1azl, 1bas, 1bea, 1bgf, 1bhr, 1bkq, 1bom, 1boq, 1bqd, 1bsj, 1bvb, 1bwj, 1bzn, 1cdo, 1cjh, 1cmk, 1cnf, 1fl, 1gv, 1ii, 1jq, 1xm, 1xu, 2hw, 2xq, 3anj, 3bgt, 3blf, 3bnu, 3cd, 3co, 3pz, 3zz, 4bx, 4by, 4dl, 4gh, 4jm, 4nt, 4oi, 4ya, 5ek, 5er, 5es, 5fv, 5hl, 5ik, 5mo, 5tj, 5xa, 5xk, 8acf, 8aha, 8amm, 8anb, 8and, 8asv, 8ato, 8atu, 8awp, (1cw), 8axb, 8axn, 8azd, 8azh, 8azr, 8bdb, 8beh, (1cw), 8beo, 8bny, 8brl, 8bwa, 8 cay, 8cdz, 8cei, 8ch (1cw), 8cko, 8crb, 8csr, 8cuu, 8dat, 8ij, 8kg, 8ow, 8qk, 8sb, 8uk, 8vy, 8xae, 8xak, 8xh, 8xj, 8yd, 8zw, 8zz, 9aap, 9afn, 9ahp, 9aiv, 9ajh, 9akd, 9amh, 9amk, 9 aot, 9aps, 9arz, 9avp, 9awm, 9aze, 9bds, 9bed, 9bhd, 9brk, 9 bus, 9bwz, 9cf, 9czl, 9dgq, 9dr, 9dwq, 9dxt, 9dyn, 9ecr, 9ei, 9kp, 9of, 9ox, 9uc, 9uu, 9vk, 9zn (1cw).

SPARK.—1adc, 1ary, 1aw, 1ayo, 1boq, 1hub, 1bzn, 1ck, 1cni, 1ew, 1gm, 1or, 1rx, 1by, 3fb, 5zl, 8azr, 8bah, 8bda, 8bun, 8kj, 8tj, 8ts, 8us, 8zy, 9aaw, 9ahp, 9amk, 9au, 9avp, 9bes, 9bwz, 9cf, 9czl, 9dag, 9dxt, 9dzy, 9of, 9tv, 9vz, 9zn.

VOICE.—9xac, ksb, nof, kyw, wbad, whz, wdaf, wdaj, wdap, wgm, wgr, wgy, whas, whaz, whb, wip, wmak, wnac, woc, woo, wsb, wwj.

3AVC, R. KANTROW, 718 S. 5th St., Philadelphia, Pa. (November.) (Det. and 1 Step.)

CW—1aw, (1agh), 1aju, 1bdi, 1bkq, 1bqi, 1buq, 1cik, 1cm, 1cmk, 1cxx, (1gv), (1xm), 1xu, 2anm, 2awl, 2bjo, 2brb, 2bqh, 2ckr, (2cqz), 2el, 2fp, (2ke), 2lr, 2xap, 2xq, 2zk, 2zl, 3aay, 3afb, (3ais), 3aji, 3ba, 3bit, (3blf), 3bvc, 3rb, 3su (3xm), (3zo), 4bs, 4bx, 4dc, 4ea, 4ed, 4fv, 4hw, (4nt), 5ek, 5er, 6ka, 8abs, 8ado, (8afd), 8ago, (8agz), 8ahd, 8aim, 8amp, 8amq, (8asv), 8atc, 8atu, 8auk, 8awp, 8axb, 8azd, 8bcl, 8bdv, 8bet, 8bo, (8btr), 8bxh, (8cbc), 8cjh, 8ck, 8cmm, (8cur), 8cpx, 8ib, 8iq, 8pt, 8sb, 8sp, 8uk, 8ve, (8wr), 8xe, 8xh, (8yd), 8zw, 8zy, 8zz, 9al, 9ano, 9aot, (9api), 9aps, 9bds, 9bed, 9bik, 9bo, 9dgq, 9dky, 9ox, 9ii, 9io, 9uu, (9yb), 9yoj, 9zn.

Canadian 3co, 3bp. I would be glad to hear from any one hearing me.

3BMN—Raymond J. Carr, Petersburg, Va.

SPARK—2sq, 3acy, 3aic, 3aogv, 3arm, 3bif, 4fb, 4gn, 9mc.

CW—1aw, 1eo, 1gv, 1ii, 1pm, 1xm, 1qp, 1xz, 1ze, 1bdi, 1bes, 1bet, 1bgt, 1bgi, 1brq, 1bwj, 1byw, 1caj, 1cmk, 1cnf, 2hj, 2ke, 2kf, 2rm, 2rz, 2ts, 2vh, 2wb, 2zl, 2afa, 2agc, 2aho, 2aja, 2ajw, 2auz, 2bd, 2bdm, 2bgi, 2boi, 2bqu, 2brd, 2bxp, 2ccd, 2cjg, 2cjr, 2ckl, 2cms, 2cpd, 2cqz, 3ab, 3ba, 3bg, 3ca, 3cg, 3fs, 3hd, 3hg, 3iw, 3jj, 3hk, 3hx, 3mb, 3no, 3ot, 3su, 3yh, 3zo, 3aag, 3acq, 3adr, 3adt, 3aft, 3afw, 3ary, 3bfq, 3bji, 3btk, 3bsb, 3bup, 3can, 3cel, 3ccu, 4bk, 4bq, 4bx, 4dc, 4ea, 4eb, 4el, 4er, 4fb, 4fg, 4fj, 4ft, 4hz, 4id, 4jk, 4jy, 4kk, 4kl, 4pz, 4ya, 4yi, 5dl, 5ik, 5ir, 5kc, 5mo, 5pv, 5xa, 5zb, 5aag, 5zav, 8eo, 8fm, 2fs, 8ij, 8ju, 8fg, 8fg, 8ml, 8qq, 8rm, 8sb, 8ue, 8vq, 8ve, 8wr, 8xe, 8xq, 8zd, 8zy, 8acf, 8ago, 8ahr, 8aim, 8ais, 8alj, 8alt, 8amm, 8atu, 8asv, 8aue, 8awz, 8axc, 8axn, 8bdu, 8bek, 8beo, 8bex, 8bfm, 8bgj, 8bjs, 8bjv, 8bjy, 8bkh, 8blc, 8bnh, 8bpl, 8brc, 8bsy, 8but, 8bvr, 8byf, 8byt, 8cab, 8cak, 8caz, 8cei, 8cgu, 8cjz, 8cko, 8clk, 8cma, 8cqz, 8ctn, 8cur, 8cus, 8cve, 8cyj, 8cyo, 8czc, 8dae, 8dat, 8zag, 8zwg, 9ei, 9ep, 9io, 9km, 9lq, 9lh, 9ox, 9pw, 9uc, 9uu, 9vr, 9vz, 9wx, 9afk, 9afr, 9ahq, 9aiy, 9amh, 9anq, 9ase, 9awf, 9bed, 9bdb, 9bda, 9bds, 9bhn, 9biz, 9bsz, 9cie, 9dhg, 9dvn, 9dwq, 9dwk, 9dyn, 9dzn.

CANADIAN—3bv, 3co, 3dh, 3jh, 3xn.

6ZY, THOS. A. MARSHALL, Honolulu, Hawaii.

1bka, 2afb, 2bgm, 2fw, 2fz, 2go, 2awl, 2lo, 3auu, 3co, 3dh, 4km, 4fg, 4id, 4gh, 4by, 5ag, 5aec, 5di, 5ek, 5eo, 5gv, 5kc, 5nk, 5px, 5pb, 5sf, 5sk, 5sm, 5tc, 5uo, 5zau, 6ak, 6alu, 6avr, 6atg, 6ada, 6aqu, 6awt, 6akt, 6arf, 6abx, 6ahq, 6asj, 6arb, 6aat, 6avd, 6bun, 6bcr, 6bjy, 6bac, 6bu, 6biq, 6bql, 6bqc, 6cp, 6cc, 6cu, 6cn, 6en, 6ea, 6ec, 6eb, 6ek, 6gf, 6gx, 6ik, 6iv, 6jd, 6ka, 6mqu, 6oaa, 6pi, 6qw, 6tc, 6tw, 6ti, 6zg, 7sc, 7bk, 7hm, 7bj, 7uu, 7zo, 7lr, 8anb, 8aqo, 8aio, 8anj, 8amd, 8awm, 8bo, 8bfm, 8bxa, 8bef, 8bxh, 8beo, 8caz, 8cgp, 8cmi, 8cf, 8cbd, 8ml, 8nd, 8ow, 8pd, 8xac, 8yd, 9aul, 9amb, 9awm, 9axu, 9aog, 9aws, 9avz, 9aw Canadian, 9awl, 9am, 9aux, 9lrq, 9bb, 9brg, 9cp, 9cg, 9ccv, 9cfy, 9cip, 9dpa, 9dtc, 9dsm, 9dky, 9dtm, 9dpa, 9gk, 9lz, 9uu, 9wu, 9yaj, 9zn, 9zaf.

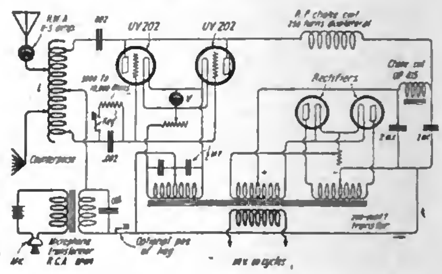
Queries Answered

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.

L. P. Authier, Williamsett, Mass.

Q. Will you please give me what you term "a wonderful C. W. and phone hook-up for two 5-watt tubes" using an Acme 200-watt transformer and two Kenotrons for rectification? The hook-up to be a simple one, no unnecessary condensers, grid leaks or resistance, etc. On this diagram the capacity of condensers to be given also of grid leaks. The number of turns on the inductance. In a word I would like an explanation of the hook-up.

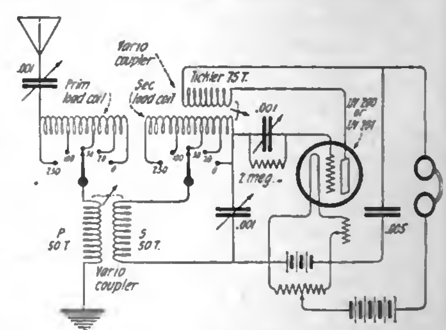


A. L is helix of 30 turns of ¼"-1/16" edgewise-wound copper strip—5 inches diameter, ¼" between turns. Key may be in series with grid leak or in filament lead. See diagram.

* * *

R. P. Stoops, Scottsbluff, Nebr.

Q. Kindly give me the dimensions for a three-circuit tuner with primary, secondary and tickler coils which will tune up to three thousand meters. I should like particularly to know how to effect the coupling of the tickler coil, whether to rotate forty or fifty turns of secondary inside the tickler coil or not. I want to use No. 24 B&S gauge wire throughout, using vario-couplers instead of loose couplers.



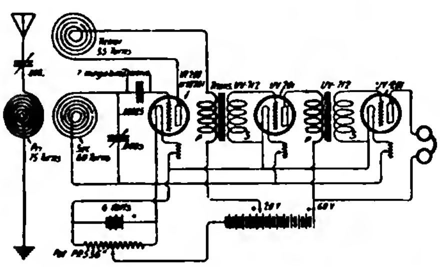
A. In order to get best results, a vario-coupler with about 50 turns on both stator and rotor should be used to couple between antenna and secondary circuit. In addition primary and secondary loading coils are used as shown in diagram. These are not coupled to each other. The tickler coil is of about 75 turns and coupled to the secondary loading coil only—rotating inside of it. The primary may be wound in a single-layer coil on a 3½-inch diameter tube. It contains 250 turns with taps at 0, 20, 50, 100 and 250 turns. The secondary loading coil is similar—except that the tickler coil rotates inside. It is important to use a tap at 0, especially at the short wave lengths. It may be necessary to tap the tickler coil at the middle if you wish to go down to about 200 meters. Other dimensions are shown in the diagram.

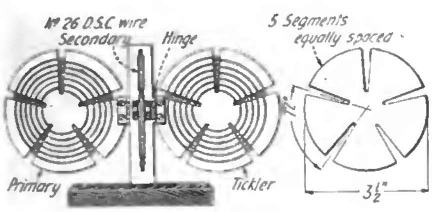
* * *

M. J. Rodda, Detroit, Mich.

Q. 1. I am writing you in regard to an up-to-date receiving transformer, as described in "Practical Amateur Wireless Stations" chapter XLV, entitled "The Experimenter's Workshop," page 124, figures 4-5-6-7. The information that I would like to secure in regard to this transformer is, what capacity or how many volts will this transformer step-up to from a certain voltage? The construction is very well explained. Probably if I state my position you may know just what I want. I am planning on making a long range receiving set with a spider web coil, having a primary, secondary and tickler. The spider web coil has been recommended as being a simple but very effective part, and also have in connection a loud speaker. I understand that transformers are necessary and I would like to get the desired information. Also, if you have any suggestions to make for a real good up-to-date, simple, but effective hook-up it will certainly be appreciated.

A. 1. Below is hook-up for use with spider web coils:





* * *

J. W. Sloan, Newark, N. J.

Q. I am using dry-cell tubes with enclosed hook-up. With this I get local stations loud, but nothing distant. By using variometer in grid circuit of detector I get WHN and KDKA, but only by holding my hand at a certain distance from the variometer. When I take my hand away everything fades out. I am using a loose coupler with a table mounting, therefore I cannot shield the set. Can you tell me how to remedy this?

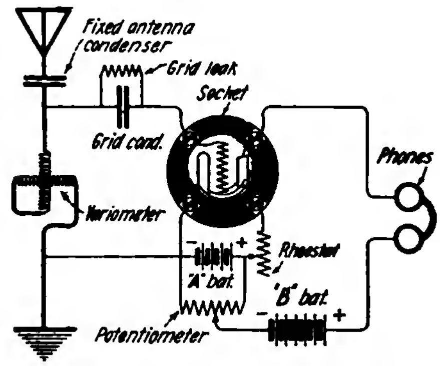
A. You are probably not fully in tune. You should add more turns to the primary of the variocoupler or else short circuit the antenna condenser and tune only by means of the taps on the coil. You cannot, however, get accurate tuning adjustment by the latter method. Hence we recommend the retaining of the series condenser and the purchase of a variocoupler with more turns in the primary. Your antenna may be too short—it should be at least 80 to 100 feet long. It is not absolutely necessary to shield the set if you use long rods fastened to the shafts for the various tuning adjustments. The body cannot then come close enough to affect the tuning. You can try pasting tin foil in back of the dials. If another stage of audio frequency amplification is added, you will be able to work a loud speaker.

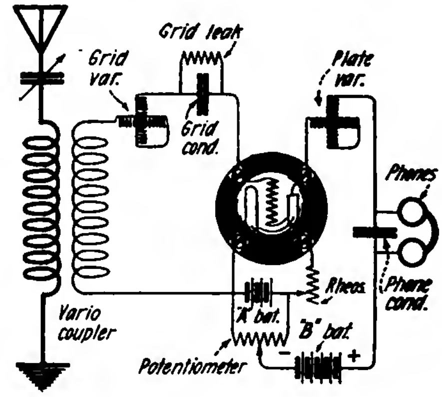
* * *

Donald Fenske, Gaylord, Minn.

Q. I wonder whether you can furnish me with one or two efficient hook-ups using the following instruments: 1 variometer, 1 detector tube, 1 rheostat, 1 potentiometer, 1 "B" battery, 1 "A" battery, 1 21-plate variable condenser, 1 antenna series condenser (fixed), 1 phone con., 1 grid con., 1 grid leak, 1 V. T. socket, 1 pair headphones.

A. Here is one circuit using the material you have available. Below is another, which is much more satisfactory—but you will find it necessary to purchase an additional variometer and a variocoupler.





* * *

J. A. Woods, New York City.

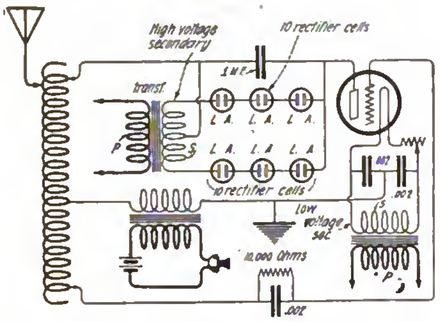
Q. In an article by Mr. A. Ringel in current issue there is a "reflex" hook-up using 3 tubes which gives 1 step radio, regen. detect. and two steps audio, if I am right. I would greatly appreciate some data for the variocoupler. I have a coupler on a 4" tube with a 3½" ball. Would you indicate the proper winding of the three coils primary or plate, grid, and tickler ball? I am using VT 1 and VT 2 tubes and want to make up this set for loop. I believe I can use two tubes and get 1 radio frequency, regenerative and detector, 1 audio frequency with this outfit by not using third tube and second transformer.

A. Approximately 50 or 60 turns of any convenient size of wire (say 24 to 28 D.S.C.) on each of the coils is sufficient.

L. Page, 80 Chambord, Montreal.

Q. 1. Will a rectifier do for the transmitting set described in the May issue of THE WIRELESS AGE on page 64 by K. Gitlitz?

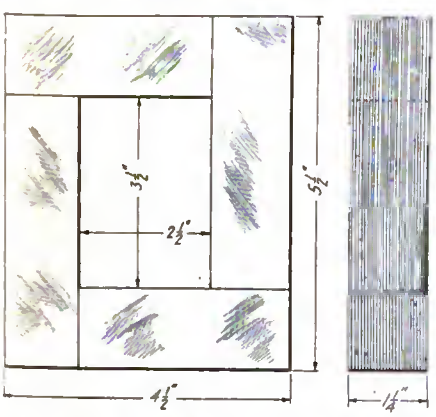
A. 1. A rectifier may be used instead of a direct current generator for telephony. The modulation system described on page 64 of the May WIRELESS AGE is suitable only for powers of the order of 5 or 10 watts, and is not very satisfactory with larger tubes.



The rectifier, if electrolytic, is of lead and aluminum plates in a solution of ammonium phosphate. You will need a total of 20 cells then. It is better to use two kenotron rectifiers, however. For such circuits see "Modern Radio Operation," by J. O. Smith.

Q. 2. How would I make this transformer? What size core? What size wire, secondary, how many turns? What size primary, how many turns?

A. 2. The primary of the transformer should contain 220 turns of No. 18 DCC wire. The secondary for filament lighting should contain 15 turns of No. 12 DCC wire, and the high voltage secondary contains a total of 2,500 turns of No. 24 or No. 26 wire, with a tap of 1,250 turns. The dimensions of the core are given below: Fifteen to twenty mil. iron is satisfactory.



Q. 3. What range would I have with 500 volts on the plate, with an antenna L shape, 3 wires 65 feet long?

A. 3. Your range will ordinarily be about 75 to 100 miles in daylight, although greater distances may be covered at night.

* * *

I. J. Dounes, N. Y. City.

Q. On page 80 of THE WIRELESS AGE for ober you show a diagram using five s, four stages of radio amplification, de- r and three tubes doing double duty as amplifiers. I am very much interested s hook-up, but I wondered if this could ed using the same five tubes with only ges of audio, but so arranged with switches so that the set could be four stages of radio amplification and detector, and then, if desired one, or two, tubes to do double duty as audio amplifiers according to the amount of amplification needed. Also could switch be included to allow the use of detector and amplifier tubes—provided as needed—and cutting out the radio amplifiers. I believe this would be a very desirable receiving set.

A. See article entitled "Practical Reflex Amplification," this issue, for additional information on reflex amplifiers.

* * *

Charles E. Jeffery, Salt Lake City, Utah.

Q. 1. Please give me the winding and size of the wire for all the coils in the set described on page 74 of the May, 1922, issue of THE WIRELESS AGE.

A. 1. For 1,500 meter reception, use coils of 1,250 to 1,500 turns each in primary and secondary and 500 turns in tickler. These may be standard honeycomb, Remler, or duolateral coils. These coils have an inside diameter of about 2½ inches and outside diameter of about 5 inches and about 1 inch wide. They are wound with No. 28 single silk covered wire. It is best to use a three-coil mounting here.

Q. 2. Also please give me the names of all the other parts used for this.

A. 2. Primary and secondary variable condensers are each .001 mfd. capacity. The grid condenser should preferably be variable up to .001 mfd. capacity. An ordinary air condenser can be used here. The grid leak is of 2 megohms resistance. The tube may be either a UV-200 or UV-201 Radiotron or else an Aeriotron type WD-11, the new Radio Corporation tube.

Q. 3. What volt battery should be used?

A. 3. The UV-200 or UV-201 requires a six-volt storage battery for the filament and 22 volts for the plate. The WD-11 requires only a single dry-cell although the single cell of 2 volts from a storage battery is satisfactory if proper resistance is used in the filament lead. The plate voltage is 22 volts.

Q. 4. Can a loud speaker be used with this set?

A. 4. A loud speaker cannot be used with this set unless you add two steps of audio-frequency amplification.

Q. 5. What distance can be had by 15,000 meters?

A. 5. You will probably be able to hear all the American high power radio stations, and under favorable conditions, most of the European stations. You must realize, of course, that this is code and not telephone.

Q. 6. What size of vacuum tube combination should be used?

A. 6. The tubes to be used are mentioned above. For amplifier UV-201's are used.

* * *

Theodore Stahl, Birmingham, Mich.

Q. 1. In your September number an article was published regarding some "French High Power Transmitting Tubes." Please advise me regarding manufacturer's name, address and serial numbers of these tubes.

A. 1. These tubes were made by the Société Française Radioélectrique, Levallois-Perret, France. We do not know their serial number.

Q. 2. Please give me the name and address of the publishers of "Radioélectricité."

A. 2. "Radioélectricité" is published at 12, Place de Laborde, Paris, 8e, France.

The Monthly Service Bulletin of the

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THE illustration which accompanies this article, shows Edgar C. Gause and his radio receiving station located at Kennett Square, Pa. The station is really more than just a receiving station, as Mr. Gause has done extensive experimental work in bringing it to its present state of excellence. Mr. Gause has heard broadcasting stations located in Cuba, Colorado and Michigan. Mr. Gause sometimes allows his neighbors to listen to the broadcasting music by holding the receivers of his radio set against the transmitter of the local telephone line. A loud speaking horn is used in addition to the usual head receivers. Mr. Gause is a member of the Chester County Radio Association of Parkesburg, Pa.

Radio receiving equipment of Edgar C. Gause, at Kennett Square, Pa.

△ △

WILLIAM K. AUGHENBAUGH, call letters 8AKI, has moved from Johnstown, Pa., to 1432 12th Ave., Altoona, Pa. A 5-watt I. C. W. transmitter is used at this station.

△ △

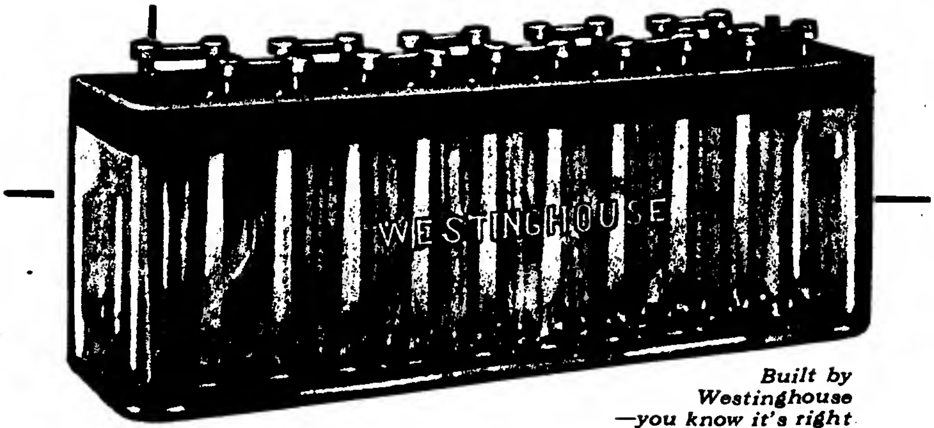
HARRY H. Carman, 2EL, Freeport, L. I., has been getting up early these cold mornings recently and has been successful in working 6XAD on Catalina Island several times since November 22nd, when transcontinental two-way work was first put through between these two stations. Both these stations and their equipment have been fully described in previous issues of THE WIRELESS AGE.

△ △

RADIO communication in Denmark, both by telegraph and telephone, is being furthered by two new clubs, organized and supported by some of the most prominent figures in Danish communication work.

△ △

THE Signal Corps, U. S. A., has decided to sell one thousand of its vacuum tubes, type VT-11, and it is offering the tubes to the public at $5.50 each, not more than three to any one person. The tubes were manufactured by the General Electric Company. They are hard tubes, take 1.1 ampere for the filament at 3½ to 4 volts, may be used for detection with 20 volts on the plate, and for amplification with 40 volts. Neither the filament nor plate voltages are at all critical. The base is such that the tube can be used in standard radiotron sockets. The tubes may be purchased from the Chicago General Intermediate Depot, Office Signal Supply Officer, 1819 West Pershing Road, Chicago, Ill.



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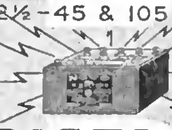

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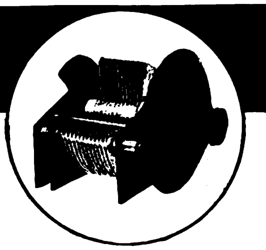

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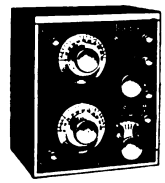

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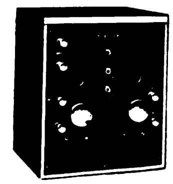

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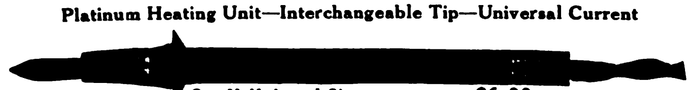

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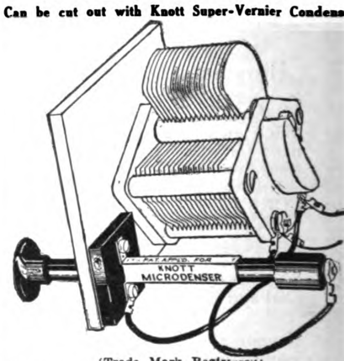

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1 AKF Norwich Radio Club, 51 Broadway, Norwich, Conn.
1 AKJ George H. Carter, 198 Moody St., Waltham, Mass.
1 AKK H. C. Maney, 129 Robinson St., Providence, R. I.
1 AKL C. N. DeRose, 289 Elm St., Northampton, Mass.
1 AKP Howard L. Miller, Forbes St.......Burnside, Conn.
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1 AKR H. C. D. Pollock, 15 Whitford St., Pawtucket, R. I.
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1 ANL Beaumont J. Morehouse..........Branchville, Conn.
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1 ANY Robert C. Moyer, 310 Summer Ave., Reading, Mass.
1 AON John H. Gough, 570 Adams St.....Quincy, Mass.
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6 CAE L. R. Higgins, 11 Marita St.....Anaheim, Calif.
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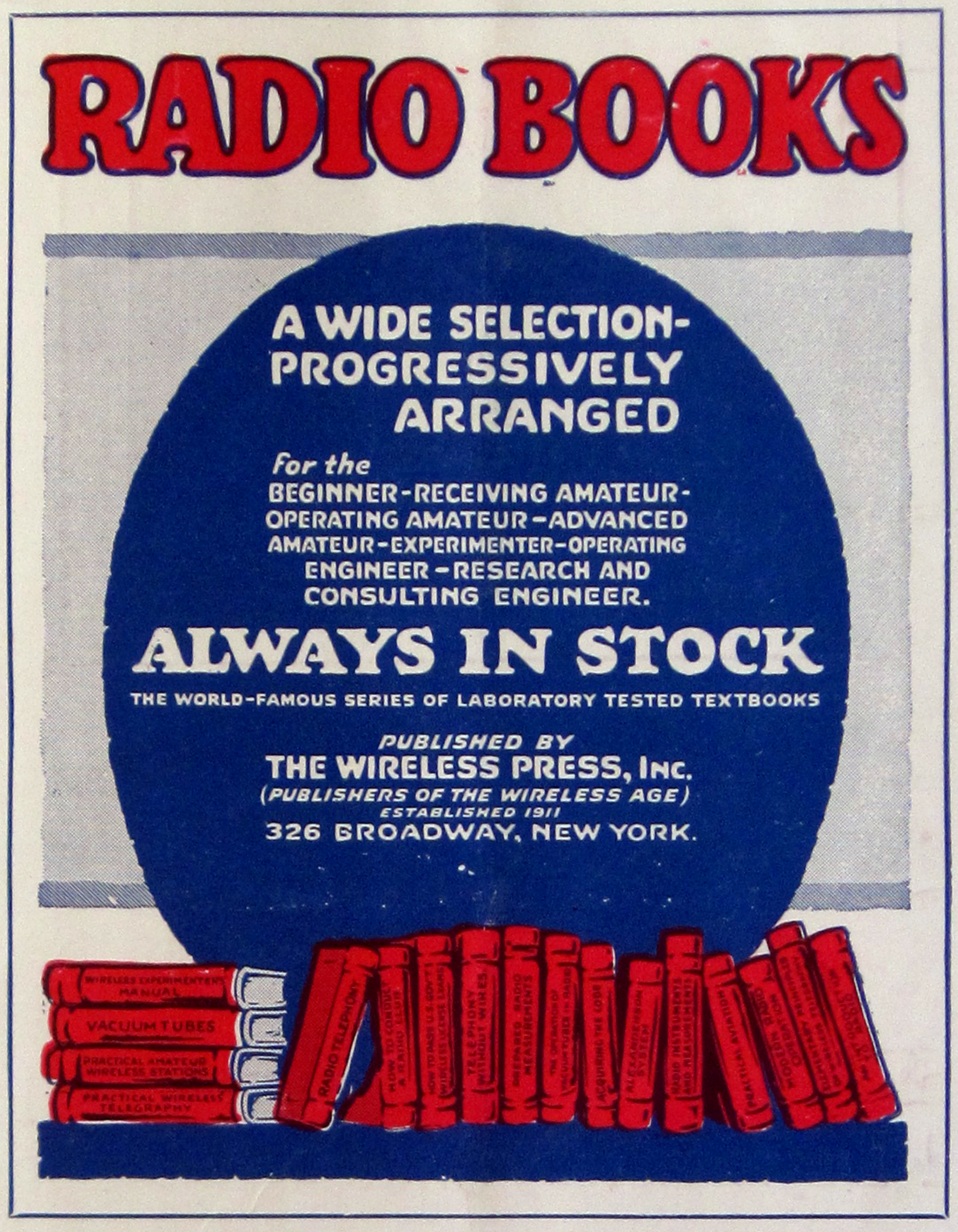

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