Popular Radio

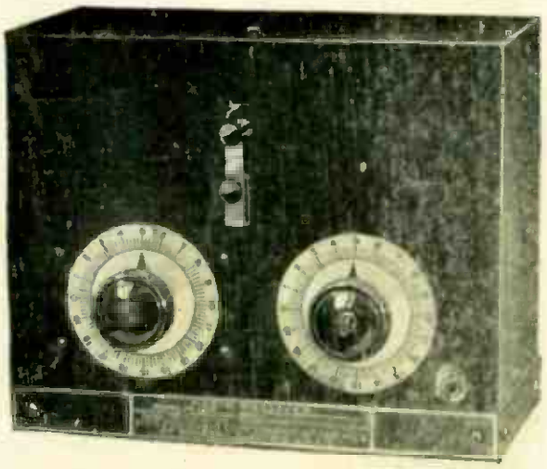
JUNE 1922

15¢

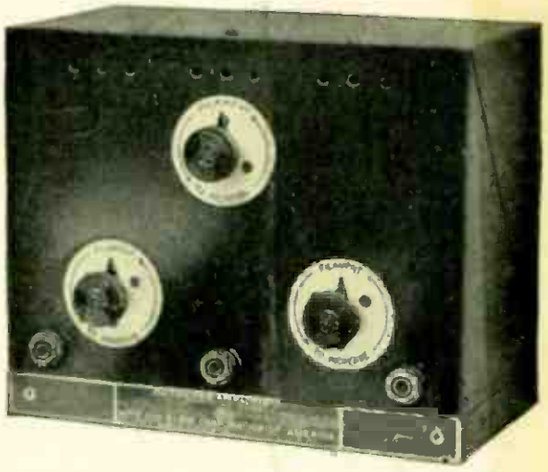
Read
RUNNING DOWN LAW BREAKERS BY RADIO
And Other Articles of Interest and Practical Value to the Radio Amateur

"ORDERS FROM HEADQUARTERS"

Crystal or Vacuum Tube Detection with the same set



Radio Receiver Model AR-1300



Detector Amplifier Model AA-1400

These two sets (Radio Receiver Model AR-1300 and Detector Amplifier Model AA-1400) meet the demand of the novice who wishes to start with a simple crystal detector and later to pass on to vacuum tube detection and amplification at minimum cost.

Radio receiver Model AR-1300 is a new tuner for the broadcast enthusiast. Used as a crystal detector it is a complete receiver. Used with Model AA-1400, here shown, the crystal detector is switched off and amplification is controlled by regeneration.

Detector Amplifier Model AA-1400 consists of a vacuum tube detector and two stages of audio-frequency amplification. It is especially adapted for use with receiver Model AR-1300 to increase the strength of broadcasted concerts. The individual filament control permits close regulation of the received energy. Distortion of broadcasted music is avoided by a special high-frequency resistance across the secondaries. Three telephone jacks insure ideal selectiveness ranging from simple tube detection to two stages of amplification.

PRICES (NOT INCLUDING ANTENNAE, TUBES, AND BATTERIES)

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Detector Amplifier Model AA-1400	75.00
Total for Combination	$125.00

SEE THESE NEW G. E. PRODUCTS AT YOUR NEAREST DEALER

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The Radiohome Audion Receiver

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The De Forest Catalog containing complete sets, parts and wiring diagrams will be sent on receipt of 12c in stamps.

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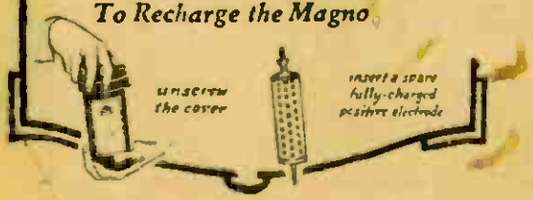
To Recharge the Magno



MAGNO *for* Radio

The Ideal "A" Battery Equipment

Can Be Recharged In One Minute
any time—any place
As Easily As Replacing An Electric Light Bulb

The Magno Round-Cell Storage Battery provides a permanent economical source of current, and assures uninterrupted service. It is a two volt unit. Three units connected in series comprises the ideal "A" battery equipment.

Each positive electrode is rated at 25-30 ampere hour capacity on continuous discharge. Dealers will exchange discharged electrodes for fully charged "spare" electrodes at 25c each.

Size, 3½ x 7 inches—Weight, approximately 5 lbs.

Descriptive Folder RA-6 on request.

Price per cell	$6.00
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Direct from us if your dealer cannot supply you. Dealers: Write for discounts.

"Every Battery Its Own Service Station"

MAGNO STORAGE BATTERY

Aeolian Bldg. — CORPORATION — New York

POPULAR RADIO

CONTENTS *for* JUNE, 1922

VOLUME I NUMBER 2

(Cover design by J. Clinton Shepherd)

DEPARTMENTS

VOLUME I JUNE, 1922 NUMBER 2

Published monthly by Popular Radio, Inc., 9 East 40th Street, New York, N. Y., telephone number Vanderbilt 9985; H. B. Emerson, President; P. O. Batch, Treasurer. Price, 15 cents a copy; subscription $1.50 a year in the U. S., $1.75 in Canada; elsewhere $2.00 a year, payable in advance The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

KENDALL BANNING, *Editor* LAURENCE M. COCKADAY, R.E., *Technical Editor*

A PAGE WITH THE EDITOR

TO state that the May number of POPULAR RADIO was "swept off the newsstands" is but to use a phrase that, (at the time this June number is going to press) is as trite as it is true. The sales of our first number were unprecedented; of the 125,000 copies distributed to the newsdealers it is estimated that 75 percent were sold within the first ten days.

* *

Apparently POPULAR RADIO is meeting the demand of the radio amateur; it has even exceeded our own expectations of what he wants.

* *

As evidence, the Editor has been literally deluged with letters from amateurs, radio experts and government officials. Here are a few specimen excerpts from the mail bag:

From the Navy Department:

"AN interesting and well-balanced publication—one which should appeal to that section of the general public who manifest only a casual interest in radio as well as the radio amateur, the professional radio operator and the radio engineer."

—COMMANDER S. C. HOOPER, U. S. N.

From the Bureau of Standards:

"YOUR magazine should be favorably received by many persons who are coming to find radio a field of much interest."

—S. W. STRATTON, *Director.*

From an Advertiser:

"To date—ten days after publication—we have received one hundred and ninety inquiries in response to our advertisement which appeared in the first issue of POPULAR RADIO. These inquiries come not only from all parts of the United States, but also from Cuba and Canada."

—THE MAN-DAY RADIO CORPORATION

From a Business Man:

"MAY I express my appreciation of the first issue of POPULAR RADIO. As a jaded reader of magazines and other forms of current literature, I can truthfully say that the first issue of POPULAR RADIO was a refreshing treat to me—a reader who does not have any knowledge of the mechanisms of radio, but through your pages began to understand what it was all about for the first time."

—GEORGE BARRETT ANDREWS

From the War Department:

"GENERAL SQUIER expressed himself as very pleased with your publication."

—LOUIS COHEN, *Signal Corps, U. S. A.*

From a Radio Expert:

"A VERY large fifteen cents worth; there is every reason for its success."

—PAUL F. GODLEY, *Montclair, N. J.*

From Radio Amateurs:

"POPULAR RADIO is the first radio magazine to really help me; it's one I can understand."

—JOSEPH SAHRER, *Meriden, Conn.*

"THE best and cleanest little knowledge-giver I have ever seen.

—CARL H. ELLERSICK, *St. Louis, Mo.*

"I CONSIDER POPULAR RADIO the finest and most thorough magazine I have ever seen in giving a plain, clear understanding of instructions for the amateur to follow."

—GEORGE A. MOORE, *Brantford, Ontario.*

* *

OUR first paid subscription was received April 5, 1922 from William A. Mackay, known to radio fans as 2AQB and famous as the creator of the Mackay system of Naval camouflage. Mr. Mackay thus becomes our oldest living subscriber.

* *

But the May number was only a starter. The following numbers will be bigger and better yet. Among the contributors to the next few issues are such distinguished radio experts and writers as Dr. Charles P. Steinmetz, Dr. E. E. Free, Hiram Percy Maxim, Dr. Henry Smith Williams, Ellis Parker Butler, George Creel, James H. Collins, Prof. Michael Pupin, T. Commerford Martin, Paul Godley, Homer Croy, Dr. Clayton H. Sharp, Watson Davis, Will Irwin, Gerald Stanley Lee, J. C. Gorman —not to mention our own Laurence M. Cockaday.

* *

THE first issue of POPULAR RADIO went on sale on the newsstands April 15th. The following Monday morning our Technical Editor received twenty-one questions for our "What Readers Ask" department. One of the questions was:

"Now that we have radio, where will the little birds sit that used to perch on the telegraph wires?"

The inquiry has been referred to the Audubon Society.

* *

To meet the demand from the news dealers, we are printing 40,000 more copies of this June number than we printed of May.

* *

To protect the radio amateur against misrepresentation in the sales of radio equipment, POPULAR RADIO is developing plans (a more extended notice of which will appear in the July number) for the establishment of the POPULAR RADIO INSTITUTE, to be conducted under the direction of our Technical Editor. No advertisement will be accepted for our pages until it has been approved by the experts connected with the Institute.

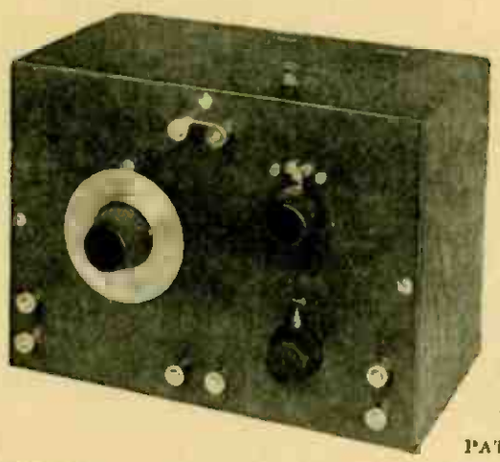
* *

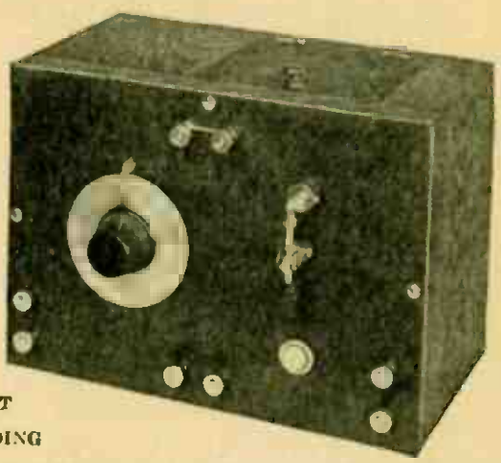
IN our July number will appear one of the most startling and important articles ever written by an American physicist—prepared exclusively for POPULAR RADIO, by the distinguished Dr. Charles P. Steinmetz.

Kendall Banning

Editor, POPULAR RADIO

MAN-DAY RADIO *for* QUICK DELIVERIES





OUR CIRCUIT
is covered by
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Type T R B-1 is a complete Man-Day Radio receiving outfit guaranteed to receive clearly up to 75 miles. Equipment consists of vacuum tube, 3000 ohm Turney phones, aerial, insulators, ground, lightning protector, 6-volt, 40 amp.-hour storage battery, 22½ volt B battery, two-circuit tuner, charging device. D. C. only (for A. C. $15 additional). Expert workmanship throughout. Complete, (list) $58.00.

Type C D R-1 is a complete Man-Day Radio outfit, guaranteed to receive clearly 35 miles from the larger broadcasting stations. This receiving outfit is equipped with 3000 ohm Turney phones, aerial, ground, insulators, lightning protector, bakelite panel, buzzer push-button,—all compactly enclosed in an open-top, handsomely-finished oak cabinet. Complete (list) $35.00.

Two-step amplifier matching above type T R B-1, with Jack control, added to the type T R B-1, the outfit will receive up to about 500 miles depending on the vacuum tubes used.

BOTH types of the above Man-Day Radio outfits are delivered complete, ready for setting up. They are by far the most sensitive and sharpest receiving sets made. It is the Man-Day Circuit which puts the Man-Day Radio in a class apart.

We can make immediate deliveries, but the present great activity in radio buying makes it imperative that you take quick advantage of this opportunity to get the most efficient radio outfit made—an outfit that sells at a popular price.

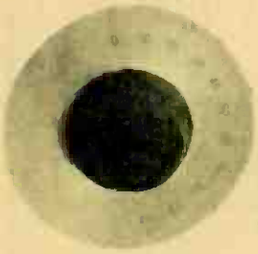
Man-Day Radio parts also ready for immediate delivery. If your dealer has not Man-Day Radio write us or order direct.

Liberal discounts to dealers and jobbers off the list prices.

RADIO PARTS *Ready for Quick Delivery*

Man-Day Binding Posts

Top cannot be detached. Knurled knob. Nickel plated. List price, 12 cents each.



Man-Day Dial

German silver dial with finger-ease knob. ¼" shaft; 3¼" diameter. List price, — 95 cents each.

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Finely polished and nickel-plated. Bayonet type socket with standard receptacle. List price — 95 cents each.

MAN-DAY CORPORATION
135 West 33rd Street
New York City

DEPARTMENT OF COMMERCE
OFFICE OF THE SECRETARY
WASHINGTON

M April 8, 1922

Mr. Kendall Banning, Editor
Popular Radio
9 East 40th Street
New York City

My dear Mr. Banning:

The advances made in the field of radio telegraphy and radio telephony during the past year have been phenomenal. These advances have been in large measure due to the great interest which amateurs have taken in this whole field. I am sure that the government has every wish to see the interests of the amateur radio operator fully safeguarded and will always be glad to cooperate with him in the extension of the usefulness of this service.

Yours faithfully

Herbert Hoover

HH.MS.

SECRETARY HOOVER TO THE READERS OF *POPULAR RADIO*

Once upon a time the radio fan was afraid of so-called "governmental interference." This fear originated in the necessary repression of all but governmental and certain carefully guarded commercial stations during the war. Since then, however, the United States has done and is doing far more than any nation in the world to encourage the amateur in the development of the radio art—and will continue, as Secretary Hoover here assures the readers of POPULAR RADIO.

International

THE RADIO ON THE TRAIL OF THE CROOK

Every evening at about 8:00 o'clock the chief operator of broadcasting station WGI, Mr. L. D. Trefry, sends out police reports that warn the radio amateurs of New England to be on the lookout for certain fugitives whom the authorities are seeking. The station offers $10.00 *to every amateur who assists in making an arrest.*

Popular Radio

VOLUME I JUNE, 1922 NUMBER 2

Running Down Law Breakers *by* Radio

By FRED C. KELLY

THE radio was first used—and used successfully—for running down criminals as far back as 1902, only ten years after Sir William Crookes made the astounding announcement to the skeptical world: "Here is revealed the bewildering possibility of telegraphy without wires, posts, cables or any of our present costly appliances."

The significant police message was sent from Avalon, on the Island of Catalina, to San Pedro, on the mainland of California—towns which at that time had communication with each other only by slow mail steamers. The message announced that two colored thieves were about to land with their loot from a vessel which was specified.

The two thieves were arrested on the gangplank.

Between that elementary step and the most recent development of the radio in transmitting fingerprints and photographs of malefactors (a sort of long range Bertillon system of identification employed by the French government), a vast amount of experimenting has been done. Yet the uses of the radio by the police are only barely beginning.

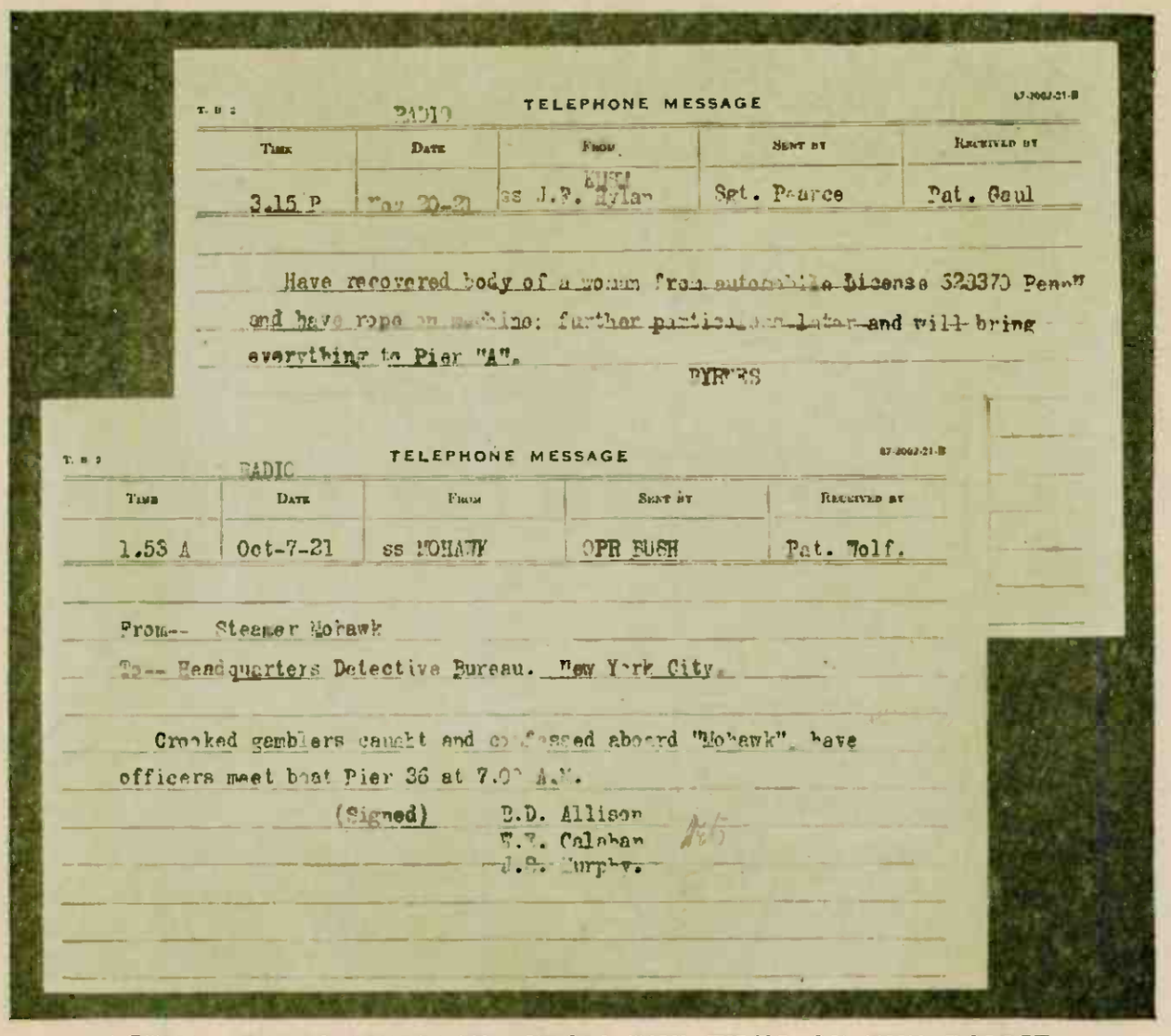
The Police Department of New York has equipped its police boats and is at present equipping its airplanes with radio apparatus.

The Police Department of Chicago is experimenting with direct communication between headquarters and its patrolmen on their posts.

The Police Department of Boston is broadcasting warnings every evening as a regular part of its daily routine.

And some of the most interesting uses of the radio in rounding up crooks by radio are now being worked out by the police of our smaller cities and towns, as is here told by a war-time official of the United States Secret Service and a well-known authority on detective methods.

—EDITOR



TELEPHONE MESSAGE

RADIO

Time	Date	From	Sent by	Received by
3.15 P	May 20-21	ss J.P. Dylan	Spt. Pearce	Pat. Gaul

Have recovered body of a woman from automobile License 323370 Penn and have rope on machine: further particulars later and will bring everything to Pier "A".

BYRNES

TELEPHONE MESSAGE

RADIO

Time	Date	From	Sent by	Received by
1.53 A	Oct-7-21	ss MOHAWK	OPR BUSH	Pat. Wolf.

From-- Steamer Mohawk

To-- Headquarters Detective Bureau. New York City.

Crooked gamblers caught and confessed aboard "Mohawk", have officers meet boat Pier 36 at 7.00 A.M.

(Signed) D.D. Allison
W.F. Calahan
J.S. Murphy.

ACTUAL RADIO MESSAGES FROM THE FILES OF THE POLICE DEPARTMENT

How the radio enables headquarters to keep in touch with guardians of the law on the water and in remote places with which communication has heretofore been impossible, is evidenced by these typical radiograms

IF there is one thing I dote on it is crime. Though I have never taken an active interest in perpetrating crime myself, I like to know the mental processes of those who do. A burglar friend once told me of a scheme he had used for ascertaining if a family is temporarily away from home. He placed a small thin leaf in the keyhole of the front door and returned two days later to note results. If the leaf had been crushed by the inserting of a key in the lock, he would then know that the house was not deserted. But if the leaf was undisturbed, he intended to take a chance and break in. After hearing of this, I went to a police sergeant acquaintance to learn of police methods for protecting homes when the family is absent. He told me of various systems of burglar alarms, and the care required to have wires for such apparatus either buried or beyond the reach of anyone who might desire to cut them.

It is a fascinating battle of wits between those who are trying to enforce the law and those who would break it. In many respects the criminal has the advantage. He knows his own plans and also knows in a general way the working methods of the police, while the police know nothing of projects that a criminal may have in his head. Before a burglar enters a house, he finds out when the policeman patroling that beat is most like-

ly to be somewhere else. But the policeman cannot plan definitely how to outwit the burglar because he doesn't even know that the burglar is going to be there. If he knew as much about the burglar's plans as the burglar does about *his*, his job would be easy enough. The best the police can do is to have a system so broad and sweeping that it will discourage crime wherever or however planned. This system is at times startlingly effective—and radio telephones are going to make it even more so.

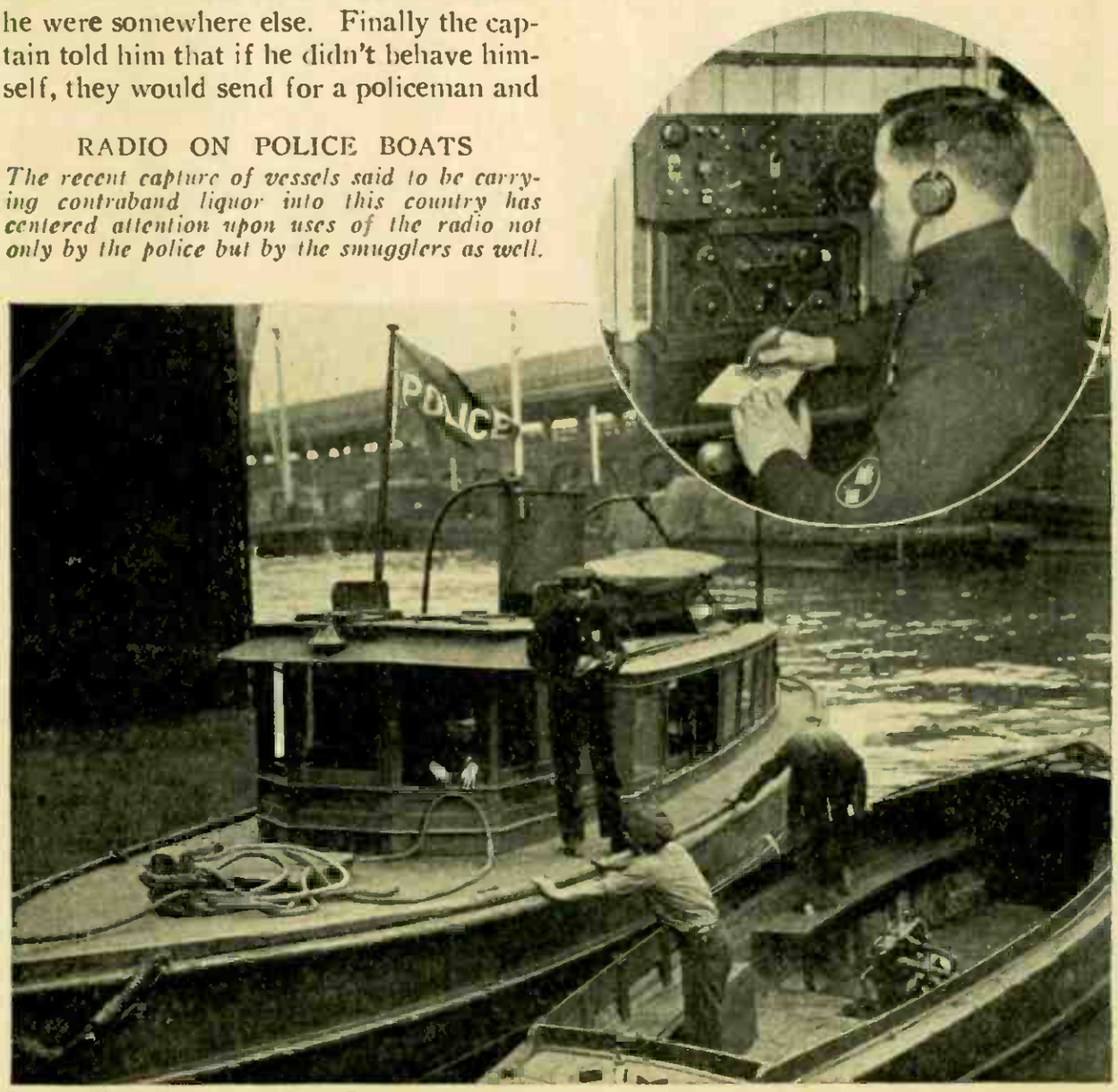
On a small boat lying at anchor in New York harbor one night, a man became obstreperous and threatened to shoot the captain and others. He was so troublesome that several aboard almost wished he were somewhere else. Finally the captain told him that if he didn't behave himself, they would send for a policeman and have him placed under arrest. The idea of summoning a policeman out there in the middle of the bay struck the trouble-maker as highly amusing, and he laughed heartily. A raucous, sneering laugh it was, like an old-fashioned stage villain.

But the situation wasn't so funny as he thought. In a few minutes a New York policeman stepped aboard and took the fellow in charge. The captain had 'phoned by radio to police headquarters and a message had been sent from there to the police launch which was less than half a mile from the disorderly man.

The New York police department is about to add other patrol launches, each equipped with radio receiving apparatus,

RADIO ON POLICE BOATS

The recent capture of vessels said to be carrying contraband liquor into this country has centered attention upon uses of the radio not only by the police but by the smugglers as well.



Photos by Kadel & Herbert and Brown Bros.

and criminals who seek to go down to the sea in ships may have many a plan upset. Scores of messages are telephoned to New York police headquarters each day from incoming and outgoing ships. I give elsewhere a few samples of these selected at random. Even so personal an enterprise as committing suicide is going to be more and more difficult.

Those not familiar with metropolitan police methods may be disappointed that radio telephones have not worked a greater revolution in means of communication between headquarters and men on the street. The one drawback to radio talk between policemen is lack of privacy. If a sergeant at central office should 'phone to an outlying precinct station to send reserves to Madison Square Garden because of a possible riot, and this message were picked up by amateurs, within half an hour the bystanders on hand at Madison Square Garden to witness the excitement might number about 2,000,000.

Central News Service

COULD YOU IDENTIFY THESE MEN?

This is what a photograph looks like after it has been transmitted over the Belin machine. The police of France are experimenting with this method of long-range identification.

Moreover, even the old-fashioned telephone system has bigger possibilities than is generally understood. I sat one night talking with the desk sergeant in a precinct station when he received a message about an attempted burglary that he desired to give to Patrolman Potts, then strolling about his beat.

"I'll call Potts to the 'phone," remarked the sergeant, and he pressed a button. Four minutes later Patrolman Potts rang up from a police call box on a street corner, and inquired what was wanted.

The man at the desk had switched on a signal in a street lamp-post. This signal consisted of a green light—two short flashes, repeated every four seconds until it brought an answer. When several policemen are on the same beat, there might be a different signal for each individual. The usual plan, I believe, is for one patrolman to be designated to watch for the signal and then carry the message to the fellow-officer who is wanted.

If, instead of a wire 'phone system the message were sent by radio, the result might be much the same.

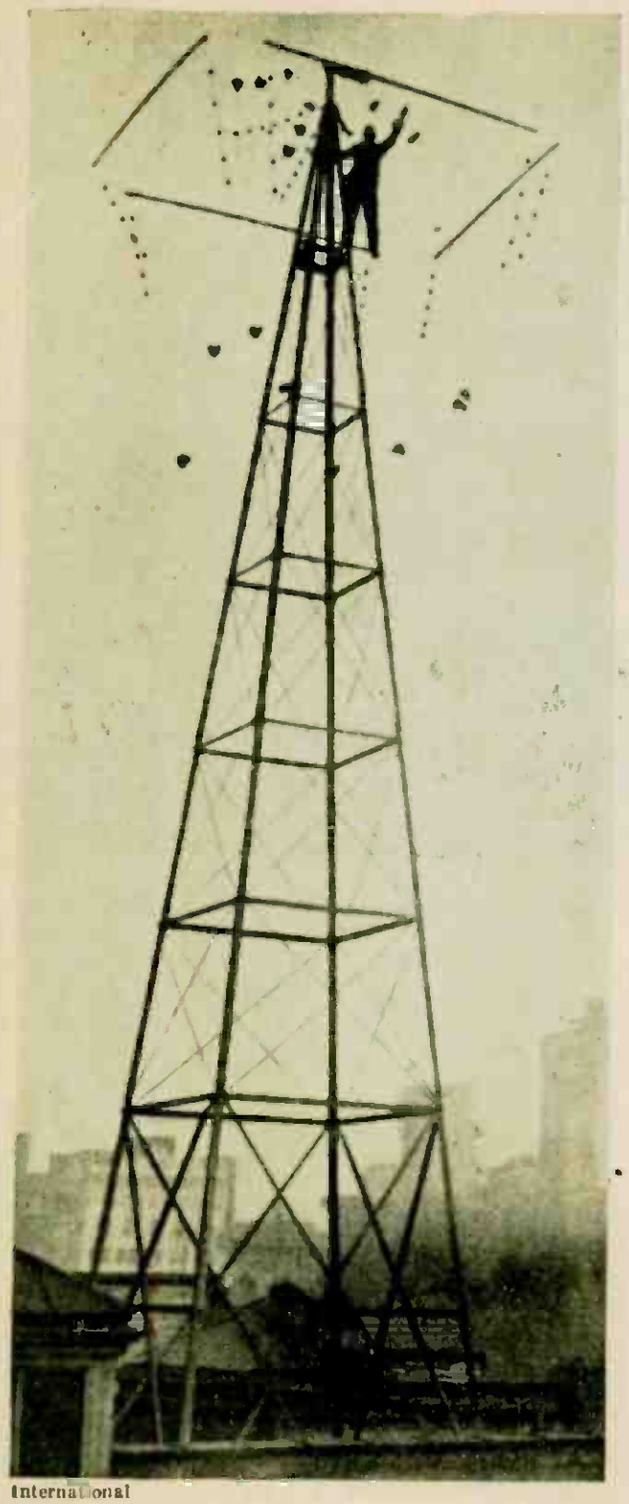
Radio receiving apparatus small enough for a man to carry in his pocket has been perfected. But it is necessary to wear a headgear with receivers over the ears and if all policemen wore these as they walked about the streets they might receive radio messages, but might fail to hear much else. For the present, police radio messages are likely to be sent only to regular receiving stations, placed at strategic points, and the chances are that it will be some time before patrolmen regularly receive orders as they pace about their beats. But already in use in Chicago is a police automobile equipped with both receiving and sending apparatus. While there is the handicap already mentioned that the messages lack privacy, this outfit has distinct possibilities. With it a policeman could chase an automobile thief or a murderer and report progress to his chief, ask for further orders, or have other pursuers sent in another direction. The trouble is, though, that a straightaway long

Central News Service.

A MACHINE THAT TRANSMITS FINGER PRINTS BY RADIO

The recent announcement that the Police Department of Lyons, France, has adopted a device for sending portraits of crooks by radio brings into prominence the invention of Edouard Belin, the telestereograph. Belin's apparatus consists of a copper cylinder, not unlike that in one of the early Edison phonographs. This cylinder is made to revolve while at the same time a microphone diaphragm (somewhat resembling the sound box of a phonograph and a recording stylus) passes slowly along it in a lengthwise direction. The picture is placed face downward on the copper cylinder after the latter has been covered with shellac; the cylinder is then placed in hot water so that the paper may be removed while the gelatine film of the print is left on it. Some of the gelatine is dissolved but this dissolution is proportional to the lights and shadows of the picture; because of this fact the picture forms a bas relief upon the cylinder with the darker portions higher than the lighter ones, inasmuch as the darker parts are more resistant to the action of the water. The cylinder is then placed in the machine and the apparatus set in motion. The stylus of the microphone presses against the surface of the picture, covering point by point every part of it, thus causing the microphone diaphragm to vibrate to a greater or less extent, according to the height of any given portion of the bas relief. As this diaphragm is exactly like the transmitter of a telephone except that it is moved by the stylus instead of sound waves, it sends impulses of electricity to the receiving apparatus. The

path made by the stylus over the revolving cylinder is spiral in form. At the end of the wire is the receiving apparatus. This comprises a cylinder which moves at exactly the same rate of speed as that of the sending apparatus, but instead of the metal needle which formed the transmitting stylus or "translator" the stylus here, whose function it is to impress the sensitive film upon the cylinder, is a fine thread of light. The electrical impulses which are sent over the radio or wire from the gelatine film as just described, set in motion an extremely sensitive galvanometer, in which there is a delicate quartz thread bearing a small mirror. This mirror is twisted slightly in one direction or the other in precise accordance with the movements imparted by the stylus to the microphone at the transmitting end. At one side of the mirror is a lamp whose rays are focussed upon it; this pencil of light shifts its position so that it reproduces upon the cylinder the lights and shadows of the original picture.



International

THE AERIAL OVER THE POLICE HEADQUARTERS OF CHICAGO

During the past few months experiments have been carried on in Chicago by George E. Carlson, of the Department of Gas and Electricity, for keeping police headquarters in constant touch with its patrolmen by means of the radiophone. The experiments are significant in that they anticipate what will probably be a highly valuable application of wireless. This picture shows the aerial located on the roof of the Chicago City Hall, in which the police headquarters are located.

distance chase between a criminal and a policeman is a rare occurrence. We see such things in moving pictures but rarely anywhere else. The difficulty about catching a criminal is that one usually doesn't know which direction he took. Hence, the only way to catch him is to notify people in *all* directions to look for him. This is where the greatest use of radio telephones for thief catching seems likely to be—broadcasting descriptions and other information from the police of one town to another and to the public.

With the number of private radio receiving outfits likely to be in use a year from now, an escaping criminal would not feel safe in approaching any farmhouse for food or shelter, no matter how obscure the lane on which it is located. Robert Fay, the German agent who made a marvellously ingenious escape from Atlanta penitentiary and got to Spain before he was captured, once told me how he never went to a farm house for food until he had first made certain that no telephone wires entered it. Absence of telephone wires will no longer give an escaping criminal safety.

I once asked a famous New York criminal what he would do if he suddenly found it necessary to disappear from his ordinary haunts and keep in hiding for several months without danger of being traced.

"I'd take a lower berth from New York to Canada," he replied, "and when I got well up into the woods, I'd open the window in my berth at some little siding or small way station and drop off the train unobserved. I probably could stay about there in the woods, at farm houses and small villages for a long time before it would occur to people that I was anybody in particular. Few of the natives in such outlying places have telephones or bother to read the newspapers."

There are a number of flaws in this scheme that I need not go into here. But the main point is that when nearly all the country people have radio receiving out-

fits, as seems likely to happen, there won't be any more outlying points.

The greatest weakness in our police system is that it is local rather than national. There is surprisingly little systematic co-operation between the police of different cities. They are willing enough to help each other, but are poorly organized to do so. If a clever forger victimizes banks in Detroit, then in Cleveland, it should not be difficult for the police in Pittsburgh or Buffalo to figure out that he is evidently working eastward. But they probably never know this until too late. Radio broadcasting of such information should help to unify police work over a wider area.

One of the first cities to seize the opportunities offered by radio 'phones for police work was Dallas, Texas. This was the result of a letter to the Dallas police department from Frank M. Corlett, manager of a Texas division of The American Radio Relay League, the big national organization of amateur radio operators. Corlett proposed that the local police broadcast such information as they wished to make public about crime, and let amateurs throughout Texas and adjoining states turn this over to the police or constables of their communities. As the police department had no radio apparatus at that time, the broadcasting was done at first by Mr. Corlett. After the value of the plan was proved, the city bought apparatus for the police department. The station has ordinarily a range of 200 miles in day time and 500 miles at night. Messages have been heard as far away as North Dakota and California. Louis W. Turley, the Dallas police and fire commissioner, declares that one capture which resulted more than paid for the installation of the apparatus. By way of rewarding the amateurs who receive their messages and co-operate with them, the Dallas police not only send out crime reports, but furnish a complete daily entertainment—concerts, news of sports, sermons, lectures, and other features. So far as I know this is the only municipally-owned radio outfit that furnishes such service and is probably the first time on record where a police department has ever made itself so entertaining as well as useful.

An important feature of the radio as applied to the running down of crooks is the chance it gives to the radio amateur to take part in the capture of the fugitives. One of the most spectacular of these incidents occurred recently on a payday in the small town of Crafton, Pa. The doors of the First National Bank had been open half an hour and the employees were making up the payroll for some

A POLICE CAR EQUIPPED WITH A RECEIVING AND SENDING RADIO SET

International

That the radio apparatus installed on this police car is no toy is indicated by the size of the resonance coil that is supported by an especially built framwork.

twenty firms, when a car drove up outside and stopped. In the car were five men, including the driver. Quickly four of them entered the bank and drew the blinds, while the fifth remained seated in the car.

"No funny business now," warned the leader of the visitors. "We want that money."

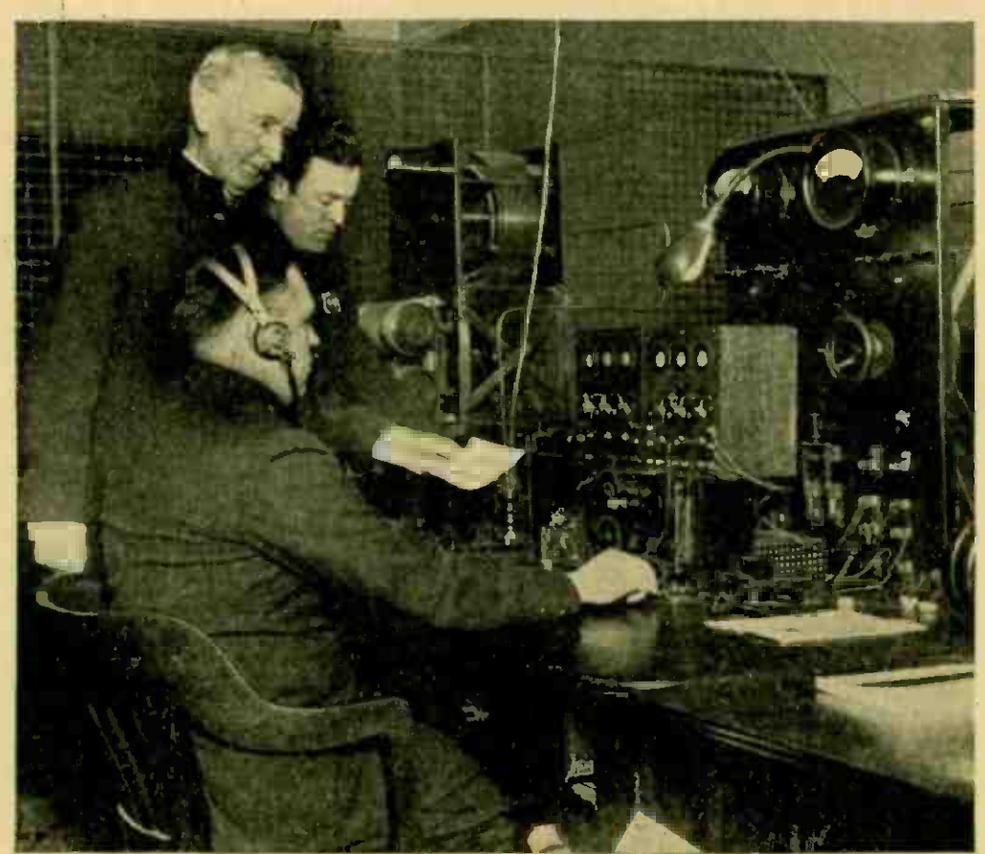
The employees of the bank were driven into the vault, at the point of the revolver, but as the teller went in he succeeded in throwing the safety switch so that the air-tight door could not be closed. This left only the "day door"—and for his pains he received a clubbing from a revolver in the hands of one of the men.

The assistant cashier was standing at a cabinet examining a note when the men entered. On the window sill near him was a pistol. He started to reach for it.

"Get that guy," one of the robbers yelled.

The cashier darted for the weapon, but a bullet reached him. He was killed.

Scooping up $24.000 the four men ran down the steps to the machine and sped away. Just at this moment Hebert W. Haberl, a sophomore at the Carnegie Institute of Technology, came around the corner on the way to the bank to make a deposit, arriving in time to catch a glimpse of the speeding machine and to make a note of the plate number. Rushing back to his home-made radio set, he sent out an emergency. An amateur in Pittsburgh, eight miles away, picked up the message and hastened to his car, drove to the police station where he picked up five detectives and gave the police their first information about the robbery. The pursuers rushed toward Crafton. On the way they met the bandits' car, and recognizing the plate number, they opened fire. The bandits' car was finally wrecked and



Kadel & Herbert

WHERE THE OUTGOING POLICE MESSAGES ORIGINATE

At New York police headquarters, where connections are maintained with the police boats especially and where it presumably will be maintained in the not distant future, with the squadron of airplanes that constitute a part of New York's police patrol.

Brown Bros.

IN THE OUTLYING DISTRICTS THE RADIO WILL BE INVALUABLE TO THE POLICE

Among the State constabulary forces and such far scattered forces as the Northwest Mounted Police of Canada, the radio will eventually be extensively used in the running down of criminals.

the money recovered, although the robbers succeeded in escaping.

Notwithstanding the big possibilities of radio 'phones for rounding up criminals, it is easy to exaggerate. No one appreciates so well as the experts that the system will have its limitations. This is true of every great invention. Those who know best what a thing can do and why it does it, are the ones most capable of seeing also what it cannot do. One of the most conservative men I have ever talked to about the ultimate speed and uses of the aeroplane is Orville Wright, who invented it. I have not heard of a radio expert who expects the wireless 'phone to supercede the wire 'phone for police communication. But it is certain that broadcasting will be an important adjunct to criminal detecting methods now in use. The cost of reaching hundreds of small villages and outlying country sections by telegraph or ordinary long distance 'phone would be so great as to be prohibitive. By radio the cost is so trifling that it is well worth while to send out bulletins even though only a small percentage of shots hit a mark. And the fact that the radio service used by the police at present is effective augurs what developments will take place.

¶ *While the police are experimenting with radio, the crooks are actually using it—and using it extensively, as the recent investigations into the activities of the rum-runners show. In the July issue another member of the Secret Service will tell how the crooks are doing it, and how they are being caught at it.*

Wireless That We Can See

Between the Tremendous Radio Waves 150,000 Meters Long and the Tiny "Gamma" Wave .000,000,000,05 Meters Long Are Included All of the Ether Vibrations that the Human Senses Can Detect. And All of These Waves Are Related to One Another.

By E. E. FREE, Ph.D.

The wavemeter developed by the Bureau of Standards for measuring wavelengths.

SOME DAY we may be able to hear light as well as to see sounds. Indeed, science has already made it possible to make visual certain sound waves—or at least the effects produced by sound waves. An example of a photograph of a sound (called an "occillogram"), is reproduced at the top of Page 90. It is not at all inconceivable that when more is known of the range of ether waves and the two as yet unexplored areas are understood that some amazing possibilities will be opened up for appealing to the human senses in ways that are not yet known.

Light and wireless are the same thing. Light is a kind of wireless composed of waves with a very short wavelength. X-rays are wireless of still shorter waves. Shortest of all are the wireless waves called "gamma rays"—the rays given out by radium, the last despairing S O S signal of the radium atom as it explodes.

All of these rays and waves, light and wireless and the others, are waves in the ether, waves of the kind called electromagnetic. Electromagnetic waves are waves started by electric disturbances. They are similar to the waves which you start on the surface of a still pond of water when you drop a stone into it. The various kinds of ether waves, just like the water waves may be classified according to wavelength, according to the distance from the crest of one wave to the crest of the wave which follows behind it.

The great water waves of the ocean, the waves which roll in as breakers onto the beach, may be hundreds of feet from crest to crest. That is, they have a wavelength of 200 or 400 or 600 feet, whatever the crest-to-crest distance may be. The tiny waves in the still pond into which

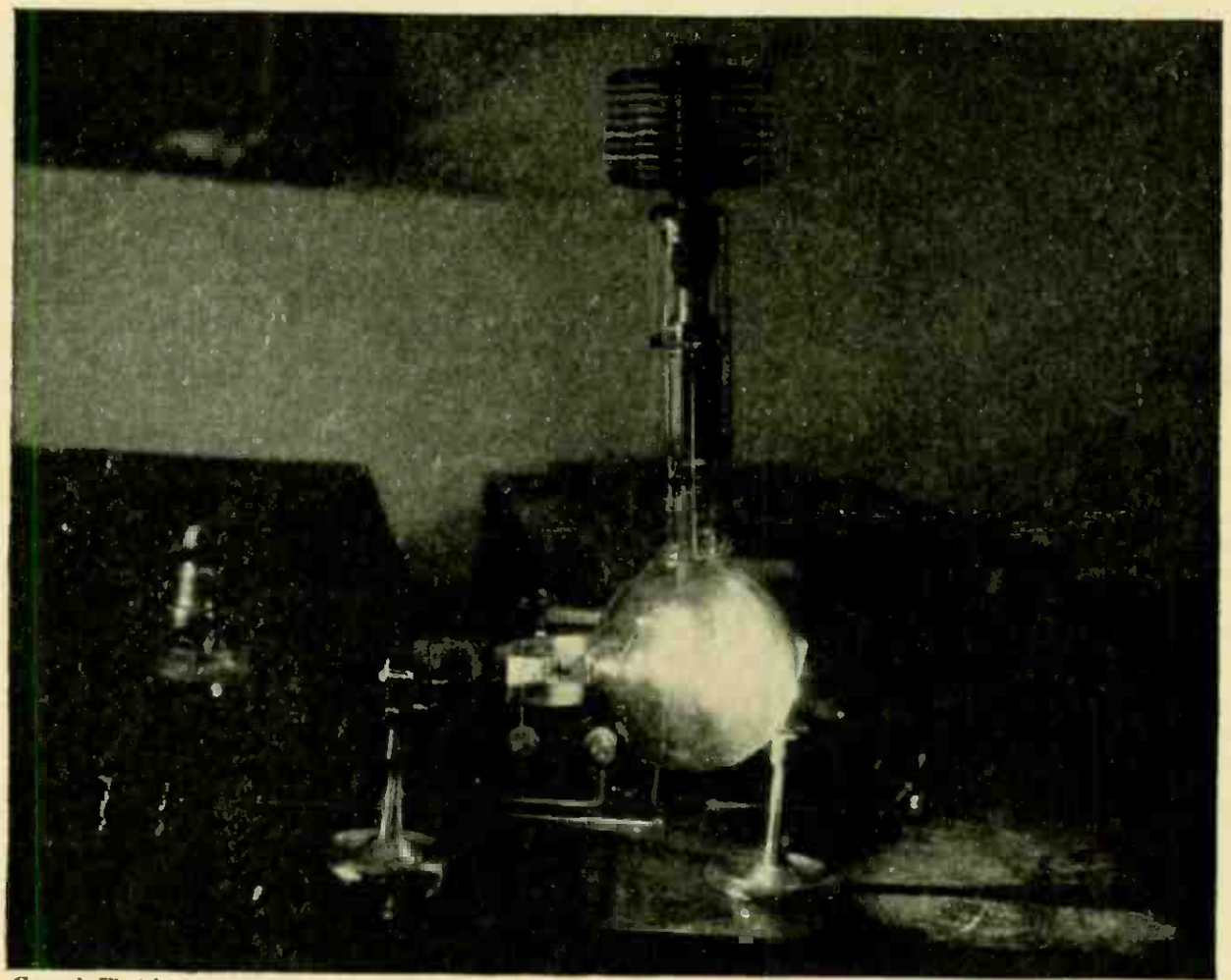
you have dropped a little pebble may be only an inch or half an inch or even less, from crest to crest. But between the pond wavelets with a wavelength of a fraction of an inch and the mighty ocean waves of lengths up, perhaps, to half a mile, there is no real difference in kind. There is only a difference in size in wavelength.

Exactly so with light and wireless. There is no difference in kind, in real nature; there is only a difference in wavelength.

But, of course, this difference in wavelength is a very real and important difference. Our eyes happen to be adjusted to perceive, to "see" only a certain range of wavelengths, a rather limited range, too. And all of these "visible" waves are very short. Even thousands of millions of them would not equal the length of some of the great waves of wireless.

X-rays are shorter still, but of the same family. Violet rays, the so-called "infra red" rays or radiant heat, the "gamma ray," all these are other brothers. They are exactly the same thing as light and wireless; they are merely longer or shorter; they differ only in wavelength. All of them are waves in the ether. All are of the same race and nature, alike just as the pond wavelet and the great ocean roller are alike. And they differ only as these two differ—in size.

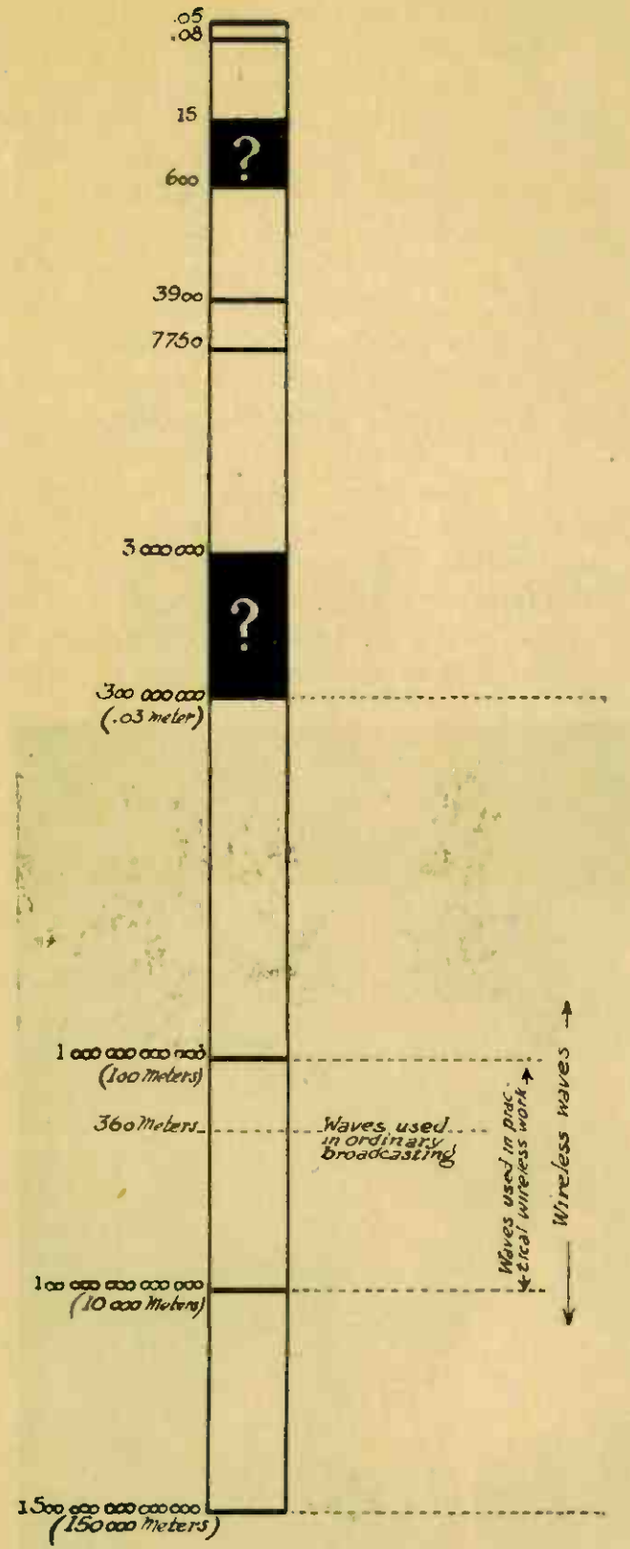
Now let us see just what these size differences are. The ordinary waves of practical wireless are from 100 meters to 10,000 meters long. That is, from the crest of one wave to that of the next one, as they follow each other along through



General Electric

A COUSIN OF THE RADIO WAVE

The X-ray tube invented by Dr. W. D. Coolidge. It operates on the same principle as the audion tube. Unlike its predecessors, it can be used continuously and does not require adjustments of the vacuum.



THE ENTIRE ETHER WAVE FAMILY, SHOWING THE TWO UNKNOWN BROTHERS

The relationship between the radio waves and the various light, sound and other waves are illustrated in this diagram. These wavelengths are indicated in Angstrom Units. Note the two as yet unexplored areas.

space, there is a distance ranging from 100 meters to 10,000 meters, (328 to 32,-808 feet) depending upon the wavelength that is used in radio transmission.

In experimental work (though not, so far as I know, in practical wireless), ether waves of both longer than 10,000 meters and shorter than 100 meters have been produced, transmitted, and received.

And while we are considering extra long waves we must not forget the very long impulses which Marconi has picked up and which he believes to be of an origin outside the earth, perhaps from Mars. These remarkable waves are reported by Marconi to have been sometimes as long as 150,000 meters, which is, I believe, the longest ether wave yet detected (or produced) by human agency. One hundred and fifty thousand meters is 492.000 feet. or over ninety-three miles—a distance as great as that from New York to Philadelphia—for illustration.

This is the great-grandfather of the whole wave family. With it the series of ether waves begins.

The next shorter wave than this, the slightly younger brothers that are not quite so tall, are the usual wireless waves that run down to about 100 meters long. Within this range we can get, and do get and use, practically any wavelength we want. All are about alike. All are produced by sparks, or other electric disturbances, and are picked up and translated for us by audion tubes, crystal detectors or similar devices.

Even below the 100 meters which we are thinking of as the lower limit of wireless, the waves remain about the same. They are created similarly. They can be similarly picked up and detected. Only, as every wireless fan knows, they decrease in range, in ability to go a long way through the ether.

But suppose we decrease continually the wavelength of our wireless; suppose we produce shorter and shorter waves, waves down to a length of one mete or of one-tenth of a meter, or even less. What will happen then?

Keystone View Co.

A MACHINE THAT CONVERTS LIGHT WAVES INTO SOUND

By means of this device called the optophone, invented by Dr. E. E. Fournier D'Albe, the letters on a printed page are, by a process of illumination, translated into a series of noises which the blind can interpret in the form of words.

A curious phenomenon takes place. As we decrease the wavelength the waves become less and less like typical wireless waves and more and more like another kind of wave—a kind of wave which seems, at first sight, to be totally different. More and more like waves of—what do you think?

Heat. Plain ordinary heat—the heat you feel when you stand in front of an open fire; the heat given out by the filament of an electric lamp.

Are heat waves, then, the same as wireless waves?

Certainly they are. They are merely very much shorter waves. The fire is wirelessing to you when you feel its warmth.

In actual length, measured in meters, the heat waves are very short. The longest of them which have been studied by scientists are about .0003 meter long, or about one-tenth of an inch. The shortest wireless waves which have been studied so far in the laboratory are about one hundred times this long, or about .03 meter, or nearly 12 inches. There is, therefore, a gap between the longest heat waves and the shortest wireless waves, a gap not yet filled in by scientific knowledge.

Before we investigate this undiscovered gap, let us go on running our eye down the ether wave family. What are the still shorter waves like, the waves shorter than the heat waves from the fire? Here there is no gap. Heat waves shade insensibly into visible light.

Suppose you heat a piece of iron in a flame, or better still, by passing an electric current through it. First it is cold to the touch, then warmer; warmer that is,

to actual contact of your finger. Gradually it gets warmer still. You can feel the heat from it even when your hand is an half inch or so away. You do not have to touch it.

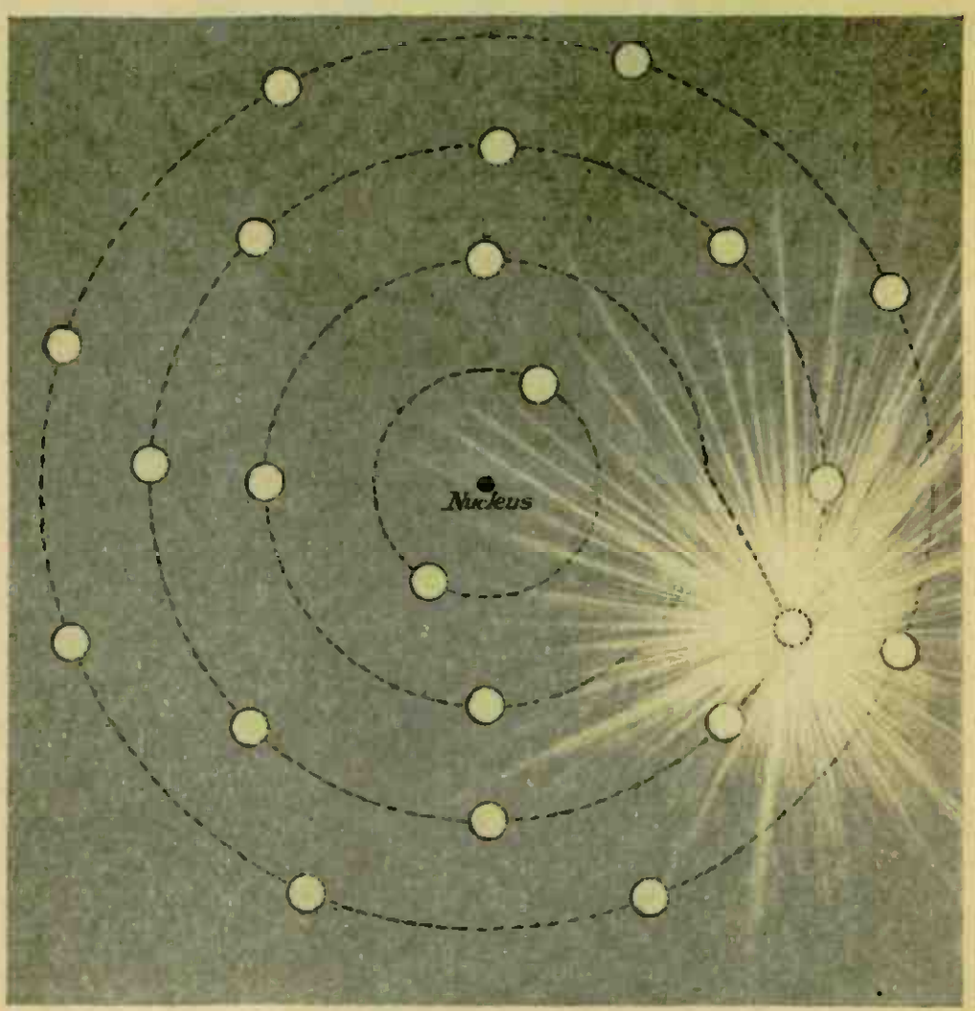
This is radiant heat. The iron is giving off rays of heat, the shorter wireless waves just like the wireless waves that come from the fire.

But the iron gets still hotter. It radiates more heat, and you would learn, if you analyzed these heat rays by means of physical instruments, that the wavelength of the rays was getting shorter. That as the iron got hotter it gave off shorter and shorter rays of heat.

Presently the iron glows. It gives off light. At first this light is a dull red light. What has happened?

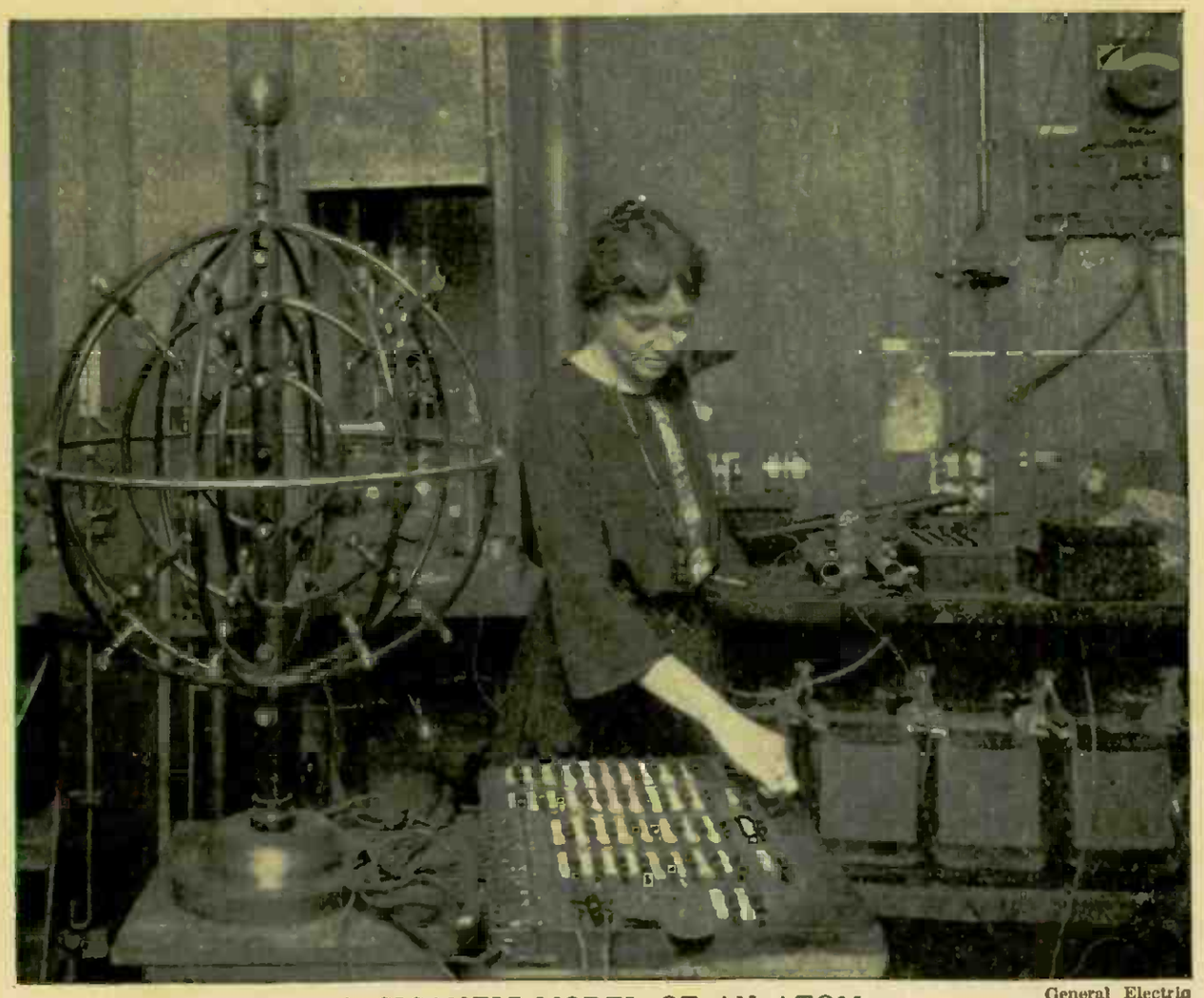
Merely this. The heat rays have gotten short enough to be visible. They have become light.

At first, as everyone knows, the light is red. But higher heating produces not only more light from the iron, it produces a different light; a light of different shades; first orange and yellow and finally, when the iron is very hot, a pure white. This, too, is merely a matter of wavelength. Red waves are the longest visible waves, the longest kind of light. Orange waves are a little shorter, yellow a little shorter still. The entire spectrum, the six colors of the rainbow, are distinguished physically only by the wavelength of the light. Next in length to the yellow wavelength is green, then blue, and finally violet, the shortest of all. White light is merely a mixture of all of them, of waves of various wavelengths.



HOW AN ATOM PRODUCES LIGHT

Occasionally one of the electrons that move about the nucleus of the atom jumps from its own orbit into another. This phenomenon produces a pulse of light.



General Electric

A GIGANTIC MODEL OF AN ATOM

The electric lights represent the electrons that revolve about the nucleus. By a manipulation of the switchboard any combination of electrons from 1 to 56 may be represented by the lamps.

The numerical wavelength at which radiant heat ceases to be heat and becomes red light is a wavelength of about .000000775 meter, less than one-millionth part of a meter.

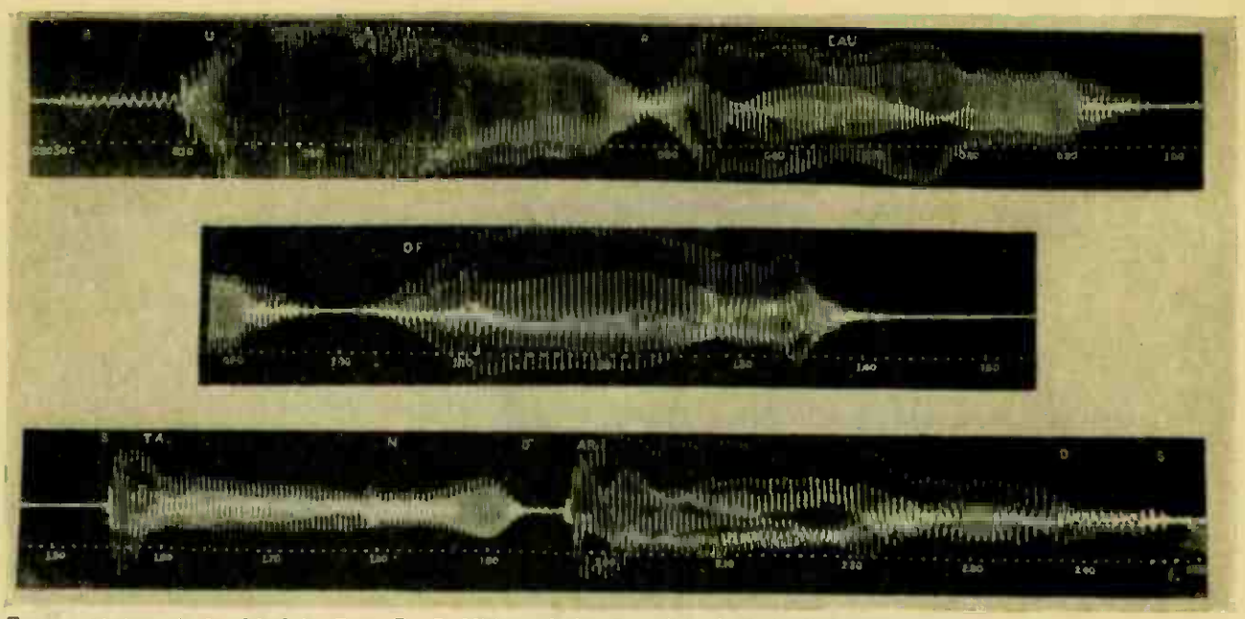
For convenience (since the rays of light are so short relative to the meter), these wavelengths are not usually set down in meters but in what are known as "tenth-meters" or Angstrom Units, which are ten-billionth parts of a meter. Ten billion of these units make one meter. The wavelength of red light, the just visible light on the border between light and heat, is, therefore, about 7750 Angstrom Units.

Of course this limit, this longest wavelength of visible light, has no physical meaning. It depends merely on your eye. The eye happens to be able to see a wave of this length. It cannot see one of say 8000 units. It is possible, even, for the eyes of two people to differ in ability to see red light. Some persons, for instance, cannot see in the spectroscope the deep red line of the spectrum of potassium. For them this line—it has a wavelength of 7702 units—is not light at all; it is heat. Others can see it. For them it is light.

The limits of wavelength that mark off the different colors, as determined for the average human eye, are as follows, all given in Angstrom Units:

Red	7750 to 6450
Orange	6450 to 5900
Yellow	5900 to 5600
Green	5600 to 4900
Blue	4900 to 4500
Violet	4500 to 3900

Of course these figures are only ap-



From a photograph furnished by Prof. D. C. Miller, of the Case School of Applied Science.

A PHOTOGRAPH OF THE SOUND PRODUCED BY THE HUMAN VOICE

This is literally a picture of the spoken words "Bureau of Standards"—a sound wave that we can see. The waves are recorded on the waving lines of this "oscillogram," as the picture is called.

proximate. Eyes differ much in ability to see different colors even when people are not consciously color-blind.

The fact that vision or visible light depends on a bodily organ—the eye—is evident, also in the limited number of wavelengths which constitute this visible light; that is, it is limited in comparison with the many wavelengths of heat waves or of wireless waves. Heat waves may vary in wavelength from the 7750 units of the shortest heat wave to over 3,000.000 units. The entire spectrum of visible light, on the other hand, is confined between wavelengths of 7750 units and 3900 units.

But what lies below 3900 units? Are there still shorter waves?

Indeed there are, many of them. Immediately below light and differing from light only in happening to be invisible to the human eye are the waves of the so-called "ultra-violet light," or the violet ray. These extend, with decreasing length to a wavelength of about 600 Angstrom Units. They affect photographic plates just as light does. They may be collected and dispersed by lenses as light is. In fact they *are* light—but invisible light. The eye does not happen to be able to see them. There is some evidence, indeed, that the human eye may be exceptionally deficient in this, for the eyes of certain insects and animals may be able to see ultra-violet light which is invisible to us, just as the insect ears are believed to be able to hear sounds too shrill for our ears to catch at all.

Below the ultra-violet, below a wavelength of 600 units, there is another gap in the series. One of the wavelength brothers has died, or he is hiding out and we have not yet discovered him. No ether waves are known from about 600 units to about 15 units. This does not mean that they do not exist. Probably they do. Any day some inquiring scientist may turn over an experiment and find the missing brother of the wave family.

At a wavelength of about 15 units begins one of the most remarkable kinds of radiation in the entire family, the X-ray. Much like light, yet with remarkable power of penetrating opaque matter, X-rays have proved to be one of the most useful tools of medicine and surgery and a great aid to scientific research as well. By using them it has been possible to investigate the atomic structure of crystals, almost to see the

atoms as they lie side by side, as regular as the soldiers of a well-trained army, inside a tiny crystal of common salt. But all this is another story.

The shortest X-rays now known are about one tenth of a unit long. But there is still the younger, shorter brother, the gamma rays given out by radium. These rays have, apparently, wavelengths of from .05 to .08 unit. They are the latest form of radiation to be discovered. As yet not much is known of them. But they are, like all the others, waves in the ether, just like X-rays and light and radiant heat and wireless, except that they are shorter. They are the wireless of the radium atom, the ethereal cry which goes out from the atom when it suffers the atomic explosion that causes radio activity.

It is a long series, this family of ether waves, and a great family. It comprises wavelengths so different that even their difference, expressed in figures, is beyond our mental grasp. From 150,000 meters to .05 of one Angstrom Unit—or .00000000005 of a meter. Thirty thousand million millions of these .05 unit gamma ray waves equal in length only one of the great wireless waves detected by Marconi. A figure so vast is beyond the reach of real comprehension.

How are all these waves caused? What produces the different kinds of wave motion, of wave energy?

The longest of them, the true wireless waves, start from movements of electric charges, from surges of electricity in and out of antennae or from alternations of the direction of the current from a dynamo or a vacuum tube generator. The next longest ones, the heat waves are started by vibrating molecules.

And the light waves, so physicists have come to think, are started by vibrations inside the atoms themselves, by movements of electrons from place to place inside the tiny intra-atomic solar system. They are atomic wireless. The X-rays, also, are atomic in origin; probably due, as are the light rays, to vibrations of the electrons. The gamma rays are caused, we think, by similar internal vibrations in the atom, but by more violent ones, by the vibrations which accompany the explosion of the atomic nucleus.

All of these waves are wireless waves; wireless from molecules, dancing the constant dance of heat; wireless from electrons dancing inside the atoms of luminous substances; wireless from the atomic convulsion in which the radium atom dies.

Wireless is not limited to the ether wave which you pick up from your friend's sending station in the next block.

So much for the ether wave family. But what about the gaps in the family—about the missing wavelength brother?

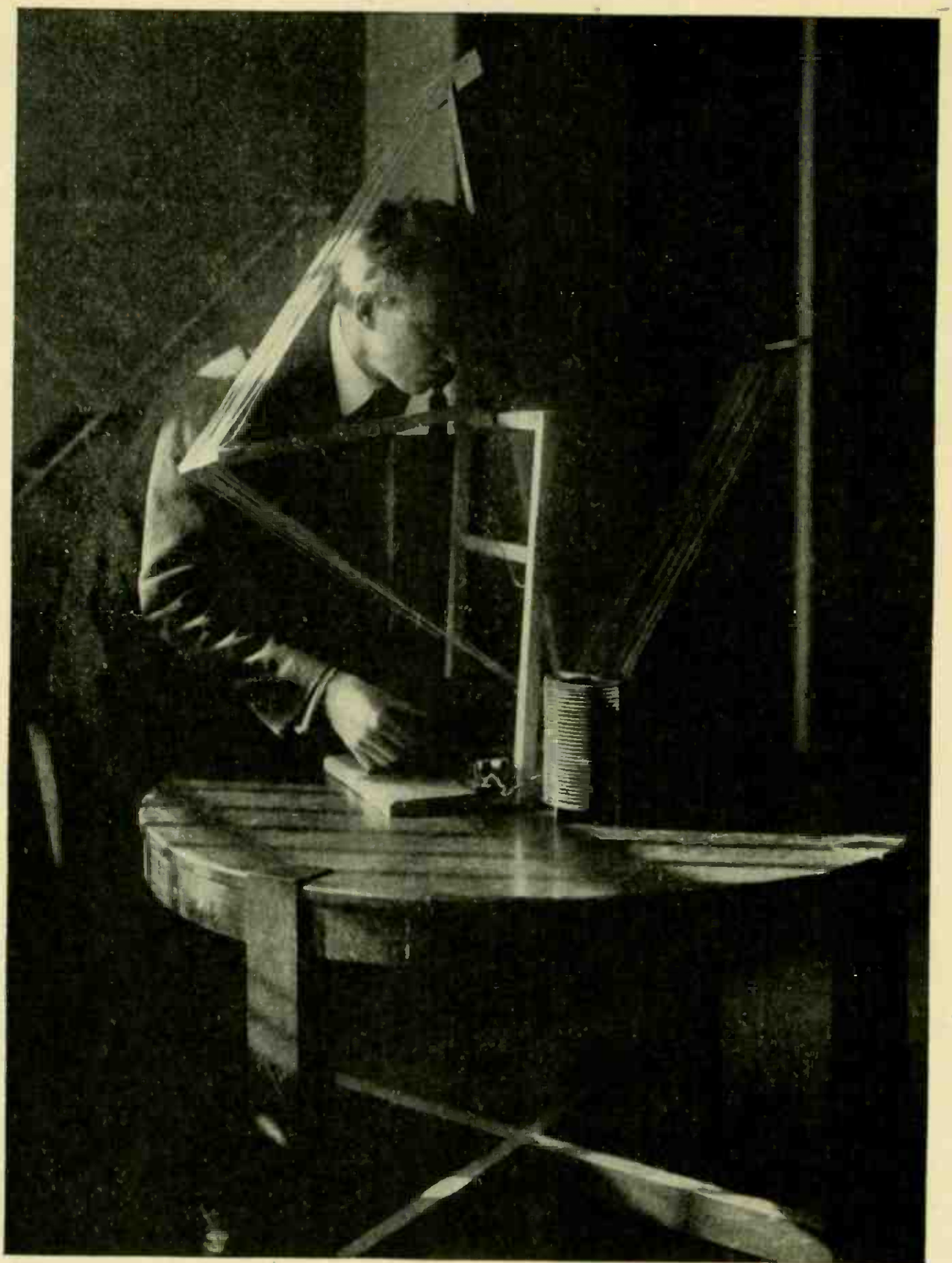
The brother that I would most like to meet is the one between heat waves and wireless, between wavelengths of about one tenth-inch and of about 12 inches. These waves are not known. What are they?

Possibly they are merely heat waves like their shorter brothers or wireless waves like the longer brothers.

But perhaps they are not quite like either of these. There is one important difference between heat waves and wireless waves; that is the difference in human perception of them. Heat waves we can feel with the skin, probably with all of our nervous tissue. Wireless waves we cannot feel or perceive at all, so far as we now know.

Now at what wavelength does the heat sensation stop? Can we extend it? Can we extend it even to wavelengths within the wireless field? If we studied thoroughly these intermediate waves—the waves which belong to the missing brother of our family—could we devise methods, perhaps, to perceive wireless waves directly, learn how to feel them, train our nerves to pick them up, to act as a sort of bodily detector?

This is speculation; these questions are imaginative. I don't know the answers to them. But some day the wireless experimenters are going to find out.



From a photograph made for Popular Radio

USING A LOOP AERIAL FOR TESTING THE DYNAMIC ACTIVITY OF THOUGHT

If the human brain emanates definite waves or vibrations, Dr. Carrington points out, they will conceivably affect the electric current that flows around the loop—providing the apparatus is sensitive enough. The problem of the scientist is to create instruments that are sufficiently delicate to record such impulses.

THE FIRST OF TWO REMARKABLE ARTICLES THAT TELL HOW PSYCHIC INVESTIGATORS ARE EXPERIMENTING WITH A POSSIBLE KEY TO ANOTHER WORLD.

Will We Talk *to* the Dead by Radio?

By HEREWARD CARRINGTON, Ph. D.

The author is one of the most widely known figures in the field of psychic phenomena both here and abroad. Whether or not the reader believes that a separate spiritual world exists—a point which Dr. Carrington neither affirms nor denies—the fact that unexplained energies are being recorded on sensitive radio apparatus makes the author's laboratory work significant insofar as it promises to open up realms now closed to us.—EDITOR.

WILL it be possible in the near future to send wireless messages, or establish some analogous mode of communication with the spirit world—as many advanced psychic students believe?

Recent remarkable advances in wireless, on the one hand, and in psychical research on the other, would seem to indicate that something of the sort is not beyond the bounds of possibility. If we assume the existence of some spiritual world, it is entirely possible that some such mode of communication will be established.

Marconi and numerous other investigators in the realm of pure science have recently stated that they have received consecutive and systematic radio impulses which they cannot account for and the origin of which yet remains a mystery.* They are inclined to believe that these radio impulses emanate from beings that live upon some other planet, and who are attempting to communicate with us in this manner. Certain it is, they claim, that these messages do not originate upon our planet, as no sending apparatus yet devised by man is capable of transmitting the enormous wavelengths which they have been enabled to catch and detect. And it seems certain, also, that these messages are too regular and systematic to be attributed to any freaks of nature, such as sun spots or atmospheric electricity. It is not irrelevant to call attention to these so-called "messages" in the discussion of the attempted modes of communication by means of ordinary radio apparatus, the details of which are familiar to all experts.

In considering the possibility of intracosmic communication through the medium of highly sensitive instruments, it is necessary, first of all, to remove from one's mind certain prejudices in order that the ground may be cleared for the reasonable discussion of the possibility of communications of this character. The foremost obstacle which arises concerns the actuality of any such spiritual world.

Is there or is there not a spiritual world?

The sceptic answers no; he denies the possibility of its existence, upon scientific grounds. If his contention is correct, if no spiritual world exists or can exist, then any mode of communication with it is obviously impossible.

On the other hand, it must be accepted that there are forces at work about us that have not yet been analyzed or understood—forces that science may some day measure.

For example, we can sense even if we cannot see another individual's mind or ego.

How do we know that a mind exists in the person to whom we are talking? Only by the evidence of those senses by which it communicates with our own mind.

How do two minds ever communicate with one another? They communicate in three ways, and in three ways only:

* See "Are We Getting Radio Signals from Another Planet" in POPULAR RADIO, May, 1922.

(1) By means of air vibrations—speech;

(2) By means of marks made upon paper—writing;

(3) By means of certain bodily movements—sign language.

Only by these methods do we get into contact with other minds; hence by common agreement we infer their presence because they react in the same way that we would to these various stimuli.

But these modes of communication are all symbolic and more or less imperfect. No one of them conveys the full meaning of the thought, and it is the experience of almost everyone that he can never fully express and convey to another person precisely what he feels and thinks. Therein lie the imperfections of our transmitting and receiving apparatus.

It seems reasonable to conclude, therefore, that there is a real world which is unseen and in a large measure as yet unsensed. It is, in fact, the more real world than the purely physical world we know. It is the world of thought, of mind and consciousness. It is, in short, the spiritual world, in which we habitually live even while in the body; it is certainly real to us, even though it is never directly seen by any of our senses while we are inhabiting physical bodies. Nor has this world as yet been registered upon any delicate recording apparatus which has been devised.

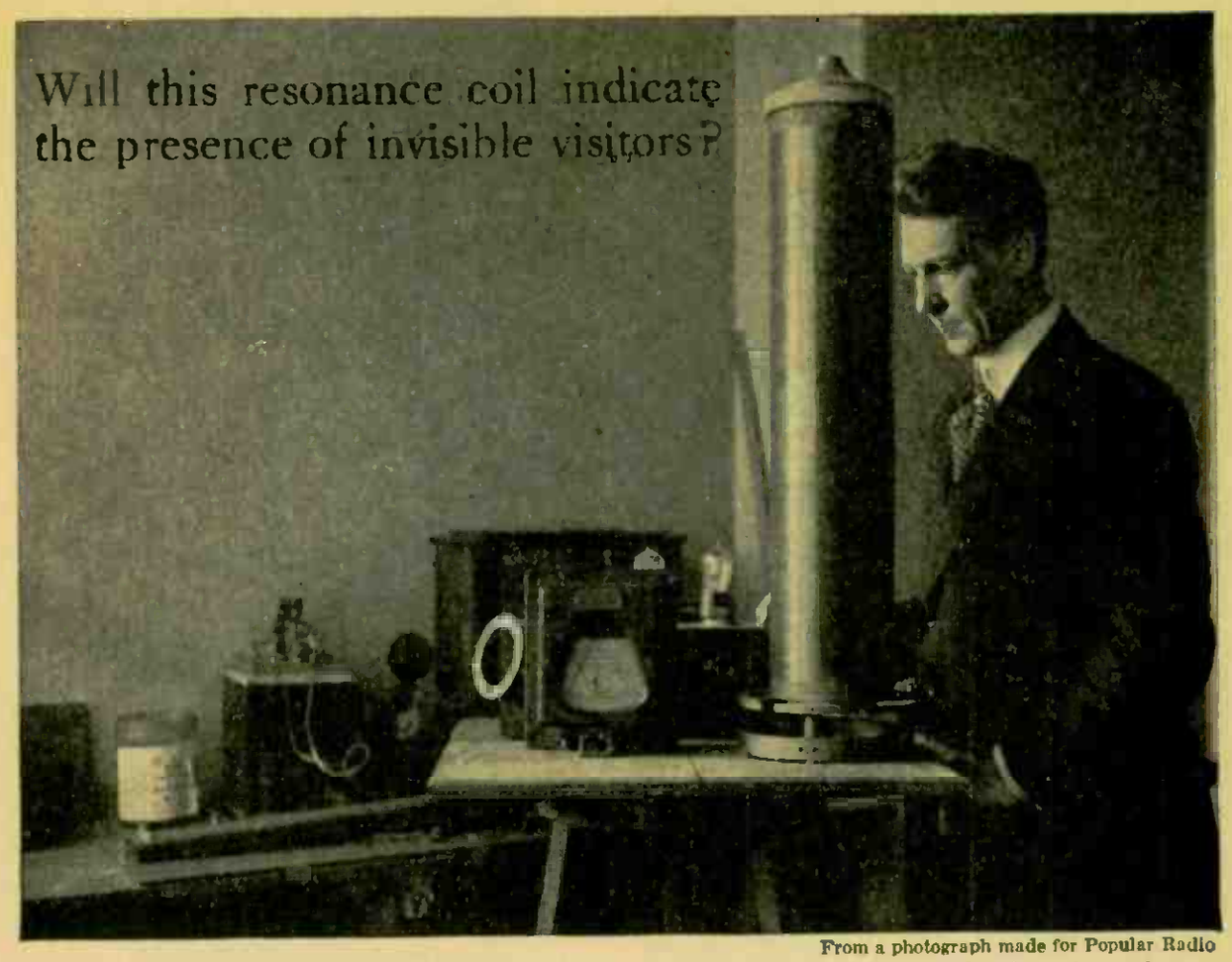
Granting the reality of such an invisible world, therefore,—a world of mind and consciousness—the question arises: Does this world continue to exist after the destruction of the physical body?

All religions, of course, answer this question in the affirmative; the tendency of modern physical science, on the other hand, is undoubtedly to answer in the negative. The attitude assumed by the psychic researcher is that the question resolves itself into a matter of evidence—a question of fact. If such a world exists, it should be capable of proof. And certain psychic phenomena seem to offer proofs that some such world exists, and under certain conditions it is capable of contacting with our physical world.

Assuming some such world does exist, how are we to conceive any method of communication with it? Recent researches indicate that thought is dynamic. The activity of the mind does actually modify the ether and send forth definite vibrations, not unlike radio impulses which are capable of registration. Dr. Baraduc, of Paris, has succeeded in obtaining a number of curious photographs of what appear to be etheric swirls, which he claims were generated by a series of definite thoughts and emotions. In other words, he had succeeded in photographing the dynamic action of thought. It seems reasonable to suppose that when thoughts are created they should generate etheric activities, just as they are known to create or coincide with definite physical, chemical and electrical changes, which have been determined and registered.

If thought, then, can modify the ether in some such manner, it is equally reasonable to suppose that some day an instrument will be devised which will be capable of detecting and registering these impulses, just as we have already devised receiving apparatus for the detection of the gross etheric waves which are sent out in wireless telegraphy. All that is needed to accomplish this is sufficiently poised and delicately attuned recording apparatus.

Could we but find an energy common to the two worlds—the physical and the spiritual—we should have here a medium of direct communication between them, possibly by instrumental means. It is conceivable that such an energy might be manipulated, or controlled, by means of thought; it is equally conceivable that this energy might also be detected by means of delicate instruments yet to be devised. This action and interaction might not even be direct; it might be indirect. By means of a series of intermediaries one slightly more material than



From a photograph made for Popular Radio

If a human being approaches this coil, the variations of the current flowing through it are immediately recorded. If, during a seánce, no living being is near this coil yet some unseen energy is recorded, may not these unknown presences indicate some heretofore undiscovered psychic forces?

the last we might obtain a continuous series of connections from an immaterial to a material sphere.

The Gnostics, as we know, held this view; their "demons" corresponded to the "Ten Intelligences" of the East. The Gnostics held that matter and spirit could have no intercourse—they were, so to speak, incommensurate. Granting this premise, how was Creation possible? Their answer was a kind of gradual elimination: God created an æon; this æon created a second æon, and so on until the tenth æon was sufficiently material (as the Ten were in continually descending series) to affect matter, and so brought about the creation by giving to matter the spiritual form.

We have an analogy for this in modern physics. In electricity, the "relays" aptly illustrate the principle here outlined. In working over long lines, or where there are a number of instruments in one circuit, the currents are often too weak to work the recording instruments directly. In such cases there is interposed a "relay" or "repeater." This instrument consists of an electromagnet, around which the line current flows; the delicately-poised armature of this relay, when attracted, makes contact with the local circuit, in which a local battery and the receiving Morse instrument are included. The principle of the relay is, then, that a current that is too weak to do the work itself may get a strong local current to do its work for it.

If this be true, it is certainly conceivable that spiritual beings, if such there be, might be enabled to manipulate a delicate energy of some sort which in turn would liberate a stronger energy, and so on down the line until an energy is liberated that is capable of being re-

A FACE FROM ANOTHER WORLD

An actual photograph made by Dr. Geley, of Paris, in 1909, of a materialized spirit face in formation, showing the unused visions substance called "ectoplasm" as it was issuing from the famous medium "Eva". If the camera can record such phenomena, may not the infinitely more sensitive radio apparatus perceive heretofore unrecorded impulses from an unknown world?

corded by delicate physical instruments. If, as now seems certain, the human will is a dynamic energy, and thought can impress the photographic plate, it is certainly but a step from this point of development to existing physical apparatus that is so delicate that it can register the heat of a candle at a distance of a mile and a half (as does Langley's bolometer), or measure the temperature of stars distant from us many millions of miles in space and invisible to the naked eye. The step seems but a short one indeed!

Theoretically, therefore, it seems well within the bounds of possibility that some such common energy will one day be discovered, and that some mode of instrumental communication will be established between the material and the immaterial worlds—if the latter exists.

It is the purpose of the present experiments to show only that it is scientifically possible, and that, once granting its possibility, actual communication with that world may conceivably be established by means of delicate instruments which may be devised. Certainly if such communication were ever established, it would at the same time prove the reality of such a world, simply by reason of the communication which had been established with it.

Will such an instrument be devised? It seems possible to many that science is on the verge of this discovery—a discovery which, if made, would profoundly affect our science and our philosophy, and would prove an epoch-making event. At this moment, all sorts of energies are passing through the room in which you, the reader of these lines, are sitting; they are passing through your own body, even though you are not in the least aware of it—gravitational, magnetic, electric, and other forms of energy of which you are entirely unconscious. Yet, as you know, you have merely to set up a simple piece of radio apparatus upon the table in front of you, and immediately some of these energies are caught and registered. All through the ages, electric waves have existed, but it has remained for the present generation to detect them. As soon as the suitable piece of apparatus is set up and properly attuned, your messages are recorded.

It seems rational to suppose that the human brain is in itself a detector of such impulses and that it acts as such when telepathic messages are transmitted from one mind to another. The analogy between wireless and telepathy has, of course, been urged in the past by several competent investigators: Sir William Crookes went so far as to postulate a definite range in the scale of vibrations within which telepathic or thought-waves might actually exist. It must be said, however, that as yet no conclusive evidence has been brought forward to show

that telepathy is actually vibratory in action. Some investigators, indeed, have claimed that just as gravitation holds together all the matter in the universe, so there may be a form of "spiritual gravitation," uniting life and life, throughout the Cosmos. Professor T. J. J. See has, however, put forward the theory that gravitation itself is an electromagnetic phenomenon, and, from the physical point of view, it seems incredible that anything could be transmitted from brain to brain without the intervention of some mode of vibratory activity yet to be determined.

This is, in fact, one of the problems upon which the investigators are at present engaged in the American Psychical Institute and Laboratory in New York. They are trying to discover the actuality and nature of thought-waves, and to register and record them upon suitable instruments. They believe that they have already made progress in this direction, and that they are on the verge of important discoveries. They have devised certain delicate pieces of apparatus which apparently register the dynamic action of thought and show the definite physical pressure of the human will. And, among other experiments, they are making the following tests which any one may duplicate:

In wireless telegraphy, "carrier waves" are sometimes employed—that is, continuous waves, the frequency of which can be accurately registered. Upon these can be sent "superimposed" waves, usually much longer than the first. The carrier waves seem to have the faculty of carrying along and reinforcing the superimposed waves. Investigators at the Psychical Laboratory have, therefore, conducted a preliminary series of experiments in telepathy, by placing both subjects in a high-tension electric field, through which electric waves of definite frequency were passing, and which acted as carrier waves. The purpose was that, by this means, they could reinforce and detect telepathic waves, transmitted between one brain and another. While they cannot publish any definite conclusions at the present time, they have apparently attained some striking results, which they hope to co-ordinate and publish shortly.

What is the purpose of the Psychical Laboratory? To pursue psychical research by means of laboratory experiments, conducted by qualified investigators with the aid of suitable and delicate apparatus. Many laboratories exist, of course, for the investigation of physical, chemical, astronomical and other sciences, but nowhere has there been a laboratory devoted exclusively to the exploration of the psychic realm; this is the first laboratory of this kind in the world. Within its walls are being conducted experiments which may help in the solution of a number of psychic problems. The investigators have also devised a number of instruments which are intended to record the presence of invisible energies, should they exist, and these are now being experimented with upon an extensive scale.

It seems possible, as the result of these and other researches, to believe that there is more than one ether; that there may be, in addition to the physical ether that we know and in which modern science believes, another ether—for the reality of which a number of writers have in fact contended. This has been called the "mentiferous ether," or, the ether which conveys thought-waves, and which is utilized by nature for that express purpose. Occult science has, indeed, contended for many years that there are four ethers—only the lowest of which is as yet known to the physicists. While I do not defend this view, nevertheless, there is something to be said in its favor. Certainly what may happen in these various ethers is of the greatest interest.

IF telepathic impulses may be recorded between two living persons—as science states is possible—may we not some day devise instruments so delicate as to record similar impulses from the dead? In the next issue—July—Dr. Carrington tells how these experiments are being conducted.

Ships *that* Steer

By ROBERT G. SKERRETT

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FOG and fire are the two dangers most dreaded by the modern mariner. However, the power-driven steel ship has less now to fear from internal flames because of her pumping facilities and the ability to flood at will the compartments that are menaced.

But the perils of "thick weather" still persist.

Blanketing banks of fog, obscuring curtains of snow and veils of pouring rain all too frequently lower the visibility of navigational marks and beacons and arouse anxiety in the man upon the bridge when steering his vessel toward a dangerous coast.

More craft are wrecked or lost by reason of fog than through any other condition of the weather. Thousands of lives and millions of dollars worth of property are thus sacrificed annually. Sudden temperature changes will turn the clear air above the water into an enshrouding mist, and the seafarer may find his objective shut out from view when the way ahead of him seemed plain sailing. A slight deviation from a prescribed course may make all the difference between safety and disaster.

Day or night, fog is ample reason for alarm, inasmuch as it is so easy for the navigator to make a mistake when groping onward toward his unseen haven. Lighthouses and lightships are no less essential as guides while the sun is above the horizon, and when these nautical mileposts, so to speak, are no longer visible, treacherous currents may swerve a vessel from the path of secure advance.

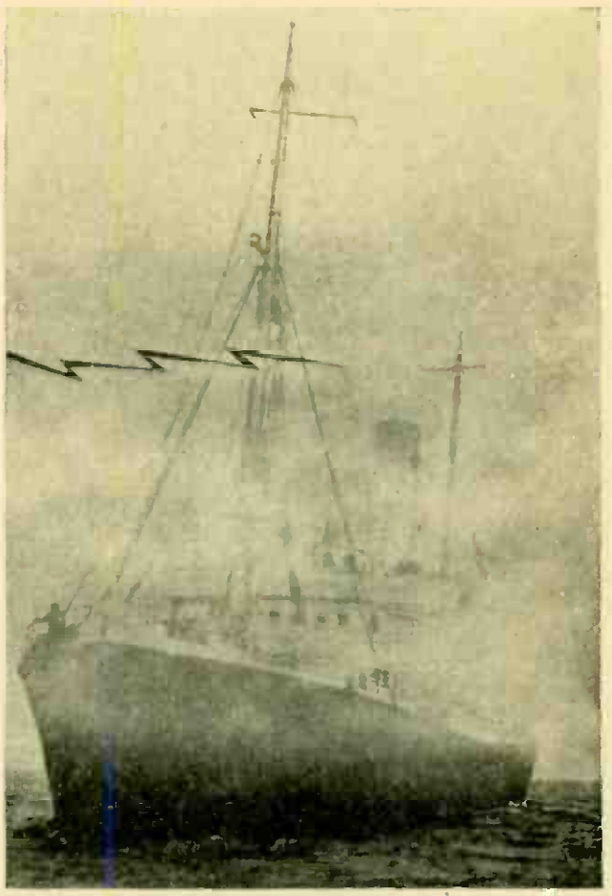
To meet these perils, the radio engineer has recently devised apparatus which rob thick weather of much of its lurking hazards. It is known as the "radio compass."

The radio compass is the outcome of radio phenomena which the man of science has turned to good account. Fully a decade back it was noticed that radio signals had a directive element; that is, they were heard loudest along a certain line when the receiving instruments were swung through an arc. Accordingly, during 1916 and 1917, arrangements were made by the U. S. Lighthouse Service and the Bureau of Standards for experimental tests between ship and shore stations for the purpose of devising some form of radio control. Those researches gave promising results, but the work was halted when the country entered the World War.

During the period of conflict, the radio experts of the U. S. Navy evolved a type of radio compass, and they established a large number of shore stations to help such ships off the coast as were already provided with radio signalling equip-

by Sound Waves

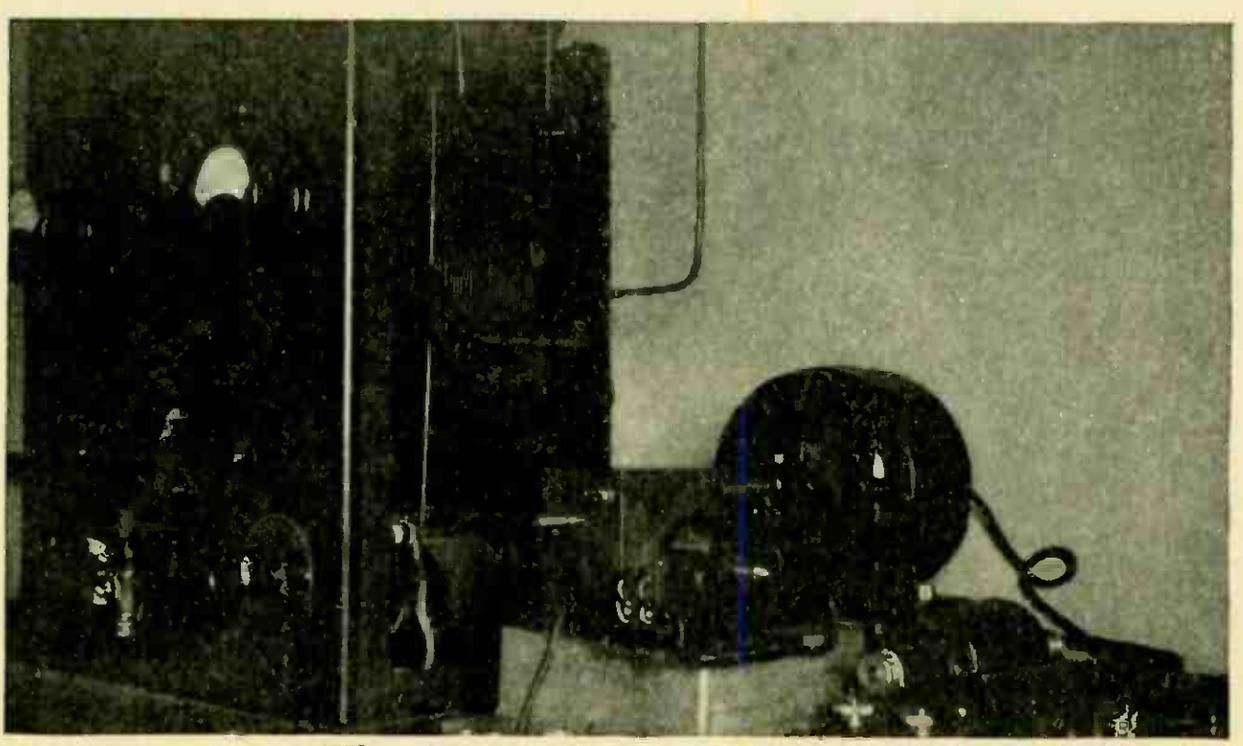
The Radio Compass, the Latest Device of Science for Overcoming the Mariners' Oldest of Enemies—Fog



International

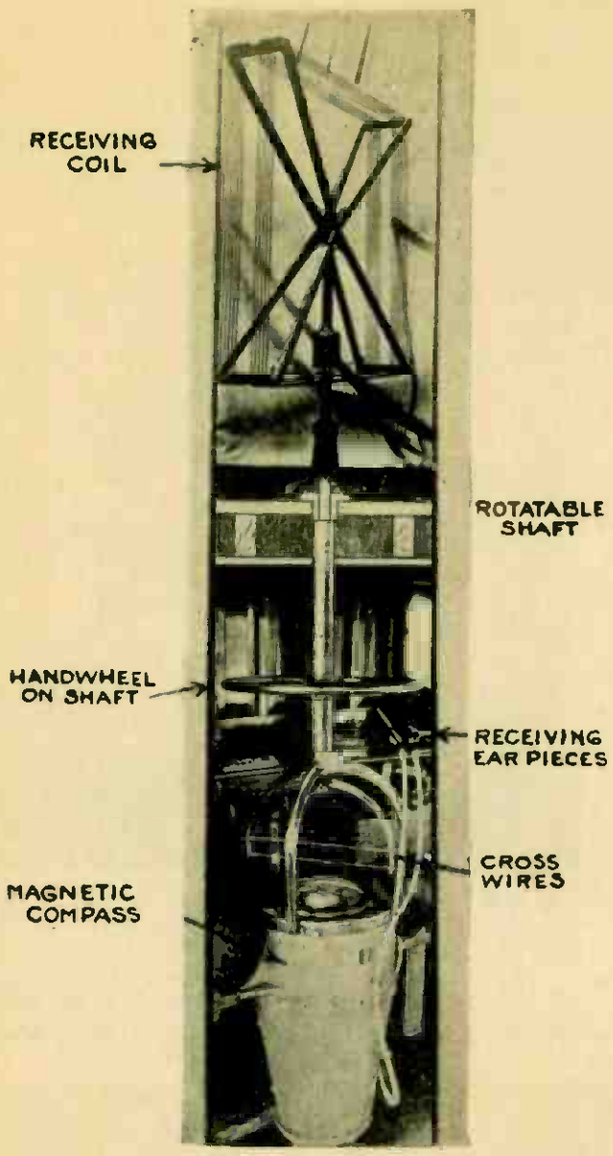
ment. The method consisted of an exchange of signals between the distant craft and one or more land stations, where, by radio cross-bearings, the vessel's position was determined and the information transmitted to her. To be effective, the inquiring ship had to have someone aboard who was capable of both sending and receiving radio code-signals. The system adopted by the Lighthouse Service operates differently, and the mariner himself ascertains the location of his boat; it is not needful for him to send a radio signal to do this.

As long ago as 1888, the German physicist Hertz made use of a coil for determining the source or direction of arriving radio waves, and the radio compass produced by F. A. Kolster of the Bureau of Standards is based upon a kindred sensitive or responsive element. His coil aerial is nothing more complex than ten turns of wire around a rectangular frame about four feet square. This



THE AUTOMATIC RADIO TRANSMITTER

This is the type of apparatus that is installed aboard lightships and light stations.



A cross section through the chart house of a lighthouse tender equipped with a radio compass receiving outfit.

frame is carried by a rotatable shaft. When the coil lies parallel with the path of the on-coming radio waves the signals received can be heard loudest, and when the coil is at right angles to the radio waves the signals are faintest. Therefore, all that the listener has to do is to swing the frame until the tell-tale dots or dashes are strongest and clearest. At that moment the pole of his coil is pointing directly at the sending station.

So far, so good, but this in itself is not enough to put the seafarer out of danger. This is how the device works from this point:

Suppose the fog-bound ship is traveling due north and that the signals are sharpest when the coil is on an east-and-west line. How is the operator to tell whether the transmitting station is off to the right or to the left of him? This knowledge is essential to his safety; he must not steer toward the open sea when his objective is in the opposite direction. In its initial form, the Kolster radio compass was deficient in this particular, but it has been modified by the addition of what is termed a unidirectional feature. This simple attachment makes it practicable to pick up a signal's maximum intensity only when a marker is pointing right at the generating station.

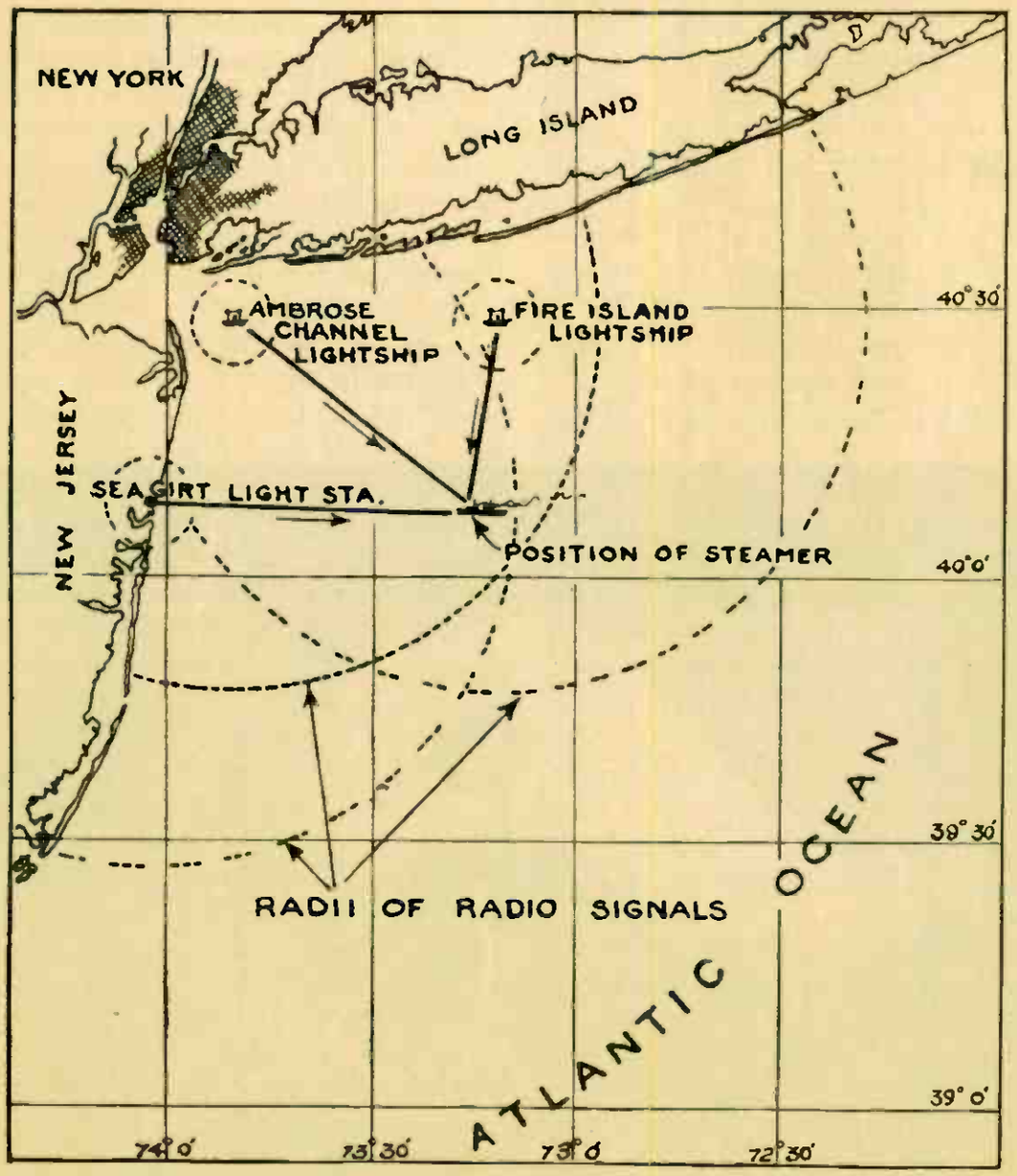
Two parallel wires set one above the other and supported by a U-frame attached to the lower end of the rotatable shaft and suspended immediately above the magnetic compass, enable the man at the helm to compare the course of his vessel with the direction whence come the guiding radio signals. This information, however, while helpful, does not give him his distance from the sending station, and this he must have so that he may head his ship toward his unseen goal without fear of running upon intervening or submerged obstacles. Therefore, radio signals have to be picked up by the navigator from a *second* station, and its bearing also checked by the magnetic compass. When a line is drawn on the chart from each of the two stations, which agree with the magnetic-compass readings, the off-shore point of intersection of the two lines indicates the geographical position of the groping craft. This is made plain in the accompanying diagram. It is a simple matter of triangulation-nautical surveying.

While the fundamental principle of the radio compass has been known for more than three decades, much study has been required to bring the apparatus to its present dependability. Nearby wiring, rigging, smokestacks, ventilators and steel masts induce what is called "re-radiation." These "radio echoes" of primary radio waves at first caused a good deal of confusion to the listener at

the radio compass. Researches by the U. S. Bureau of Standards have shown how this source of error can be neutralized; and a radio compass can now be calibrated to offset these disturbances just as a magnetic compass can be compensated against the effects of neighboring masses of iron and steel.

The ordinary telephone receivers, if used by the operator of the direction finder, would be apt to deflect the needle of the magnetic compass if brought close to that instrument. To prevent this, a special radio receiver is located at a little distance from the magnetic compass, and the signal sounds are conveyed through rubber tubing to the ears of the man at the radio compass.

The radio transmitting apparatus built for the U. S. Lighthouse Service is designed to operate automatically; each set propagates a series or a group of distinctive signals. This is indicated on the map drawing that illustrates the three radio-sending installations adjacent to the entrance to the port of New York, at Sea



HOW RADIO SIGNALS DETERMINE A SHIP'S POSITION

This diagram shows the radio-compass stations at the approach to the port of New York. Each station sends out distinctive signals; by taking radia cross-bearings from two or more of the stations, a ship nearing the coast can determine her position even though the lightships and the lighthouse are invisible.

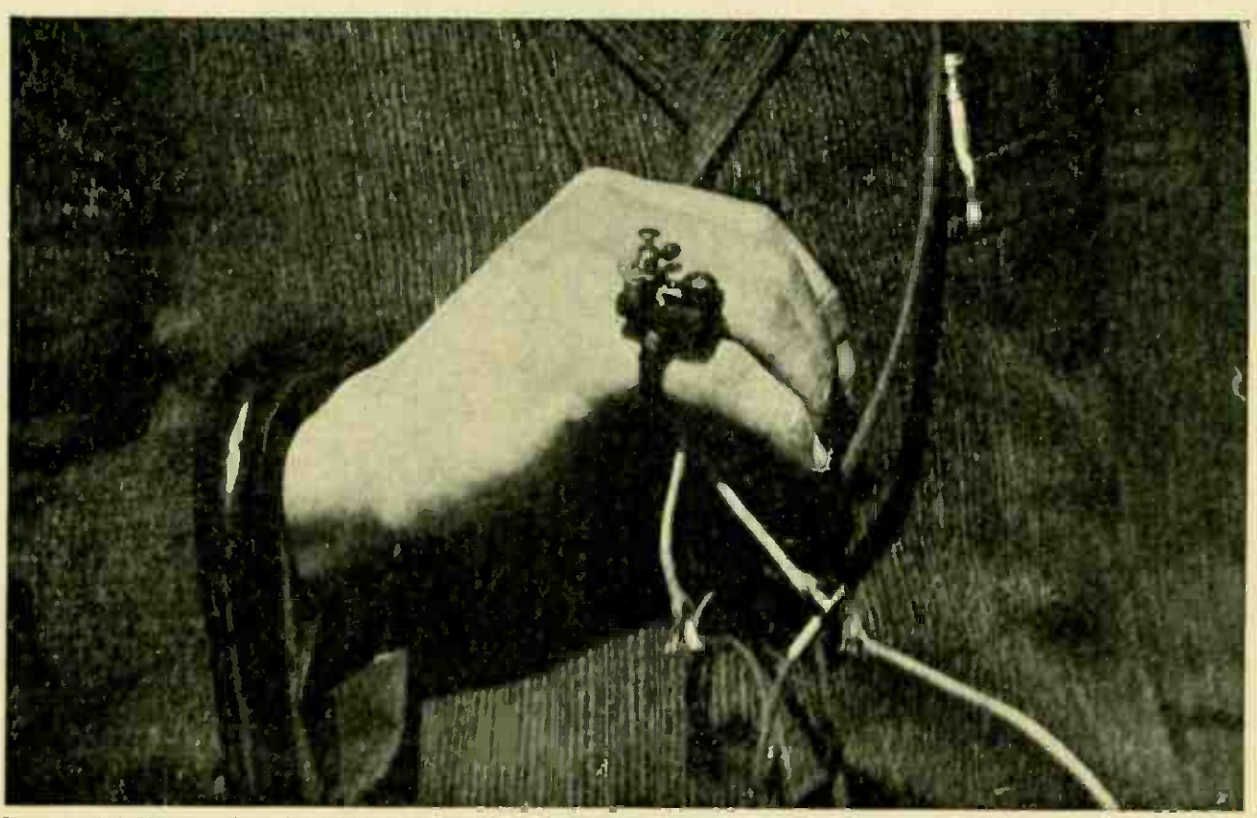
Girt, New Jersey, and also aboard the Ambrose Channel and the Fire Island lightships. In addition to the characteristic signal of each generating unit the tone of each signal is sufficiently individual to prevent confusion.

A number of lighthouse tenders now carry radio compasses, and their skippers have repeatedly demonstrated the value of these aids when traversing the waters in the vicinity of New York during the prevalence of a fog. On a run of about forty-three miles, for example, the tender *Tulip* was directed entirely by radio compass. While her commander was not very familiar with the use of the instrument he was able, nevertheless, to bring his boat within 800 feet of Fire Island Light Vessel, which was his objective. He did this with but three readings of the radio compass, and the last of these was taken when the tender was fifteen miles away from the lightship.

The advantages of the new system of guidance have been summed up thus:

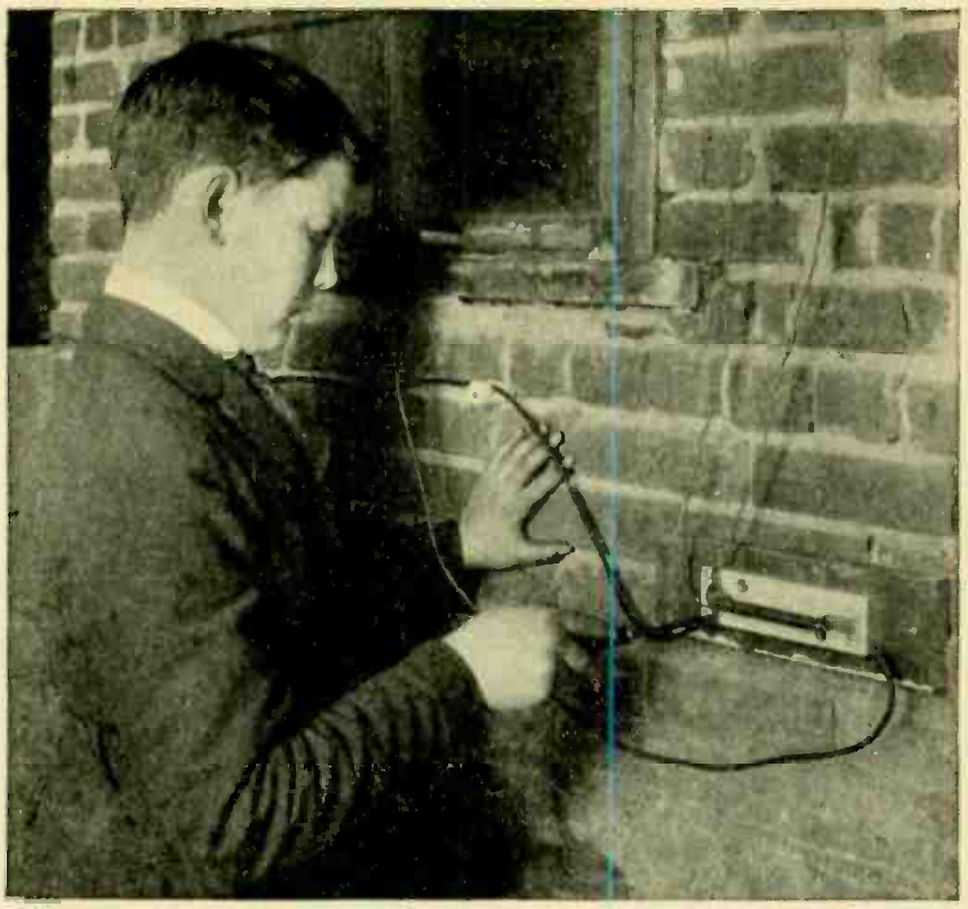
1. The navigator may obtain bearings himself, and is not dependent upon others for the accuracy of the results.
2. Any number of vessels may obtain bearings simultaneously and as frequently as they desire without interfering with one another.
3. No knowledge of radio telegraphy is necessary on the part of the radio-compass operator.
4. Transmitting stations, being automatic, may be supervised by the employees of existing lighthouses or light vessels. No additional personnel is needed.
5. The direction finder aboard a craft may be used for locating at sea other vessels that are transmitting signals, and this may be a means of preventing collisions in times of thick weather.

Experience up to date warrants the belief that the radio compass will do much to rob seafaring of some of its hazards and that it will go a long way toward reducing yearly the number of catastrophes due to low-visibility. The general adoption of the radio compass would appear to be inevitable.



Underwood & Underwood A RADIO RECEIVING SET IN A FINGER RING

This tiny apparatus was built by Alfred G. Rinehart; it measures an inch in length, five-eighths of an inch wide and seven-sixteenths of an inch thick. An umbrella is used as a ground.



Westinghouse

BE SURE THAT YOUR LIGHTNING ARRESTER IS IN ORDER

One of the several devices prescribed by the National Electric Code as a protection against damage caused by the electrical disturbances that would otherwise make thunder storms a source of peril to the radio amateur.

How To Use Your Radio Set in Summer Time

Practical Pointers and Helpful Suggestions for the Amateur

BY PIERRE BOUCHERON

THOSE who have spent so many evenings this spring listening-in to the entertainments of the broadcasting stations need not miss their radio programs during the evenings of their summer vacations. They may carry their receiving sets away with them—even into the wilderness, provided, of course, that the distance from the broadcasting station is not too great.

It is a simple matter to make up or purchase a portable set, complete in every detail, which can readily find room in a suitcase. Indeed, it has been the custom of boy scouts, campers and other radio enthusiasts for several years past to include the radio set on their summer trips. No matter where you may be located—at sea-shore or in the mountains—devotees of the Hertzian art may always be in touch with the world's affairs.

Now that the broadcasting station has become capable of sending out more entertainment and educational features than even the country's most complete vaudeville circuit has ever been able to devise, summertime radio takes on a new significance to lovers of the great outdoors.

The average vacationist, familiar with the broadcasting service, need no more think of leaving out the portable radio receiving set than he will leave out his razor or his ever-ready camera. As a matter of fact, the portable receiver does not need to take up much more room than the ordinary box camera; indeed, radio is somewhat analogous to the camera and the phonograph in this respect. Many campers who formerly took along the phonograph will want to take the radio receiver instead.

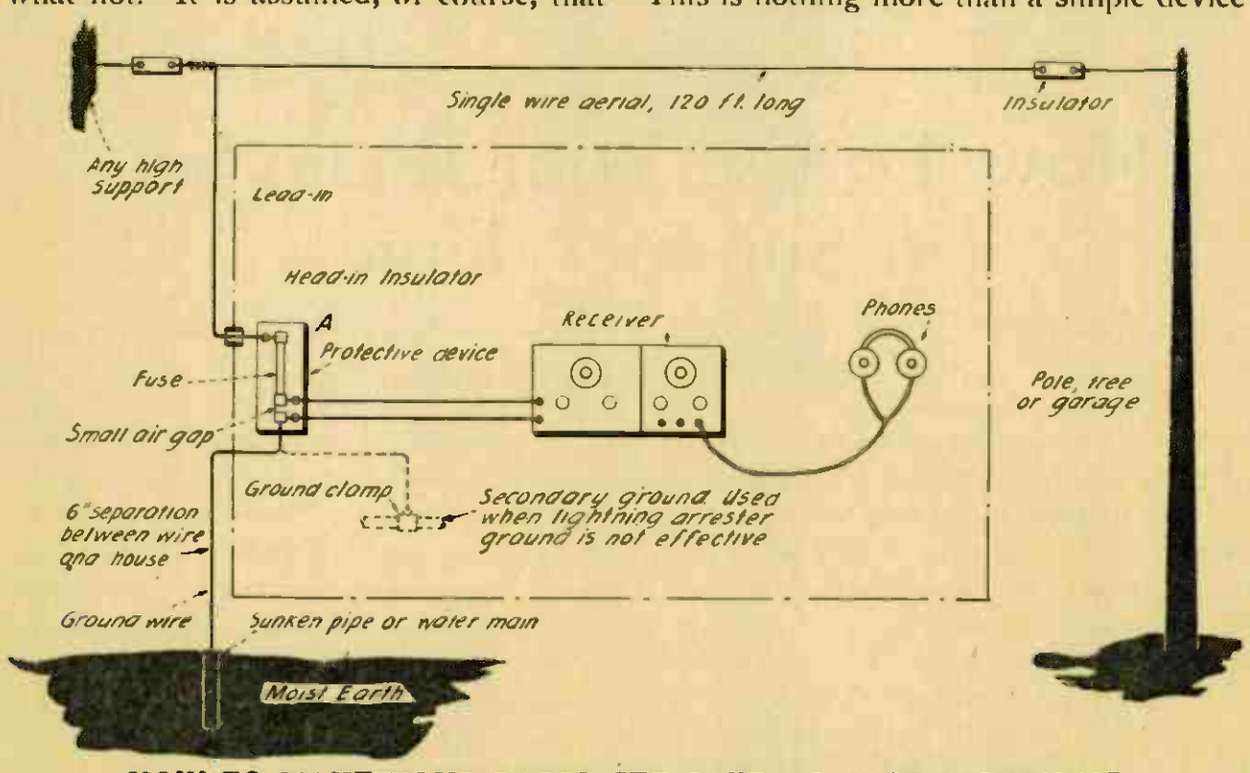
Perhaps in a short time, the summer resort drug stores and candy counters will carry spare vacuum tubes, batteries and phones, in much the same way that they carry films and other camera supplies today.

Summertime radio is sure to become extremely popular. It offers a service unparalleled in its scope and usefulness. The vacationist has at once the news of the day, weather reports, music, lectures on the how-and-why of camping and what not. It is assumed, of course, that the prospective radio-vacationist locates at a point not too remote from the nearest broadcasting station, otherwise he cannot hope to secure good receiving results. In general, the details of erecting a portable radio receiving set are the same as those applying to city operation, except that it is perhaps not necessary to make permanent antenna and ground systems. A 125-foot wire stretched between two nearby trees for antenna, and a piece of pipe sunken into moist earth or dropped in an adjacent pond or stream, will form the ground.

Aside from the outdoor use of radio during the summer months, there are some important protective details which must be followed by the broadcast enthusiast, no matter where the set is located, when he employs an outdoor antenna.

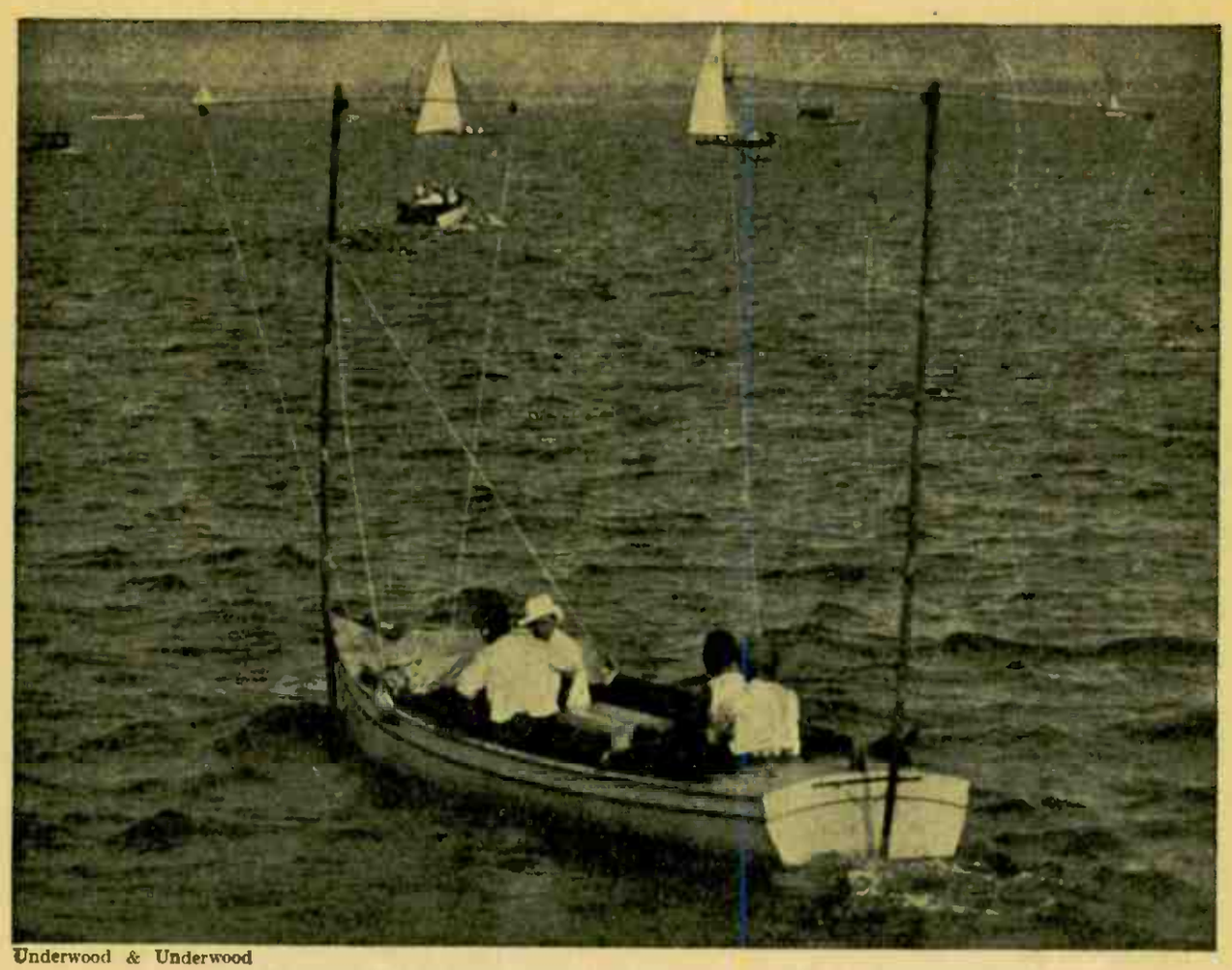
How, for instance, can he protect himself from lightning?

First of all by equipping his receiving set with a suitable lightning arrester. This is nothing more than a simple device



HOW TO MAKE YOUR RADIO SET SAFE AGAINST LIGHTNING

This shows the general arrangement of the antenna and the receiving instruments; note how the lightning arrester should be connected up and the methods both of grounding the set outside the house for protection against lightning and also inside the house for operation. For efficient reception two points should be kept in mind; high supports for the antenna and a good solid ground for operation.



Underwood & Underwood

A PRACTICAL TRANSMITTING SET ON A LAUNCH

This radio outfit was actually used last summer for reporting an international yacht race for the Royal St. Lawrence Club trophy. The set was operated on a current produced by a hand-driven generator.

similar in appearance to the plug fuse used in electric light circuit, and the National Electric Code insists that such device be employed in connection with receiving antennae. This rule is somewhat the same as that which applies to protective devices for regular land telephone lines, telegraphs, fire alarms, and other signal systems. The arrester is really a simple appliance and is usually furnished with receiving antenna equipment with full directions for installing. There are two general makes:

The *vacuum* type.

The *fuse* type.

The function of the lightning arrester is to divert to ground the heavy electrical charges picked up by the aerial during a local thunderstorm and thus protect the receiving instruments. In other words, the arrester drains off excessive charges from the receiving circuit. In general, there is no more danger of an actual bolt of lightning striking the aerial than in striking an ordinary telephone or telegraph line. It is the heavy inductive effects induced in all metallic conductors by lightning which may damage the delicate receiving instruments or possibly shock the operator.

A safe plan is further to protect the radio installation by grounding the aerial at each approach of a thunder-storm. This is best done by installing a large size single-pole, double throw switch outside of the house where the aerial enters.

The ground lead should consist of as heavy a wire as possible; in fact it is understood that the new regulations governing receiving aerials will recommend

Keystone View Co.

A TRAVELER'S SET *DE LUXE*

A radio receiving and transmitting equipment that has been put to practical purposes by an experienced amateur who used it for both telegraphing and telephoning while on tour.

No. 14 B & S wire gauge leading in as direct a line as possible to a spike or pipe five or six feet long firmly driven into the ground. The heavy wire and the spike must be erected and insulated so as to have at least six inches clearance from the walls of the house. This ground, while serving well as a "drain" for heavy electrical charges need not necessarily be the one used for actual receiving, in fact it is not recommended, for a pipe driven into the earth, unless the earth is damp and soft, will seldom prove effective. It is sometimes better to obtain the receiving ground by a permanent connection to the water mains as is done by telephone line constructors. In this connection, the ground clamp furnished with most outfits is especially useful.

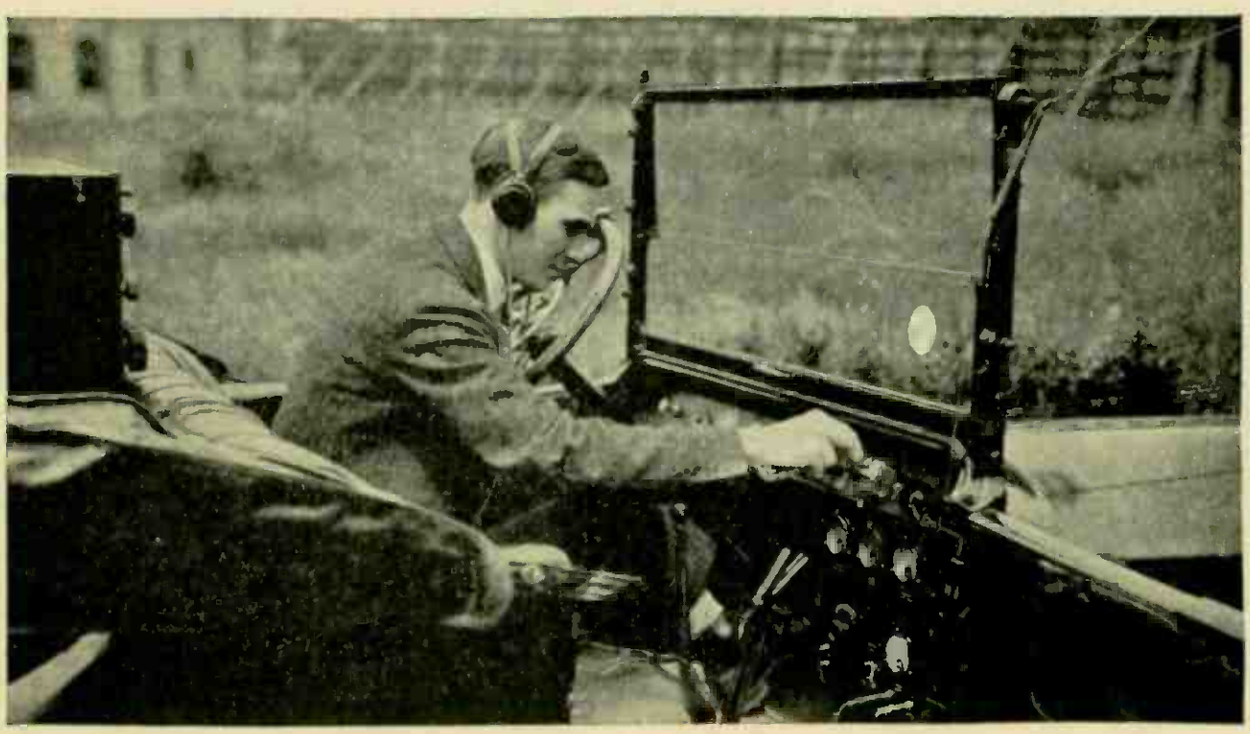
The necessary parts for the complete antenna and ground system may be listed as follows:

The Aerial

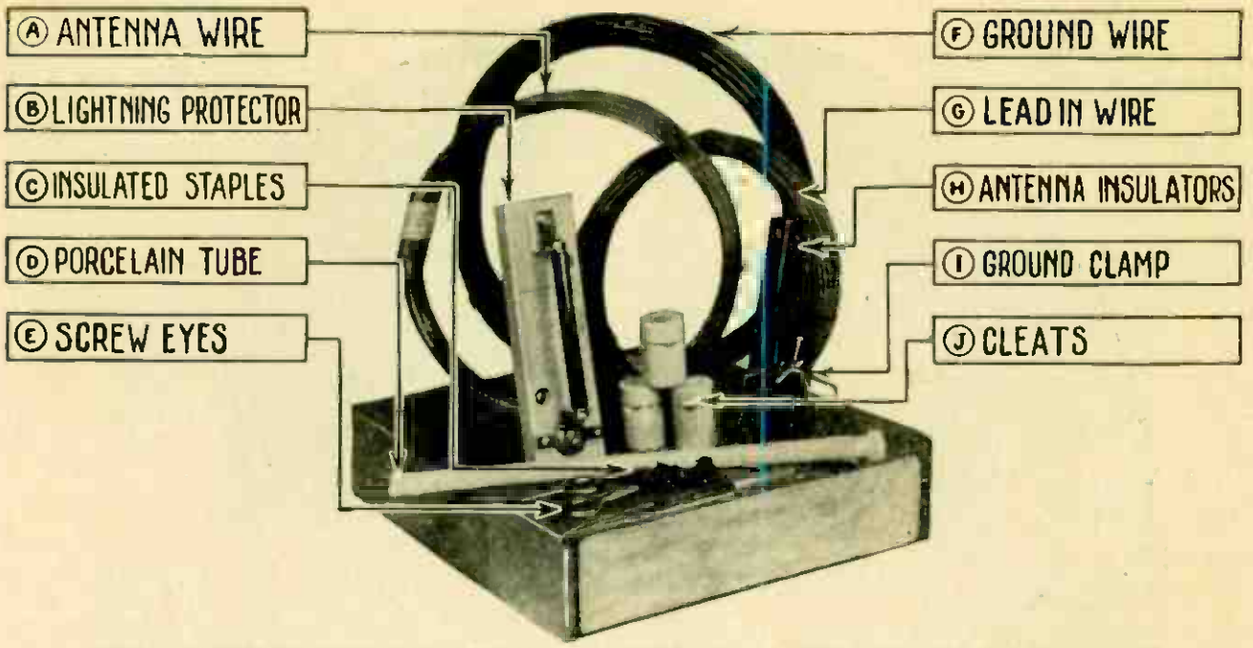
1. From 100 to 125 feet of No. 14 copper, bare copper clad, silicon bronze or aluminum wire stretched horizontally about 35 feet from the ground and provided with a suitable lead-in wire about 25 feet long.
2. Two antenna insulators.
3. A lead-in bushing insulator.

The Ground

1. Not more than 50 feet of heavy insu-



Keystone View Co.



THE COMPLETE EQUIPMENT NEEDED FOR THE INSTALLATION OF AN ANTENNA

Be sure that it includes a lightning protector—or you will not only expose the house to fire from thunder bolts but also you will violate a law that is designed to safeguard radio operators.

lated copper wire not smaller than No. 14 B. & S.

2. A number of porcelain or glass insulators to guide the ground wire to the nearest connection.

This ground is in reality of the "lightning rod" type and, therefore, should lead to earth in as direct a manner as possible.

If under operating conditions it is found that the ground obtained by sinking a pipe into earth is not entirely satisfactory—that is to say, that the signals are not as strong as they should be, all things being equal—then the ground pipe is probably making a poor earth connection, owing to the dryness of the soil. This may be remedied by the simple expedient of connecting another wire from the lightning ground to an adjacent water or steam radiator pipe system pipe. This is illustrated in the diagram.

Then again if the radio amateur is located in the country with no water main available, he must resort to an earth ground, after all. In this instance it will be necessary to sink the pipe length as deep as possible and until moist earth is reached, which is essential to make a good radio ground.

Briefly it may be said that summertime radio is no more dangerous than land line telephony, providing one installs the necessary lightning arrester device mentioned here. Of course, atmospheric disturbances are much more frequent and of greater intensity during the summer months than at any other time of the year, and this sometimes results in noisy operation. Under such conditions one must be patient and not expect too much of radio—it is not fool proof. As a matter of fact, radio broadcasting is still in the experimental stage; indeed, it has been said that every broadcasting station in the country is in reality a research laboratory. New facts are being discovered each day and the art is progressing more rapidly, perhaps, than any other branch of science has ever been known to do.

¶ *DO your know the code? Are you thinking of learning it? In the next number—July—an experienced radio operator will tell the best way of mastering it—and point out the wrong ways.*

From a photograph made for POPULAR RADIO

The "MAN IN THE MOON"

The Real Story of the Miracle That Gave Him Speech—and If You Don't Believe He Can Talk, Listen in on Tuesday and Friday Night at Seven o'Clock

By HOMER CROY

Dear Man in the Moon: I am a little boy nine years old and I listen on my wireless every night you talk. As we have numerous stars shining over our house, I wish you would name one of them after me. My house is on the corner of John Street and Franklin Avenue.

—HAROLD A. HERBERT

THAT is the way the letters are coming in to the Man in the Moon. Little Harold was so anxious to have a star named after him that he went out and looked up and sure enough—right over his house—there were many stars shining. So Harold wrote the great and wonderful Man in the Moon and told him exactly where his house was located.

This great and wonderful man, who is known to thousands of children, lives in Newark, New Jersey. Twice a week he gives children the newest and most successful kind of juvenile entertainment—a bed-time story by radio. Tonight thousands of children will want to hear what the Man in the Moon has to say, and

when he comes away down from the moon and talks to them in their own home they will be as happy as only children can be. One mother wrote in that her little girl—we will call her Sarah Smith—would not eat her oatmeal and could the Man in the Moon help her out? That night the Man in the Moon spoke into the transmitter:

"Is Sarah Smith listening? Well, the Man in the Moon wants to tell Sarah that she must eat her oatmeal if she wants to grow up to be big and strong. That is what the Man in the Moon says to Sarah."

A few days later the Man in the Moon received a letter from the girl's mother saying that Sarah was practically living on oatmeal!

That is how impressive the radio is to children. Thousands of letters pour in from children. In fact, the Man in the Moon has received as many as 1,800 letters in one week.

Who is this Man in the Moon who is bringing joy into the lives of so many children? Where is he? And what does he do between moons?

This is where the disillusioning part begins. He is William F. B. McNeary—a bachelor. But we mustn't hold that against him. For that matter, so is Santa Claus. The Man in the Moon, in real life, is the last person in the world that you would ever think of as being the greatest radio story teller for children. To part the curtains a little more: a person would probably think of him as being a kindly old gentleman walking slowly down the street, cane in hand, possibly on his way to feed the pigeons; but this is not the Man in the Moon. No indeed. Instead of that he used to be a detective.

During the war he was in Russia and Poland in the United States intelligence service—and it is due to that fact that we now have the Man in the Moon stories. It came about more by accident than anything else. In Poland he was living with a Russian family, and in the family was a daughter who could speak fluent English. She used to tell Mr. McNeary fairy stories and folk stories that her nurse had told her. These stories interested Mr. McNeary and he encouraged her to tell him more. And so she did. After a time he came back to the United States and, severing his connection with the intelligence office which he had joined as a war time measure, looked around for a job, as so many men had to do on their return. One evening he went to visit a friend near Newark who had a radio outfit and McNeary was invited to listen in. He knew nothing about radio. With idle curiosity he put on the headpiece.

"Who wants to buy a variometer? Who wants to buy a variometer?"

That was all he could hear. He had expected sweet music and instead of that all he could hear was some bug wanting to dispose of his variometer. He kept repeating it over and over and giving his call number. Then suddenly, as McNeary listened, an idea hit him: Why not put a newspaper into the air with all features—news, sports, editorial, comment, fashions—in short, everything from front page to back?

It was a hazy idea, but the more he thought about hooking up with a newspaper with this queer unknown thing called "radio" the better he liked it. Before he had gone abroad for the Government he had been a member of the editorial staff of the Newark *Sunday Call*, so he put up the idea to the editors.

But how could they send messages? Where could they be sent from? How much would it cost? He had about as much idea as the man in the moon. But the paper was interested. So he took his idea to the Westinghouse Company in Newark, but it had no sending station; only the one in Pittsburgh. At last a hook-up was agreed upon and the Westinghouse Company established a broadcasting station. He would announce in his paper what could be heard

and the night that the company would broadcast it.

At once his talk became a success. Newark became the center of the radio industry. But what to send? That was the question and a stumper it was. At first he sent out weather reports, sermons, news brevities, music records. But the big idea hadn't yet come along.

Then he hit upon the idea of broadcasting a bed time story for children.

The wiseacres in the game nearly laughed themselves sick. Who in the world would want to listen to a silly sandman story? But McNeary stuck to it. By this time he was radio editor of the *Sunday Call*, and found himself put to it for time. But he was not able to get any one else to tell the bed time stories so it fell to his lot to get up one himself. He hadn't the slightest idea for one—and then he remembered the stories he had heard in Poland. He picked out one and then thought of the name the Man in the Moon—and that night he put it on the radio.

A few letters came in reply. Next week he tried it again—and more letters came in. Soon his paper was getting more Man in the Moon letters than any other kind.

The first Man in the Moon story was told in October, 1921; after a time their popularity was such that they had to be moved up to two a week, and thus they stand to-day. But soon the supply of Russian fairy stories ran out; McNeary was now busy scratching around getting out his radio department—and yet the stories must be done. Finally arrangements were made for Miss Josephine Lawrence, editor of the children's page of the *Sunday Call*, to write the stories—and thus it is being done to-day. At seven o'clock Tuesday and Friday nights each week, McNeary takes the story in manuscript form, goes to the Westinghouse broadcasting station and there puts it into the air.

Imitators soon sprang up, until now bed time stories are being sent out by eight broadcasting stations in the United States, but Mr. McNeary remains the original Man in the Moon. He has had the title copyrighted so that there is little danger of the moon ever becoming full of men.

Merely telling stories wasn't enough, so another idea struck him. For the children who were good he named a star after them—and that day assured the success of bed time stories by radio.

The children went wild about it. How wonderful it was to think that the man in the moon had named a star after them—and that it would twinkle as long as the child was good! It beat a shoe-horn or a hairbrush all hollow. It became the new way to correct children. Immediately the children fell in with it and the Man in the Moon became a person more wonderful than Santa Claus—for Santa Claus comes only once a year. Now there are

---

I wish to thank you for naming a star for me which you did a few weeks ago. You had my name printed in the Sunday Call as Louis McMullen and I hope you didn't name a boy star for me as my name is Lois McMullen and I am a girl

I am going to be seven years old on Friday March 3rd and my Aunt Caroline in Jersey City gave me a little Fox Terrier seven weeks old for my birthday. I call him Buster. If you have any more dog stars left I wish you would name one for Buster.

I listen in to your stories every Tuesday and Friday nights and I haven't heard you name any doll stars. If you have any I would like to have you name one for my doll Janice and one for my walking doll Lois.

Please stand by for the party.

This is E. Lois McMullen signing off.

Good Evening.

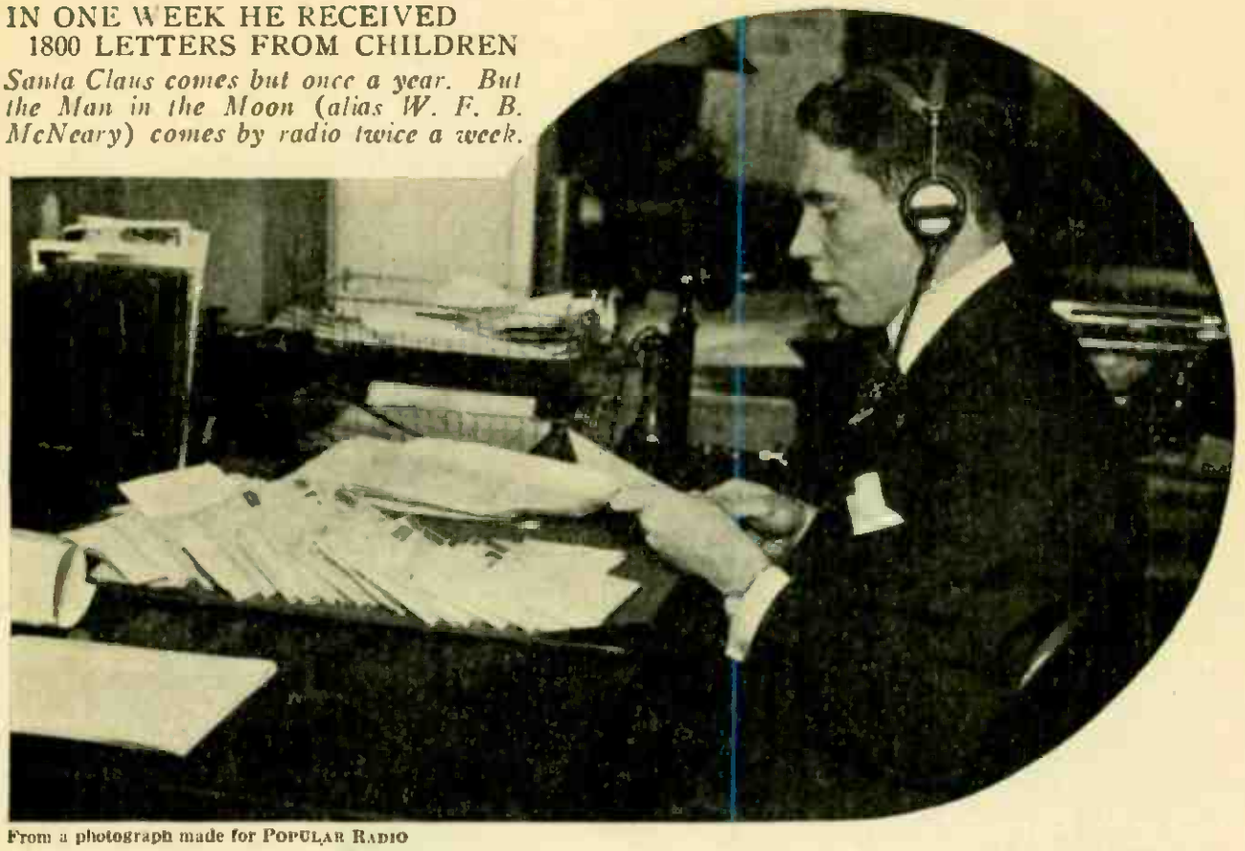
P.S. My daddy is writing this for me.

A MIX-UP IN THE HEAVENS

If the Man in the Moon named a boy-star after little Lois—who is a girl—there will have to be a lot of explaining done and the astronomical charts will have to be made over completely.

IN ONE WEEK HE RECEIVED 1800 LETTERS FROM CHILDREN

Santa Claus comes but once a year. But the Man in the Moon (alias W. F. B. McNeary) comes by radio twice a week.



From a photograph made for POPULAR RADIO

thousands of children in the United States who, if they had to choose between Santa Claus and the Man in the Moon, would probably give their fond and doting parents a surprise.

What amusing, ingenuous stories the letters tell! How they reach the heart! We wish we had more space for them, but as we have not we will have to cut them short.

I am sending you a few lines to ask you if you have three more stars left of which you can name one for me and one for my little sister and brother. My name is Emma Clodius and my sister's name is Hazel Clodius and my brother's name is Henry Clodius.

EMMA, HAZEL and HENRY CLODIUS

What a hurry they were in to write to the Man in the Moon before all the stars were gone!

I have a little cousin whose name is Peggy Chapman, and she lives in Jersey City. She listens and loves your stories too, just as I do, and she wishes you would name a star for her, but she is so bashful that she wouldn't ask you.

ROBERT STORK

I have a little sister named Natalie. Would you please name a baby star after her.

NORMA MATTE

We listen to your stories every Tuesday and Friday night. I live with my grandma on Princeton Street. My uncle has a wireless set and lets me use it. My uncle is fourteen years old.

JENNIE MAY NELSON

Won't you please name a star after me? It need n't be a very large one, as I am only seven years old. If you have any tiny stars left up there you might name one for my baby sister, Elaine. She can't hear your stories, for she must go to bed at six o'clock, but I know she would like to have a star for her very own.

JANE LORSON

What a wonderful feeling it must be to have a star of your very own!

My name is William Terry, but I like to be called "Bill Soldier," because I like horses. I am just four years old, but I will be five on August 11th, 1922.

WILLIAM TERRY

What a long time Bill will have to wait to be almost a man—until August 11th.

My brother Vincent and myself would be very proud to have stars named after us and hope you will name them this Friday. We have a baby sister named Anita, but as she only came from the stars three months ago, I guess she isn't very anxious to have a star named for her. Are you so busy

naming stars that you can't find time to shine any more? It seems like a long time since we saw you shining in the sky.

THEODORE and VINCENT BROUN

I am getting my sister to write and ask if you will name a star for me, as I am a little boy seven years old and have no mother or father and I am sure that if I hear my name over the wireless it will make me happy.

ARTHUR DULL

What a story in this! It could serve as a fiction writer's inspiration—the little boy whose father and mother are dead and who would be happy if he had a star named after him—a star from up where *they* are! It almost brings a tear to one's eye to think of the tragedy in the home—and the little boy so anxiously waiting for his star.

Note and Personal: I can tell you, little girls, little boys, if you ever read this article, that the Man in the Moon is real. I have seen him. He lives and eats and has to go to bed just the same as anybody else does. He is a nice man and he wants to name a star after every good boy and girl. If it takes him a long time to get to you it will be because he has so many, many friends. Just keep right on believing in him—and some day there will be a star twinkling for you.

P. S. Don't worry. He says that he has lots and lots and lots of stars that have never been used.

Good night, I must stand by.

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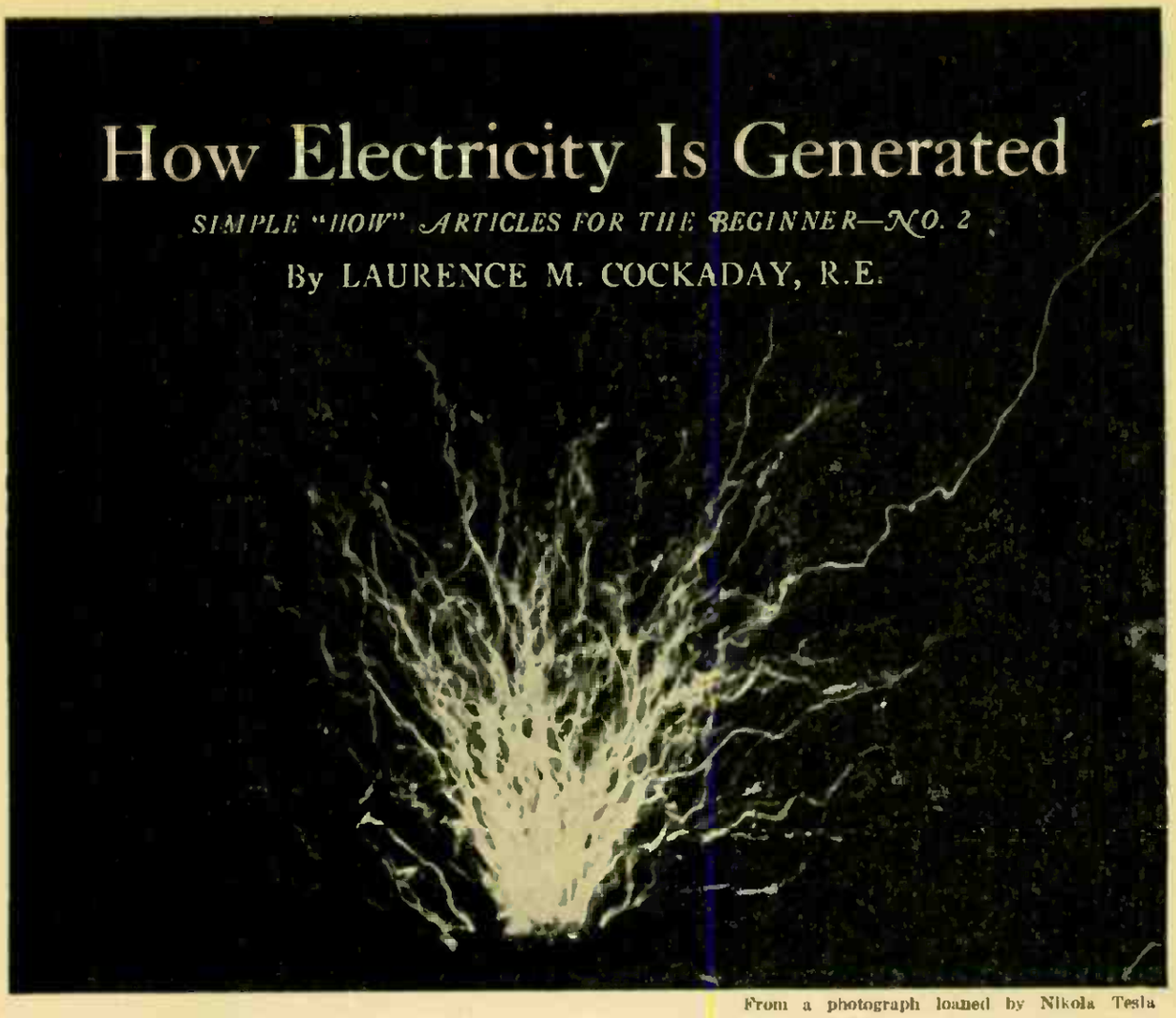
WHY LEAVE HOME TO GO TO COLLEGE?

The coming of the radio may have a far-reaching effect upon both our intermediate and our higher educational systems if the lecture courses that are being instituted by numerous schools and universities are carried to a logical conclusion. Thirteen members of the faculty of Tufts College have volunteered to broadcast lectures on their special subjects; this picture shows four of them—Prof. Arthur I. Andrews, Prof. Edward H. Rockwell, Dean Gardner C. Anthony and Prof. Albert H. Gilmer—in the station WGI, near Boston

How Electricity Is Generated

SIMPLE "HOW" ARTICLES FOR THE BEGINNER—NO. 2

By LAURENCE M. COCKADAY, R.E.



From a photograph loaned by Nikola Tesla

TO understand the radio-telephone one must be familiar with the simple theory of electricity, and to understand the simple theory of electricity one must understand the electron theory, a theory of electricity and matter that explains every phenomenon of the scientific world known today, both in chemistry and electrical engineering.

The electron theory is now commonly accepted as fact by the world of science. It deals with the smallest division of matter, called the electron.

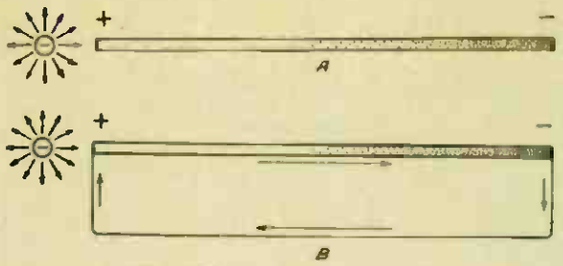
The electron is a minute charge of negative electricity; also is the smallest charge that it is possible for the human mind to conceive.

The atom is the smallest division of matter that exists in the form of matter; it is made up of a nucleus that consists of a positive charge of electricity surrounded by electrons. The only difference between the various kinds of atoms lies in the number of electrons which surround the positive charge or nucleus. Thus are explained many chemical changes that occur to substances; the number of electrons that surround the positive charge of a certain kind of atom may be deprived of a few electrons and the whole nature of the substance thereby changed. These electrons that surround the positive charge are held within certain limits as to the distance they may move from the positive charge by a very powerful though minute force.

To get a clear idea of the atom, compare it to the solar system. Liken the sun to the positive charge and the planets to the electrons. The electrons are held in their orbits around the nucleus in much the same manner as the planets revolve around the sun.

Next, consider two classes of materials that are of vital importance on account of their electrical properties; first, conductors of electricity and second, insulators against electricity.

Conductors of electricity (such, for example, as silver, copper, iron, and in fact



FIGURES 1A AND 1B

all metals to a certain extent), allow electricity to flow through their substance.

Insulators against electricity, (such as glass, rubber, wood, air, and numerous other materials) will not allow electricity to flow through their substance.

The conductive materials are made up of millions of atoms, which are in turn made up, as we have just learned, of a positive charge surrounded by minute charges of negative electricity called electrons. But the conductive materials contain, besides the atoms, countless numbers of free electrons which float in the spaces between the atoms.

Insulating materials contain few of these free electrons.

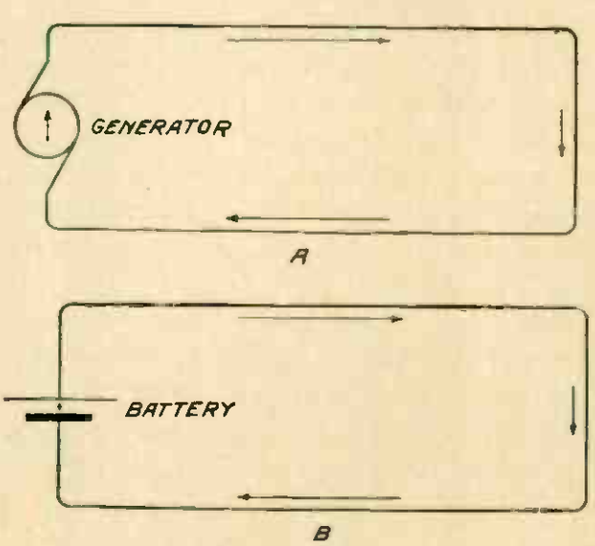
A positive charge and a negative charge brought into proximity to each other are attracted to each other. Two negative charges, on the other hand, repel each other when brought close together. So do two positive charges repel each other. This phenomenon may be easily remembered if put in the form of a scientific law:

If a unit charge of negative electricity is brought near enough to a positive charge, the attraction causes them both to run together and neutralize each other.

To understand how a current of electricity is created, first consider a copper rod as pictured in Figure 1A. This is composed of countless millions of atoms with millions of free electrons floating in between these atoms. If at one end of the rod is applied a strong negative charge or a number of charges, all of the free electrons in the rod, because they are negative charges, are repelled from the external negative charge and scramble about between the atoms in a mad rush to get to the furthest end of the rod from the external charge and all become crowded together at this far end. When a rod or wire is in this condition we say that the end where the negative charges are thickest is the *negative* end and the end where there is a scarcity of negative charges is called the *positive* end.

If there were a continuous circuit around from the negative end of the rod to the positive end the electrons would rush around through the circuit to the positive end, we would say that a current of electricity was flowing through the circuit. The current, however, is considered as running in the opposite direction to the flow of electrons, that is, in the opposite direction to the arrows showing the direction of the flow of electrons. See Figure 1B. If we were to try the same experiment with a glass rod we would not have any success, as there are few free electrons in an insulator and the electric current from these few stray free electrons would be so weak that we could not detect it except with an ultra-sensitive instrument. We say accordingly that no current of electricity flows through an insulator.

If, however, we should apply a strong external charge (which we might call a high voltage), the free electrons in the glass rod, even though they be few in



FIGURES 2A AND 2B

number, would be repelled so violently that they would collide with the atoms and knock off of them some of the electrons that were a basic part of these atoms. These freed electrons would then go racing along with the stream and soon the matter which composed the insulating rod would be decomposed and the electric current would flow through the rod in the form of a spark. In this condition the insulator is called "broken down" or ionized.

This same action takes place whenever a spark jumps across an air gap such as used in some types of wireless transmitting sets. When an atom of air has one or more electrons knocked off, its insulating properties are lost and it becomes ionized and is called an ion.

An electric generator is a device that causes electrons to be attracted to one of its terminals and repelled from the other terminal by magnetic action.

In other words, if a continuous conducting circuit is connected to the two terminals of a generator as shown in Figure 2A the generator keeps expelling electrons from one terminal and they flow around through the copper wire to the other terminal where they are sucked back in through the generator; the same process goes on continuously till the generator is shut down.

The electric battery does the same thing, only its action is chemical instead of magnetic. See Figure 2B.

Stationary charges of electricity, or "static electricity" as it is sometimes called, may be stored up in a device that is known as a condenser.

A condenser consists of two sheets of conducting metal that are separated by a

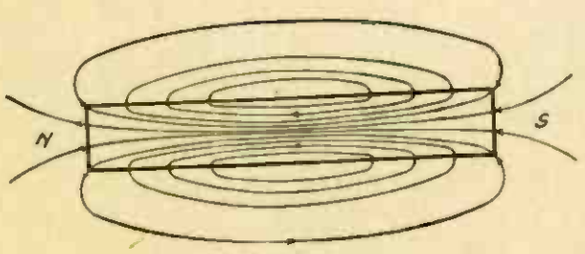


FIGURE 4

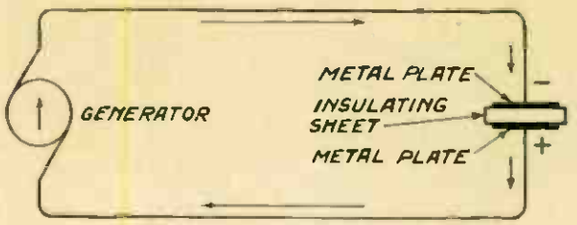
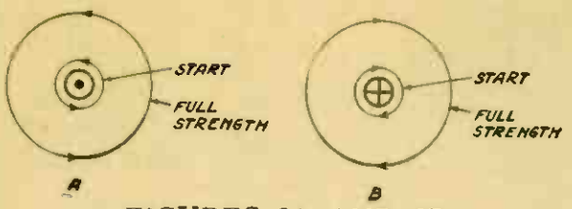


FIGURE 3

sheet of insulating material such as glass or mica; in some cases air is used. This sheet of insulator is called the "dielectric," and the two conducting sheets are called "plates."

If we take such a device and connect it to a generator, the generator will suck all of the electrons from one of the plates and this plate will then become positive, and these electrons will be pumped by the generator on to the other plate, which will then have twice as many electrons as it should have normally, see Figure 3. The electrons cannot get back through the generator; neither can they pass through the dielectric or insulating sheet. If we suddenly disconnect the generator these electrons that are bunched on the negative plate will remain trapped there and we have a store of electrostatic energy in the condenser. When we want to make use of this energy we connect a wire around from the positive plate to the negative plate and the electrons will rush through the wire, thus causing a current to flow till the charge is spent and the electrons are back in their natural places. This action may be likened to the action of water running into a reservoir until the reservoir is filled; the water can be stored until it is needed; then the gates may be opened and the water will run out and be used for some useful purpose. So the condenser is used for charging up the high voltages that are used to produce the sparks that are seen jumping the air gap in the radio telegraph transmitter. Condensers are also used for tuning purposes.

When a current of electricity flows through a wire a magnetic field is set up around the wire. This field is the same as the field or magnetic disturbance that



FIGURES 5A AND 5B

is set up around the poles of a steel bar magnet, as shown in Figure 4. Imaginary lines of force called "magnetic flux lines" extend from the north pole of the magnet to the south pole and inside of the magnet from the south pole to the north pole. This magnetic energy is supposed to be revolving around following the paths of the imaginary lines as shown in the diagram. Looking at the end of a wire through which a current of electricity is flowing away from us, Figure 5A, a magnetic ring or number of rings start to revolve around the wire. The imaginary ring expands further and further as the current gets stronger; when the current gets up to full strength it stays out at a certain distance from the wire. When the current is turned off the magnetic ring quickly contracts until it collapses back upon the wire again. If the current should be reversed and flow toward us the ring would expand in just the same manner and collapse when the current is turned off, but the rings would revolve in the opposite direction. See Figure 5B.

As an analogy, we may liken these magnetic rings to rubber bands stretched around the wire that fit the wire tightly; when a current is passed through the wire the bands begin to revolve clockwise, slowly at first and then more rapidly as the current increases. As the centrifugal force increases from the rotation, the bands expand until the current reaches its full strength, the bands have attained their highest speed of rotation and the expansion process ceases and they stand out from the surface of the wire a definite distance, where they remain revolving at a definite rate of speed. When the current is turned off the speed of rotation decreases and the bands settle back until they come to rest on the surface of the wire. When the current is reversed the bands rotate in the opposite direction and the same process of expansion and contraction are experienced.

When two wires are placed side by side and close together and the current flows in the same direction in both wires, the rings enclose both of the wires instead of two separate sets of rings, and the speed of the rings is doubled.

This principle is made use of in the tuning coils of a radio set. Every turn added to the coil increases the magnetic effect as the wires of the coil are wound close together and the current flows in the same direction in the adjacent turns. This causes the magnetic lines of force to encircle the entire coil, extending from one end of the coil, outside the coil to the other end of the coil, and back through the inside of the coil. Compare the diagram in Figure 6 with the diagram of the magnet in Figure 4; the similarity of the two fields will be noticed.

A coil is sometimes referred to as an "electromagnet." One end of the coil will be the south pole and one will be the north pole with the current running through the winding in one direction; if the direction of the current should be reversed, the polarity of the coil would also be reversed. This idea of electromagnetic energy should be well fixed in the reader's mind before he proceeds further, as it is this principle that is used in all radio apparatus; it is indeed, the "open sesame" to the beginner who expects to understand more fully the intricacies of radio and the radio telephone.

These two forms of electric energy, electrostatic and electromagnetic, will be studied more fully in a subsequent article.

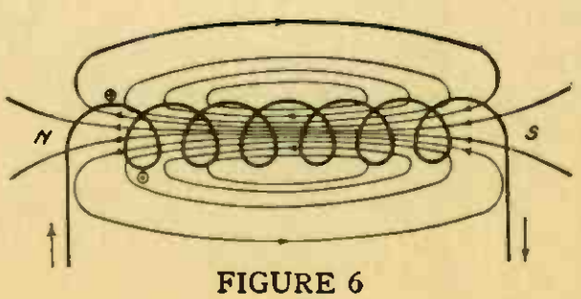
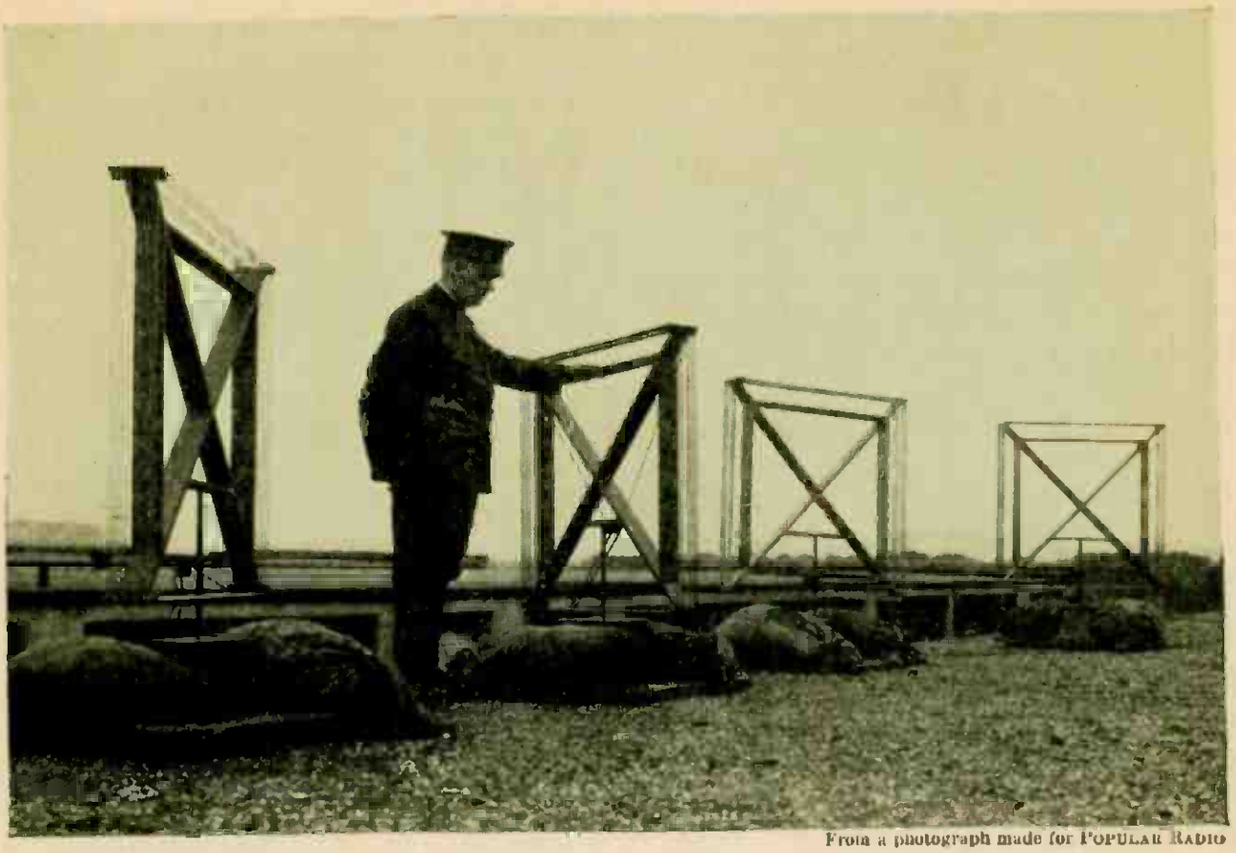


FIGURE 6



From a photograph made for POPULAR RADIO

THESE LOOP AERIALS ARE "SET" TOWARD DIFFERENT SENDING STATIONS

On the roof of the Munitions Building in Washington, D. C., where the army's radio central station is located, these antennae pick up messages that come about 6,000 miles.

"By Signal Corps Radio"

How the Newly Established Army Radio Central Is Saving Time and Money for Uncle Sam

By CAPT. WILLIAM E. MOORE

THE chief clerks of the War Department at Washington have been furnished with a new rubber stamp. It is marked "*By Signal Corps Radio.*"

The use of this rubber stamp signals a new era in interdepartmental communication. For it means that the Army is handling communications within the continental confines of the United States through the Army Radio system. The Traffic Section has become, by general order, the message center of the Army. Every army communication that originates in the Washington military area will have to be sent to this message center for distribution; even those communications that are destined to be sent out over land wires must be sent to the message center. There the officer in charge will make the decision as to whether the message shall be sent out over the army radio net or by land wire.

The Signal Corps has worked with speed but without any blowing of trumpets at this job of installing a continent-wide radio system. During the war the army received some painful lessons as to the embarrassments involved in advertising what it intended to do ahead of time. There were in the army at that time some enthusiasts from civil life who believed that one way to win the war was to tell the public all about what they intended to do. In some well remem-

bered instances the final accomplishment did not come up to the expectations. There was consequent disappointment to the public that was reflected in criticism of the army. That is the reason the army today does not believe in advertising what it is going to do.

The unostentatious manner in which the Signal Corps has carried out its plan of hooking up the entire army in America by radio was illustrated by an incident that recently took place in the office of Capt. R. B. Woolverton, the chief of the Radio Traffic Section. The Adjutant General's office called Capt. Woolverton on the telephone to inquire whether he could handle an army message by radio. The Adjutant-General was informed that messages could be sent into all but one of the corps areas in the United States. Communications with those two corps probably will have been perfected before this article appears in print.

The radio stations have not been completed in the 1st Corps area, comprising the New England States, nor in the 9th Corps area, comprising the Pacific Coast states. Through the co-operation of the Navy radio service, however, the army is enabled at the present time to communicate with 9th Corps Headquarters at Camp Lewis. The radio sections of the two branches of the military service work in the closest liaison. The army depends upon the Navy to carry its messages from the coast stations to all overseas posts of the army, such as Hawaii, Panama and the Philippines, while the army radio net is employed within the United States proper to carry Navy recruiting messages.

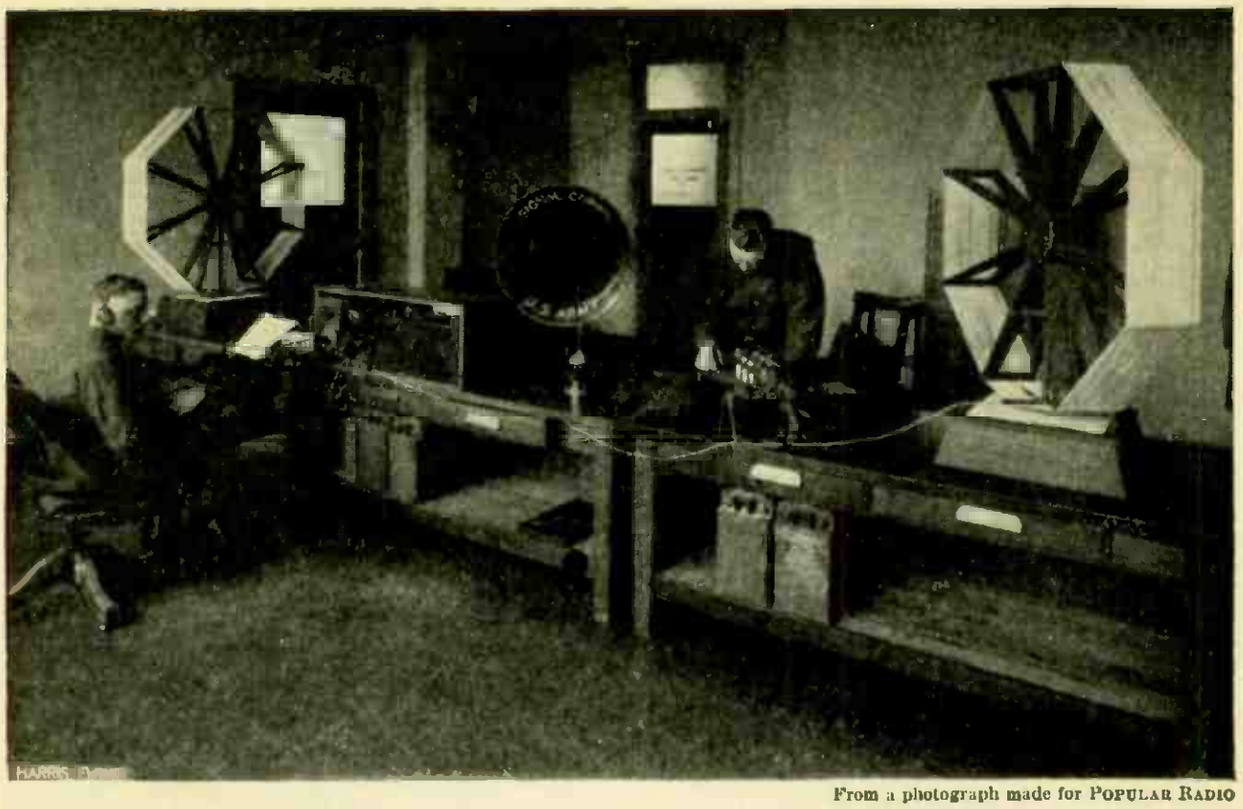
Pending the completion of the army's net work, the Navy is carrying army messages to the West coast in all emergency instances. The Navy flashes these rush messages from its station at Annapolis to the one at San Francisco. In return for this courtesy the army carries deferred messages for the Navy between the same points. Even after the army radio net is complete in all its details it is the intention of the government authorities to continue the plan of having transcontinental rush messages carried by the Navy, while to compensate the Navy for this work the army net will carry deferred Navy messages across the continent.

Through this interservice exchange there is assured a reciprocal and perfectly balanced system of communication between all parts of the United States and its overseas possessions.

Radio communication within the confines of the 8th Corps, stretching along the Mexican border, has been in operation since before the United States entered the World War, but the first station outside the border section was erected and opened for traffic December 10, 1921, at Ft. Benjamin Harrison at Indianapolis. Three months later, thirty-two stations were in operation in the United States and it was announced that within sixty days the number of stations will have been doubled. When that is accomplished it will be possible to communicate with any army post in the country by radio. Even the small one-company posts, if they are equipped with field radio sets, will be in touch through the ether, with all the other units of the army organization. The work of tying all the coast artillery posts into the army net is now under way and will have been completed before the first of June.

In Alaska the Signal Corps already has sixteen stations in operation. These are linked up with the army radio net in the United States proper by means of the army cable which runs under the ocean from Seattle to Alaska. That cable, by the way, is the only one that is owned by the United States government. When the work of the Signal Corps is completed the army post at Key West on the southernmost tip of Florida will be in direct and instant communication with the last out-lying post under the Arctic Circle in Alaska.

At present eleven of the thirty radio



From a photograph made for POPULAR RADIO

THE COMING TYPE OF LOOP AERIALS

Without the aid of towers or poles on the roof, these indoor antennae in the army radio central station receive signals from Rome, Italy.

stations in the army are equipped with radiophones; before many weeks have passed twelve more radiophones will be installed. This means that the principle army centers will not only be able to communicate by means of the written word but that they can communicate by word of mouth. What that means in terms of efficiency, especially at times of emergency, will be recognized by everyone whose business demands have taught him the relative value of telephone and telegraph.

The efficient range of the army radiophones is 300 miles, while the range of the radiotelegraph is 1,000 miles. Relay stations will be utilized for longer distances. The distance between Washington and San Francisco is approximately 3,000 miles. An army radiotelegram started from the national capital to the coast town is relayed from stations at Omaha and Salt Lake City.

The chief significance of the installation of the Signal Corps' radio net is that hereafter the nation will be entirely independent of commercial lines of communication, no matter what emergencies arise. If storms or blizzards should destroy every pole and line in the United States the radio sets of the army could still carry on the essential business of the government and, in addition, could largely aid private agencies in keeping up the necessary business of the day. When the army net is completed, as it soon will be, the peace-time establishment of the army within the continental limits of the United States will be established upon as firm a footing as regards instant touch with all its elements as was the war-time army in France, where the front line trenches were tied in, by means of the army radio net, with General Pershing's personal headquarters at Chaumont.

Civilians will scarcely understand the guaranty of national safety that is embodied in the above statement, but to all those who served in the army abroad it will carry an assurance of preparedness for any emergency. In its study of the many questions of national defense the

army has had to consider the possibility of domestic upheaval resulting from strikes, "red" demonstrations or other causes. Quick mobilization is, of course, of the highest importance under such circumstances. Under the terms of the new army organization, both the National Guard and the Reserves form part of the Army of the United States. All the units of those elements of the army are held in the closest touch these days with the headquarters of the corps in which they are grouped. A word flashed by radio from Washington would call to immediate service every regular and citizen soldier in any section of the country where danger threatened. And no destruction of telegraph and telephone lines would prevent the summons to arms from reaching its destination.

When President Taft was inaugurated in 1908 a severe blizzard in Washington and along the East Atlantic coast isolated the national capital for twenty-four hours. Such a condition will never again be possible now that the Signal Corps' radio service links every part of America with every other.

In ordinary times the army net will be employed only in carrying purely military business, unless other arms of the government come to employ it for broadcasting purposes. The sending out of daily information bulletins has recently come to be an important feature of departmental business; with the increasing facility for spreading this sort

From a photograph made by POPULAR RADIO

THE HEART OF THE ARMY "MESSAGE CENTER"

The office of Capt. R. B. Woolverton, of the Signal Corps, in Washington, through which all army radio messages may be transmitted to and received from every one of the nine corps areas—at a substantial saving in telegraph bills.

of news among the people it is certain that the volume will constantly increase. There has been discussion in government circles in Washington as to whether the army radio system should be employed for broadcasting farm service information for the Department of Agriculture. With its present number of twenty-three broadcasting stations the army is equipped to carry out that work today and is only awaiting an order from the proper source to undertake it. A decision in this matter is said to depend upon whether the Post Office Department will also enter the wireless field and assume the function of broadcasting information issuing from the civilian branches of the public service.

It is none of the army's business what other rivals enter the national service in the radio field. A decision there must rest with Congress and the taxpayers who vote for the Congressmen. But if Uncle Sam in his wisdom should call upon the army to take up the duties of news carrier to the farmers the army is equipped and ready for the job.

Mention of the taxpayer brings up the question of the cost involved in linking up all parts of the nation by means of the army radio system. Up to date, with half of the work completed, the cost has been only $500,000. The total probably will be in the neighborhood of $1,000,000.

But the saving to the army in commercial telegraph tolls will make up the cost of installation within a short space of time. The army does a great deal of telegraphing, and some telephoning. Hitherto most of this has been turned over to private organizations for transmission. Hereafter the work will be done by the army itself, with soldier operators sending over army radio sets. That the saving thus accomplished will result in higher efficiency cannot be questioned. Economy is the password of the day in government circles these days. Military and civilian servants of the nation hesitate long before they spend a cent of Uncle Sam's money. They are all afraid Gen. Dawes will get 'em, if they don't watch out.

When the army dirigible *Roma* burned at Langley Field, Va., with a fearful loss of life, there was a rush of Washington correspondents to the offices of the army Air Service to obtain details of the catastrophe. There the writers ran into the hard and fast rules for economy that have been established throughout every branch of the government service. The long distance telephone in the office of the officer in charge could not be used because the army had no authorization to spend money to obtain news for the press. After some argument an idea presented itself to one of the correspondents. The newspaper men raised the required amount $7.50, among themselves and paid for the call. Then the officer did the talking and obtained the official information they all were seeking.

In this instance the alert Washington correspondents had overlooked the one method of instantaneous communication with Langley Field. The installation of the army radio net has been carried on so quietly that even these usually well informed journalists do not yet know about it. News of the *Roma* disaster was instantly flashed to the Radio Section in Washington that day, and both the Chief of Staff, Gen. Pershing, and the Chief Signal Officer of the Army availed themselves of the radio service to keep themselves informed regarding the progress of the rescue work at Langley Field.

All of the fifteen Air Service fields have already been tied into the army net by radio. The Signal Corps supplies each flying field in the army with an airplane radio set, including radiophones for use between planes in the air and between the planes and the ground stations. The radio telegraph radius of the instruments is 300 miles.

All Air Service fields are being equipped with radio sets exactly similar to the army radio net equipments for the purpose of enabling stations to transmit

meteorological data from one station to another and throughout the army. This furnishes insurance against disasters of the air resulting from unexpected storms. In the past numbers of planes had met with accidents and sometimes destruction through unlooked for weather conditions while on long flights. Under the new conditions whereby each plane is in constant touch with all stations, such accidents can be easily avoided. If the newly installed system had been in operation last fall when the giant army flying machine *Eagle* was destroyed, with loss of life, while on a flight between Washington and Langley Field, that catastrophe would have been averted.

The flying field installation is known in the army as the "Alert Net;" it will be available not only for the flyers of the army, but for aerial mail carriers of the Post Office service as well. The army's transcontinental stations at Omaha, Cheyenne and Salt Lake City are all on the route of the transcontinental air mail service, and so can guard the postal route without any duplication of equipment or expense.

What other national duties and responsibilities the Signal Corps radio service will be able to assume have not yet been ascertained. The possibilities are so vast that even the experts who installed the system refuse to hazard a guess as to what another year will bring forth in the way of communicating through the ether.

THE FIRST SINGER TO GIVE A RADIO CONCERT FROM THE SKY

A unique recital that established a precedent was given in April by Miss Jeannette Vreeland, an opera singer, who broadcasted a program from a Fokker airplane that was speeding through the clouds over Haselhurst Field, near New York. The concert was transmitted by a 50-watt set on a 507-meter wavelength with a range of 500 miles. On Miss Vreeland's right is Lieut. Belvin W. Maynard, the famous "Flying Parson."

From a photograph made for Popular Radio

A $200 Set Built *for* a Business Man

AN exceptionally serviceable long-distance receiving set that was assembled by a New York business man is illustrated in the picture at the top of this page. The owner—Mr. Julian Chase—had no technical experience in radio work; indeed, one of the remarkable features of the set is the fact that the owner obtained his ideas partly from his radio amateur friends and partly from newspaper and magazine articles, and only incidentally from his casual operation of a small receiving set which he formerly owned.

The set is unusual, too, in that it is complete in detail for receiving all wavelengths that are used both commercially and by the amateurs, as it has a range of from 200 to 20,000 meters.

In the lower left hand corner may be seen the low wave set that is used for listening to the nightly concerts and to amateurs. To the right of this cabinet is the two-stage amplifier which amplifies the signals to great strength. Directly above the low wave set is seen the high wave set for listening to the long-distance commercial stations of this and foreign countries. The two middle switches of the upper set are used for changing over from the low wave set to the high wave set; above these switches are mounted the honeycomb coils that enable these high wavelength stations to be received. The two dials at each end of the set are attached to the tuning condensers.

Mr. Chase uses a horizontal V antenna for receiving with the lead in at the point of the V. The average length of the antenna is 90 feet. The low wave set has enabled the owner and his family and friends to hear the concerts from Newark, N. J., Pittsburgh, Pa., Detroit, Mich., Schenectady, N. Y., and occasionally from Chicago, Ill. With the high wave set, messages from Nauen, Germany, Rome, Italy, Elvise, Germany and numerous other foreign stations have been heard with sufficient strength to operate the loud speaker that is mounted on the wall at the right of the high wave set.

Westinghouse. Photo of Scipio Sindi.

THE STAR PERFORMER AMONG THE INSTRUMENTS

The violin tones are sent out by radio with almost entire fidelity, followed closely by the other stringed instruments and by the woodwinds.

Tones *that* Do *and* Don't Broadcast

The Unexpected Problems in the Transmission of Music by Radio that the New Type of Impresario Has Had to Solve

By WILLIAM H. EASTON, Ph. D.

ONE-two-three-four — hello-hello-hello—one-two-three-four ——" Have you ever picked up this string of nonsense in your receiver? If so, you have stumbled upon a radio engineer at work on improving his transmitting apparatus. Why he should use this particular formula is not clear, but it has become a tradition in radio circles, just as "This is the time for all good men to come to the aid of the party" has among stenographers.

An immense amount of the most careful kind of engineering work was necessary to produce the present radio concert. Only a short time ago a listener was astonished if he could hear anything at all and satisfied if he could distinguish "Home. Sweet Home" from the "Wabash Blues." But now he is satisfied with nothing short of a finished artistic performance, so that even after the radio engineer has succeeded in transmitting intelligible messages, he was given no rest; he has had to refine every detail of the radio telephone until a perfect reproduction of the original sounds became possible.

One of the most amazing of the early troubles was "blasting." This is due to the excessive vibration of some part of the microphone, and it produces most

unpleasant sounds when certain notes are struck. Endless experiments were carried on to eliminate it. Microphones were made of wood, tin, lead, parchment and fiber. They were made big and little, conical, cylindrical and flat. Gradually the trouble was eliminated and it is now no longer heard in the performances of the better broadcasting stations. Members of the radio audience of at least six months' standing will appreciate the improvement that has been made in this respect. Last fall it was considered impractical to broadcast a quartette because of the blasting caused by the combined voices, but now full orchestras, bands, and choruses can be handled without difficulty.

But the big struggle was with the piano. This instrument is absolutely indispensable but it is the most difficult of all to reproduce and transmit. The first attempts were dismal failures. The bass notes were a complete jumble; the middle register was tinny and the top notes refused to come through at all. Each element was given the most careful study, however, and microphones were literally built up around the piano's peculiarities. Recent results are highly satisfactory, and though there is admittedly still room for further improvement, a radio piano recital will now please even the most critical musicians.

With the piano conquered, none of the instruments present any special difficulties. The stringed instruments, such as the violin, harp, banjo and ukelele, are transmitted with entire fidelity, as are also the woodwind group, such as the clarinet and flute, and the instruments of percussion, such as the bells and the xylophone. Brass instruments, being for the most part inherently blatant, require careful handling, and cornets if blown directly into the microphone may still cause blasting.

But of all the musical instruments, the human voice is best adapted to radio broadcasting; and of all voices, the soprano is the most effective. The notes of the *artiste* are transmitted without perceptible loss and can be heard at far greater distances than any other sounds. Many listeners along the Atlantic Coast could plainly hear Mary Garden or Edith Mason when the Chicago Opera was being broadcasted from KYW, but they were entirely unable to catch the faintest trace of orchestra, chorus, or any other singer.

Of the other voices, the contralto is favored least by radio, as her deep, 'cello tones sometimes lose some of their velvety richness in transmission. Yet much depends upon the individual singer. The writer interrupted this very article to listen to a contralto whose voice seemed perfection in the ear-phones.

But a perfect instrument does not mean a successful concert. The best of pianos will do little for a poor performer, and the most complete of broadcasting stations will not give a performance that will please the audience unless it is in the hands of an experienced management.

Westinghouse photo of Gustave Longernus

THE CLARINET IS TROUBLESOME

While the mechanical clicking of the stops is unnoticed by the human ear, the radiophone not merely records it but exaggerates the sound.

One of the problems to which the manager gives special attention is the selection of artists. It not infrequently happens that a singer who enjoys an enviable reputation fails to produce a good impression by radio. Sometimes this is because the singer's success is due to personality rather than to voice, and sometimes because the radio telephone is unable to transmit the voice properly, although there is less and less trouble from this source as the transmitting apparatus is improved. The manager soon gets to know which vocal qualities are desirable and which are undesirable, but he never can be entirely certain of a singer's fitness for radio work until after an actual trial.

One condition makes his work different from that of an ordinary concert manager. In the concert hall or theatre, the musician is rarely less than fifteen or twenty feet from the nearest of the audience, but in the broadcasting studio, the microphone, which represents the listener's ears, is within two or three feet. Hence many tricks of articulation or breathing that pass unnoticed on the stage are plainly audible to the radio audience. For the same reason the clarinet and some other instruments must be placed at some distance from the microphone, or else the clicking of the stops will mar the performance. The flute, however, having no mechanical stops, does not require this precaution.

The placing of the soloist and the accompanist, and grouping of voices in a chorus or instruments in a band, and the selection of the proper microphone for each combination, are also matters that must be decided by the manager. In some of the larger broadcasting studios, a plan of the floor is made, and the locations of microphones and artists for all of the more usual performances are indicated on it. But new situations frequently come up and raise questions that can only be answered by a trial. Listeners can often note a decided improvement in a second selection over the first one in a given concert because some needed change was made during the intermission.

To help him, the manager has a staff of critics, who listen in at their homes

Westinghouse photo of Caroline Beebe

PIANO MUSIC WAS THE MOST DIFFICULT OF ALL TO BROADCAST

This indispensable instrument presented the greatest mechanical obstacles to transmission of its sounds by radio, and for a long time efforts to overcome them were dire failures.

and phone him if improvements are necessary. Some of them are employees of the company that operates the station; but the majority are unofficial members of the audience who are well versed in radio and music.

"Bring the tenor of that quartette forward! He isn't coming over strong enough."

"The trombones of that band are too loud. Keep them down."

"Tell that soprano to use less effort in her upper register."

"Tone down the piano! It's drowning the soloist."

Such are some of the messages these critics send in. The manager, of course, listens in constantly at a local receiver and is aware of most of the defects before anyone else can tell him of them, but he is so near the source of the sounds that certain imperfections escape him, and therefore he needs aid from those located at a distance.

Another one of the problems of the management is to produce a program of the most varied nature. Nothing suits everyone. Some people detest classical selections; others will not stand for jazz; and still others dislike music of any kind. The endeavor is therefore to suit all reputable tastes by compiling the list of artists and speakers on the theory that those who do not wish to listen to one will find the next one entirely to their liking. The standard applied to each number is, "Will this be of interest to at least 50 per cent. of the audience?" All matters with merely a local or group appeal are, therefore, ruled out.

Of course a station is criticised for many things that are the fault of neither its apparatus nor its management. Good reception depends just as much upon the receiver as the transmitter, and a run-down battery or a defective tube in the receiving apparatus will spoil any program, no matter how well it is transmitted. Interference from other stations also causes trouble. In addition, artists are human and are liable to fall ill suddenly or be unavoidably prevented from fulfilling an engagement for some other reason. Even the Metropolitan Opera Company is occasionally compelled to change its offering. The record of two of the major broadcasting stations is, however, that no artist of repute has ever broken an engagement except for absolutely compulsory reasons, and when disappointments have occurred an appearance has been made at the earliest opportunity.

Westinghouse photo Os-ke-mon-ton

THE EASIEST AND THE HARDEST SOUNDS TO TRANSMIT

The human voice is better adapted to radio broadcasting than any other sound—and the brass horn is the worst.

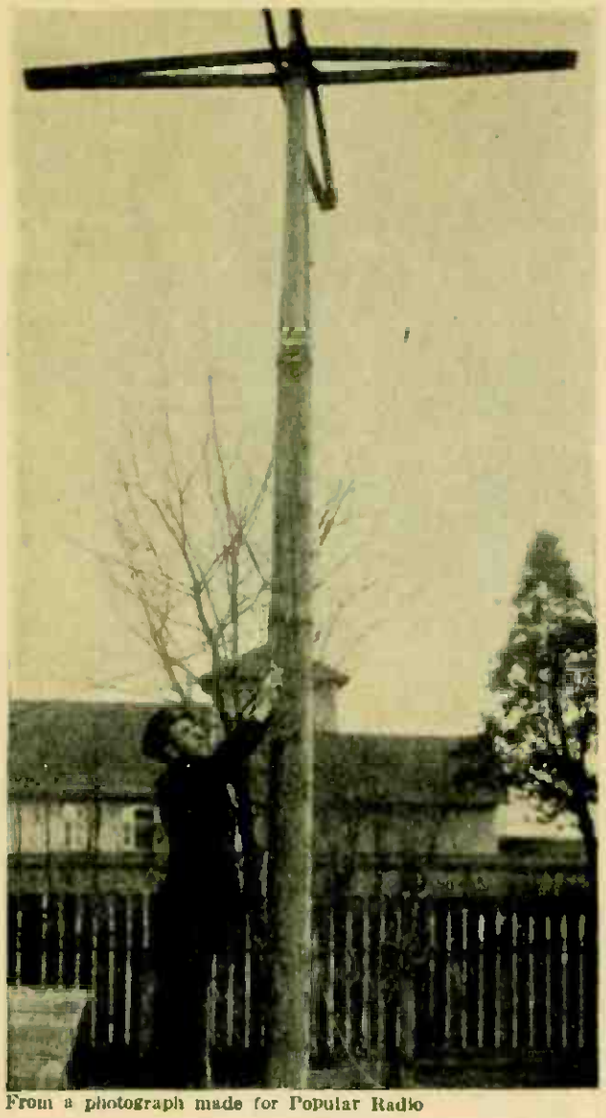
It is trite to say radio broadcasting is in its infancy. But it is in fact only eighteen months old; and if it continues to improve technically and artistically at its present rate, its possibilities will surpass anything that the most vivid imagination can dream of today.

¶ *Is the Radio Helping or Hurting the Church? Read the Next Number of* POPULAR RADIO — *for July*

An Amateur Who Made a World's Record

How a Sailor Accomplished the Surprising Feat of Sending a Radio Message Across the Atlantic on a "Little 20 Watt Outfit"

By RICHARD LORD



From a photograph made for Popular Radio

SAILOR COLLINS FASTENS THE COUNTERPOISE WIRES

The counterpoise antenna is stretched between the two towers that support the main antenna and is strung eight feet above the ground.

WHEN a gob makes up his mind to do something he usually does it, or has a good reason for failing. Here is the real story of a real gob who accomplished one of the most remarkable feats ever attempted by a radio amateur, and did it too against overwhelming odds.

The gob's name is Harry S. Collins, and he lives in Bayport, Long Island. He walked into one of the largest radio stores in New York one day last December and asked the manager whether he thought that his station, 2AJW, could possibly be heard by Godley in England.

"Some of us big fellows will probably be heard over there, but I don't think there is a chance for that little 20 watt outfit of yours," the manager told him.

That is a good way to get a determined radio amateur started.

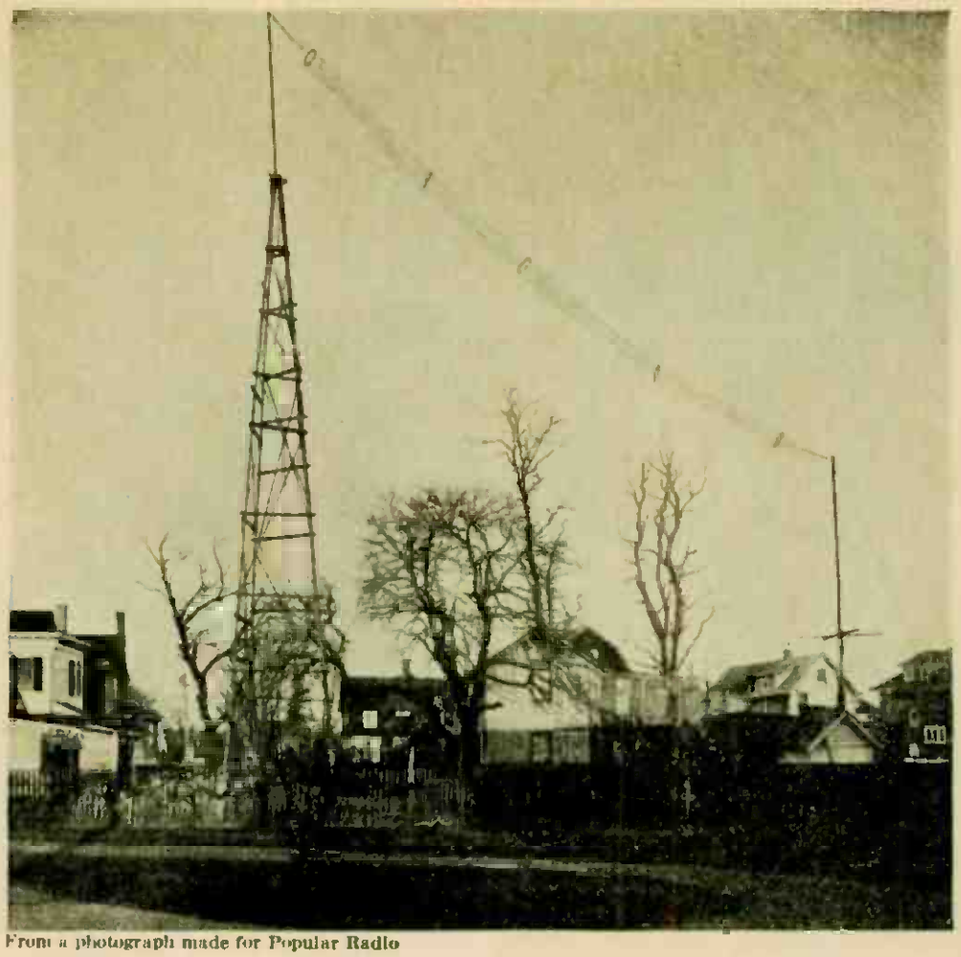
A little more than a week remained before the America-Scotland radio tests. Collins got busy. He built a sectional mast especially for these tests. It is a good model for the amateurs in the country to copy. The mast was built in three sections, each 20 feet long and 2 inches thick by 4 inches wide. The three sections were crowned by a 21-foot 1-inch iron pipe set in a special socket. The total height was 71 feet.

The method of construction which Mr. Collins used is novel; instead of building from the ground up he put his three sections together with the mast lying on its side. Then when it was completely assembled it was hoisted up by means of a block and tackle. The final step consisted of placing the iron pipe in its socket.

The antenna itself is a six-wire cage coming down to the lead-in insulator in the form of a diminutive cage.

But even with the aid of this antenna the attempt to be heard in Europe on 20 watts input seemed to most of Collins' friends as impossible as trying to tame a jungle tiger with a pitcher of milk.

To make results a bit more certain, Collins added two extra 5-watt tubes to



From a photograph made for Popular Radio

THE SECRET OF THIS STATION'S RECORD IS CREDITED TO THIS ANTENNA SYSTEM

This is the aerial that enabled an amateur to send a radio message across the ocean with a low power vacuum tube transmitter. The lattice tower is the main support of the cage type of antenna.

his equipment, thus raising his antenna radiation to approximately 20 watts. The circuit used was the conventional Colpitts, and the plate potential supply obtained from a 575-volt generator.

While Godley was freezing in the leaky tent at Androssan, Scotland, Collins pounded the key night after night with indomitable patience. If I did not know Collins, I would not believe that he had the faith that he was actually getting across. His faith must in itself have added about 100 watts to his output: otherwise I cannot explain how he did it. Certainly it wasn't luck because luck implies chance. Collins deliberately set out to establish this record and he did it. I hope his apparatus will some day be placed on exhibition in the Smithsonian Institute. Even our grandchildren, with their vest pocket radio telephones, will marvel.

Additional evidence that Collins' feat was not merely a matter of chance is the remarkable work which his station, 2AJW, is doing night after night. Using but four 5-watt tubes he has been reported in twenty states and in Canada. He has been heard in every seaport state from Maine to Florida, except Delaware and South Carolina. His radio telephone, using grid modulation, has been heard at IZE, Boston, Mass., and as far south as 3BA, Cape May, N. J.

Expensive radio equipment is not the only element that makes possible the remarkable feats that amateurs so often accomplish. Other factors are skill and persistence.

Collins has them.

From a photograph made for Popular Radio

YOU CAN SAVE FROM $6.00 to $35.00 IF YOU MAKE IT YOURSELF

Contrary to the usual belief a tube set is just as easy to make as a crystal set, and a home-made set has many advantages over a ready-made outfit.

How *to* Make a Simple Tube Receiving Set

A Complete and Detailed List of Instructions for the Radio Amateur, Illustrated with Sketches by the Author—

A. HYATT VERRILL

MANY people think that a crystal set is much simpler than a vacuum tube receiving set and that to make the latter requires a great deal of skill and knowledge. As a matter of fact it is just as easy to make your own tube set as the crystal detector set.

Of course, a tube set will cost considerably more, as the batteries and tube add to the expense; furthermore some of the instruments used cannot well be made at home. But even despite all that, many dollars may be saved by making your own set, and in addition you will have the pleasure and satisfaction to be derived from hearing the music, songs and other messages coming in to your ears over a set you have made yourself.

To make such a set as is illustrated in Figure 1, will cost from $29.00 to $40.00 complete, if all the parts are purchased ready-made; the price naturally depends

upon the quality of the supplies and instruments you use. The prices are:

Aerial and ground wires	$0.75 to	1.50
Miscellaneous wires and fittings	.75 "	1.25
Insulators	1.00 "	1.25
Air-gap or lightning switch	.50 "	.50
Vacuum tube	5.00 "	6.00
Vacuum tube socket	.60 "	1.50
Rheostat	.50 "	1.50
Variable condenser	3.50 "	5.00
Phone receivers	4.00 "	5.00
Grid-leak and condenser	.40 "	.50
22 volt "B" battery	2.00 "	4.00
6 volt "A" battery	10.00 "	12.00
Total cost	$29.00 to	$40.00

Such a set, if well made, will compare with a set which will cost ready-made from $35.00 to $75.00 if bought complete; as such sets are usually priced without batteries, phones or tube, the saving will be enough to enable you to build another set or an amplifier.

A home-made set has one great advantage over many of the ready-made sets, inasmuch as there are but three adjustments to be made in using it; the rheostat, the coil, and the variable condenser—instead of four or five adjustments as on many other sets. Although both the variable and fixed condensers may be home-made, yet it is not advisable to attempt the former as it is by no means a simple or easy matter to produce an efficient instrument of a definite capacity, which, in this case, should be about .001 mfd. The fixed condenser and grid-leak, on the other hand, are simple affairs and are easily constructed. However, as they can be purchased complete for a few cents it is scarcely worth while to attempt to make them unless you are anxious to make as much of the set as possible for the practice and pleasure you get out of the task.

The condenser consists of three strips of waxed paper (which may be purchased or may be made by soaking heavy note paper in melted paraffine wax) and two pieces of tin foil. The paper strips should be cut to about two and one-half inches in length and two inches in width; to make it easier to centre the foil it is a good plan to draw a smaller rectangle, one inch by one-half inch, on each piece of paper—using a hard pencil and very light lines—thus leaving a border ¾ of an inch all around, as shown in Figure 2.

Cut two pieces of flexible, well insulated copper wire about six inches long, and from one end of each, remove the insulation and fray out and flatten the strands of wire. Place one of these frayed ends upon the strip of paper with the flattened strands within the pencil line (Figure 2). Cut a sheet of tin foil, which must be free from holes and tears, one inch in length and half an inch wide and place this smoothly over the wire on the paper, using the pencil marks as a guide to centre it, as shown in Figure 3. Secure the wire and foil in place by a few drops of melted paraffine on the projecting border of the paper and place the second strip of paper over the foil. Lay the other sheet of foil on this and place the frayed-out strands of the second wire upon it, *but at the opposite end from the first wire*. Secure it in position with

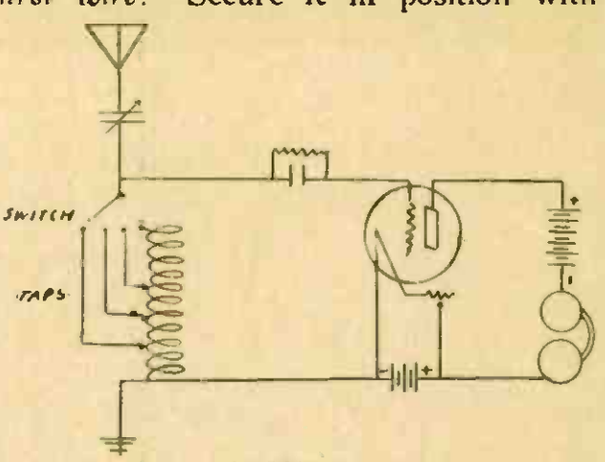


FIGURE 1

paraffine and place the third sheet of paper over all, as shown in Figure 4. With drops of melted paraffine, fasten the edges of the paper and the wires together. Then carefully roll the whole into a neat cylinder and wrap the ends securely with strong thread as in Figure 5. Finish by dipping the whole quickly into melted paraffine, by winding it smoothly with "Tirro" tape or by slipping it into a section of "varnished cambric tubing" which may be bought from any dealer in electrical or radio supplies.

The grid-leak is merely a piece of heavy note paper, or thin bristol board, placed between the two binding posts that are connected with the condenser, with pencil lines drawn on the card from post to post. Make the lines with a soft pencil; to insure a good contact carry them around the holes made in the card to receive the posts, as illustrated in Figure 6, and connect them as in Figure 7, so that the space between the binding posts does not exceed five-eighths of an inch.

Another type of condenser which is even neater and more compact and is just as simple to make employs two copper sheets and binding posts in place of foil and wire. To make this you should have some very thin sheet copper, some thin cardboard or bristol board, some waxed paper and two 3/16-inch binding posts (those from an old dry battery carbon will do very well). Cut two pieces of cardboard and one of waxed paper each two and one-half inches long and one and one-half inches wide. Cut the copper strips to 1½ inches in length and ½ inch in width. Next, mark on the card and paper the places for making the holes for the binding screws. These should be ¼ inch from each end of the strips; by making the holes in one strip and then placing this over the next, marking about the holes and so on, all may be made exactly alike. Next, place the copper strips so that one end is ¼ inch from one end of the paper or card and mark for a hole in one end (Figure 8) of each piece. In making the holes in the copper, see that they are small enough so that you have to force the binding screw through them.

Finally, you will require two short pieces of copper, each ¾ inch long by about ¼ inch wide with a hole ¼ inch from one end of each, to take the binding posts.

The condenser is now ready to assemble, but if you wish a grid-leak to use with it first mark lines with a soft pencil from one hole to the other on one of the strips of cardboard. To assemble them place the two posts through one of the

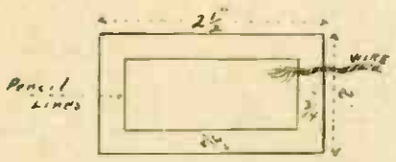


FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

FIGURE 6

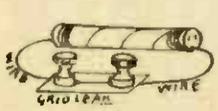


FIGURE 7

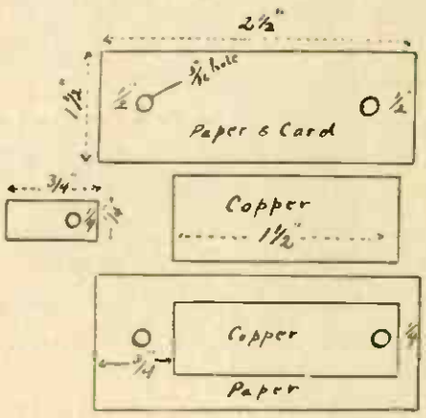


FIGURE 8

FIGURE 9

FIGURE 10

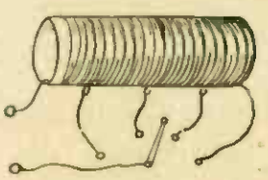


FIGURE 11

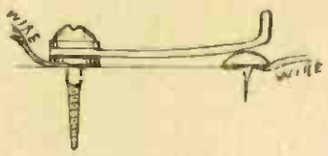


FIGURE 12

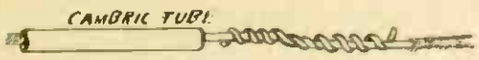


FIGURE 13

cardboard strips, with the card resting on the heads of the screws, as shown in Figure 9 (A). Place one of the copper sheets on this, slipping the hole over one post (B). Place a sheet of waxed paper over this (C). Place the other strip of copper on this and over the screw at the *opposite end from the first,* (D), and over this place the second sheet of cardboard with the pencil mark up (E). Then, place one of the small pieces of copper over each binding post (F), place washers on the screws and screw down the nuts as shown in Figure 9 (G). To connect with the set, wrap the ends of the wires about the projecting screws, place a washer over them and screw on another nut or a thumb nut, Figure 9 (H).

To make the coil for this set is as simple as to make the condenser. It is merely a "Formica" tube about three and one-half inches in diameter wound with about 45 turns of No. 26 double cotton covered copper wire and with three "taps" taken from it.

To make the coil, start the wire through a hole about one inch from one end of the tube and proceed to wind on ten turns. Then make a loop in the wire, by taking two twists on itself (Figure 10) and continue winding as before, keeping the turns or coils about ¼ inch apart. When you have wound on ten more turns make a second loop or tap and at the thirtieth turn make a third and finish winding and run the end of the wire through another hole about one inch from the end, as at starting. Leave several inches of wire free at both ends of the coil and fasten the wire to the inner side of the tube by means of sealing wax. Scrape each of the tap loops free from insulation and attach short lengths of insulated wire to each. Make a good connection, soldering if possible, and finish by covering with varnished cambric tubing. Mount the coil by driving brass tacks or screws from the inside of the tube through the bare spaces at the ends into a suitable panel or base. Then, lead one of the end wires and the wire from each tap to the four contact points of a switch, as shown in Figure 11, and connect the switch-arm to a short wire leading to a binding post and the other wire from the coil end to another binding post as shown.

When you connect up the coil in the set, the lead-in wire is attached to the binding post connecting with the switch-arm and the ground wire is led to the other post, as indicated in Figure 11. If you do not care to buy a switch you can make one very easily by using brass-headed upholsterers' tacks driven through loops in the wires—(but be sure that the insulation is first removed and the wires are clean and bright)—or by using round-headed, brass wood screws for contact points. The switch arm may be made of a strip of spring brass attached to the panel by means of a round-headed brass screw with washers above and below the arm, as shown in Figure 12.

In wiring up this set, or any other set, be careful to make good connections with the wires. The best way to do this is to twist one wire around the other, as

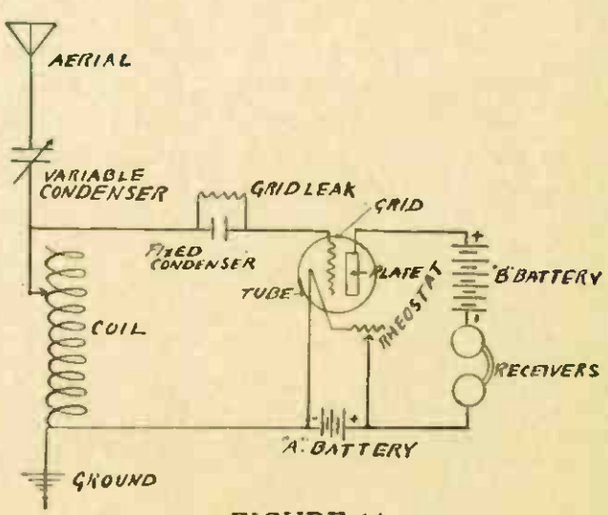


FIGURE 14

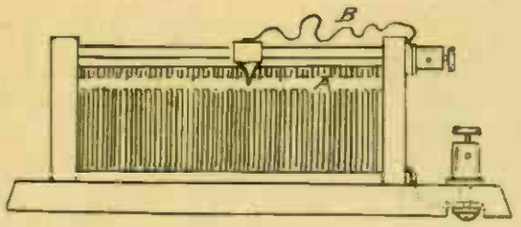


FIGURE 15

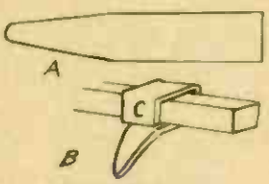


FIGURE 16

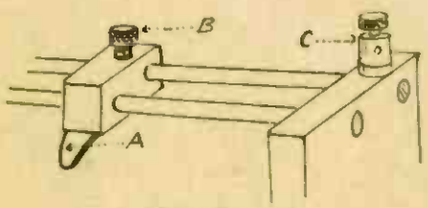


FIGURE 17

shown in Figure 13. Then the two may be soldered together, and the joint covered by slipping a section of varnished cambric tubing, which comes in various sizes, over the joint.

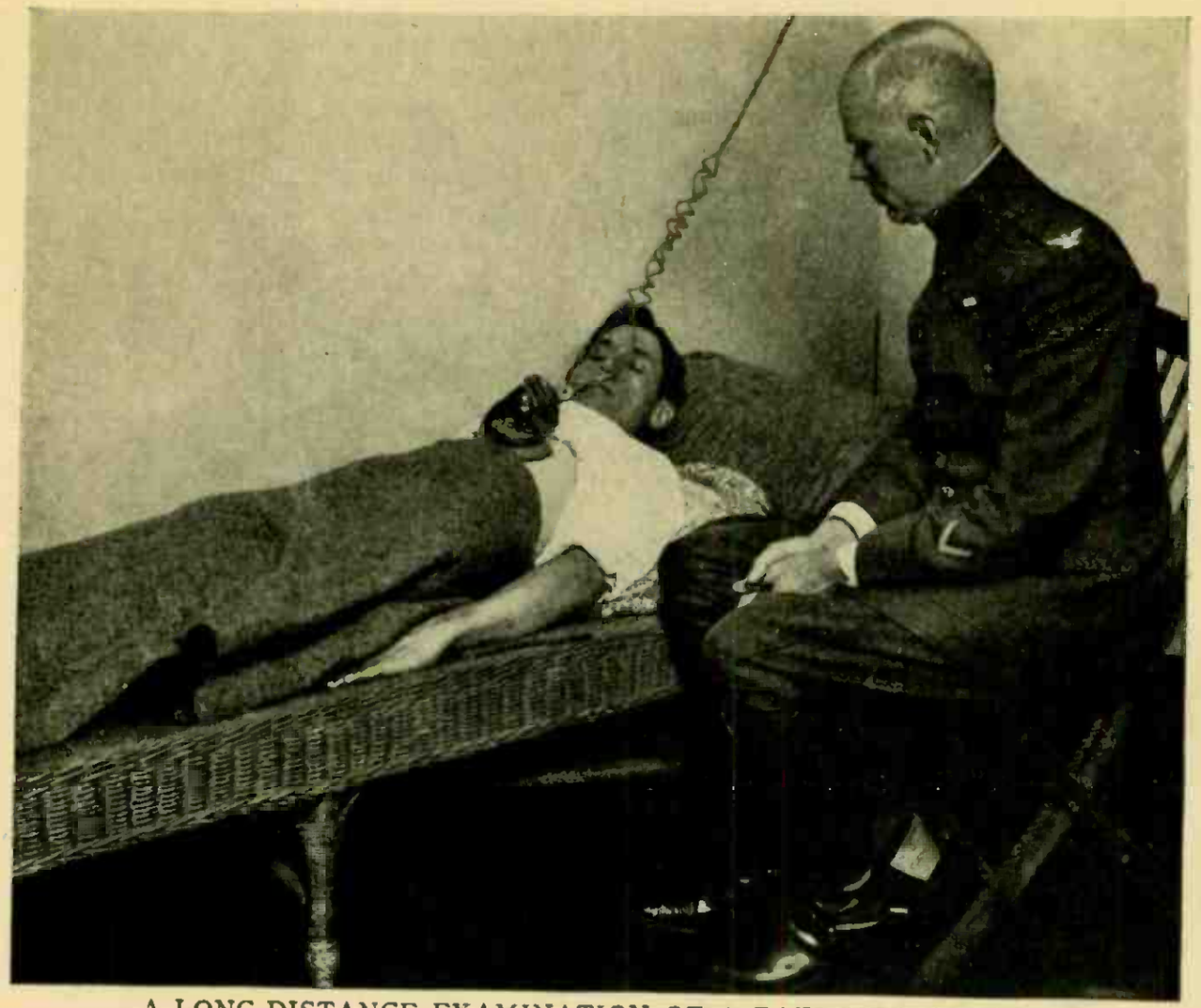
Also, be sure and do *not* run the wires parallel. Although they are thus shown in the diagram it is merely to make the figures look better and for convenience in drawing.

An even better set may be made by following the plan shown in Figure 14, in which a slider or variable coil (Figure 15) is used in place of the plain coil already described. This will add nothing to the expense of the set and will give far better results in tuning. To make this coil, wind a Formica tube three inches in diameter and six inches long with about 75 turns of No. 26 double cotton covered wire without taking any taps. Then, with a pencil and straight edge, make two parallel lines about ¼ of an inch apart along the coil, as shown at Figure 15 (A). With a red-hot iron, burn off the insulation from the wires between the two lines. Be sure that no two wires touch. Mount the coil between two uprights, as shown, and lead the wire from one end to a binding post. Next make the slider and slide rods. This may be done simply by cutting a strip of sheet brass about 1/32 of an inch thick in the form shown in Figure 16 (A) and bending it around a square brass rod as shown at Figure 16 (B). After it is shaped, slip it from the rod, and by tapping it gently at the point (C), bend it until it fits tightly upon the rod, but will slide readily back and forth. Slip the rod through it and mount the rod on the uprights with the tongue of the slider pressing firmly upon the bared wires. Solder one end of a flexible copper wire to the slider and lead it to a binding post as shown in Figure 15 (B).

If you are a good workman and have proper tools you can make a much neater slider in the manner shown in Figure 17. This consists of a block of brass bored to take two brass rods and with a tongue of spring brass or copper soldered to one side as shown at (A). A hole should also be bored through the slider to one of the holes for the rod and threaded to take a brass screw about ⅛ of an inch in diameter (B). This will serve to secure the slider to the rod when the proper position for tuning is found and will also make a good contact. A binding post should be connected with the ends of the rods as indicated at (C) in Figure 17. In either case the connections to the set are made as shown in the figures.

IN THE NEXT ISSUE:

How to Build an Efficient Loose Coupled Tuner



A LONG-DISTANCE EXAMINATION OF A PATIENT'S ORGANS

With the aid of the vacuum tube amplifier—as first demonstrated by Major General George O. Squier while he was but a colonel—a patient's heart action may be heard by the examining physician miles away.

The Thunder *of* Our Heart Throbs

How the Recent Development of the Amazing Radio Audion is Opening Up New Fields of Scientific Research.

By J. C. GORMAN

THE development of the vacuum tube or audion which has been made within the last five years and which has opened up so many fields of usefulness is of such commanding importance that it may properly be given first place over all other recent inventions of the twentieth century. Without it, our transcontinental telegraphy or telephony would be virtually impossible, and even transoceanic radio communication would be sadly crippled. The device has entered practically every field of scientific usefulness and its contributions to each of these fields are of almost inconceivable value.

One of the most important applications of the audion is its use as an amplifier. It is employed in the medical profession as an amplifier of the sounds of heartbeats and for detecting ailments that affect the working of other human organs. It is used to make the deaf hear.

It is used in electrical research laboratories for amplifying and measuring the feeblest of electric currents. It is used in ordinary telephony to strengthen weakening voice currents which have traveled great distances. It is used by college professors to amplify the tiny sounds that insects make. It also makes possible our modern radio telephony in its perfected form today.

The inventor of the amplifier, Dr. Lee DeForest, also created the three element vacuum tube which is now called the audion. One of his ablest assistants who has himself contributed invaluable service and ingenuity to the developments of both the audion and the amplifier, of which the audion is the backbone, is Mr. E. B. Myers, one of the country's most eminent vacuum tube experts and radio engineers.

Mr. Myers has done important research work in the largest laboratories throughout the country. In the development work during the war he was in the foremost ranks. Since the war he has been at work on the tube in his own laboratories, ever improving and perfecting it, he has probably conducted more experiments, made, handled, and studied more vacuum tubes than any other man outside of Cooper Hewitt himself. He has finally perfected and standardized an amplifying vacuum tube which is probably the peer of any other tube now made—the "radio audion." This device is remarkable in that it is of small dimensions, measuring only 3¾ inches in length, and ⅝ inch in diameter.

The tube contains the conventional three elements—the filament, the grid, and the plate—but its construction and electrical characteristics are new and give it its exceptional efficiency for radio work. These elements, which are of extremely small size, are all assembled and mounted on two Pyrex glass beads, with the wire connections running through the beads to the terminals at either end of the tube. Every bit of air or other gas is driven out of the metals that are used inside of the tube, before the assembly is put into its outer glass shell. The glass shell is then closed at each end, by an automatic machine that at the same time forms the glass into proper shape to hold the end terminals. Finally the tube is exhausted of all air or gases by a vacuum pump of special design. All of the parts are made by automatic machinery which insure uniformity in dimensions down to one-half a thousandth of an inch. The tubes do not vary more than two percent in physical dimensions.

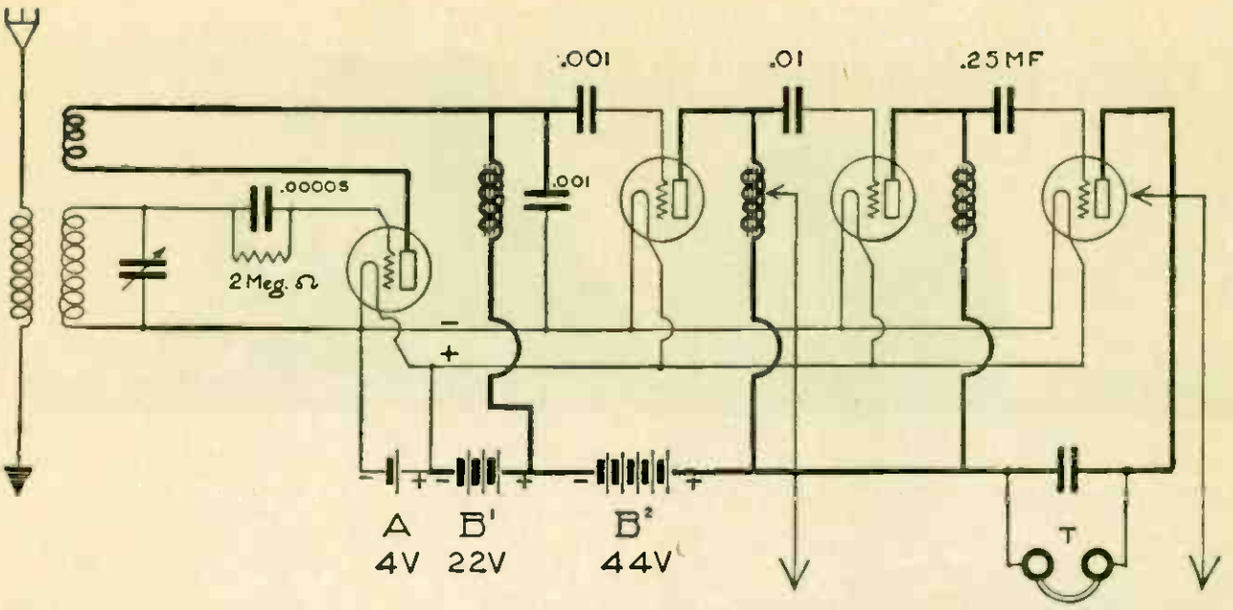
After the tube is exhausted of air and sealed, two terminal caps are fastened, one at one end and one at the other, and the tube has the appearance shown mounted in the illustrations. The tube is an excellent detector, although it is not sold or licensed for this use, and it is a wonderful amplifier and oscillator.

One special feature of the "radio audion" is the total absence of "tube noises." All of the other present day tubes give off a peculiar sizzling or frying noise, some to a much greater extent than others. This tube, however, is absolutely quiet when no signals are being received, even when used in multiple stages of amplification.

On account of the highly evacuated condition of the interior of the "radio audion," no ionization takes place when the plate voltages are increased over the 100 volt mark. In this way even greater amplification can be obtained than when using the conventional 45 volts on the plates. The amplification constant of the new tube is over four times that of the vacuum tube now in common use.

The filament is a spiral tungsten wire and is rated at .8 amperes at 4 volts. The tube will oscillate with as low as 3 volts on the plate; with 22 volts on the plate the normal space current lies between .6 and .8 milliampere. If a 4-volt battery is used on the filaments the ordinary filament resistances are entirely unnecessary, as the tube is truly non-critical.

When used with Myers' special amplifying coils and circuit, signals can be re-



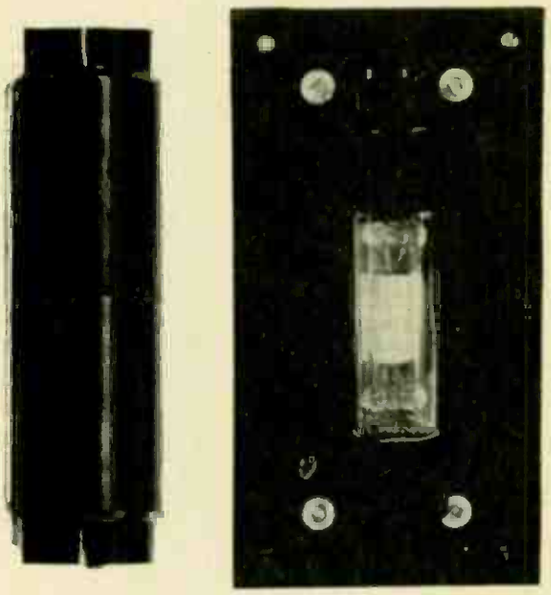
ceived with the utmost clarity and with terrific strength. Music and voice can be heard many hundreds of feet away when a loud speaker is connected to the output circuit of the amplifier.

The diagram, Figure 1, shows the method of connecting up the tubes and coils, and these instruments are supplemented by the use of four mica condensers which store up the instantaneous voltage supplied by the combined action of the preceding tube and coil. The next tube and coil take this voltage and step it up and supply it to the next set of tube and coil, and so on.

A .001 mfd. condenser is shunted across the plate to filament circuit of the detector tube to bypass the radio frequency currents. This condenser is important. Another .001 mfd. condenser is used in the grid circuit of the first stage. A .01 mfd. condenser is used in the grid circuit of the second stage, and a .25 to 1.0 mfd. condenser is used in the grid circuit of the third stage. It is necessary to shunt this last condenser with a 100,000 ohm grid leak to protect the last tube from "choking up."

With this type of circuit the phenomena known as howling is entirely absent.

The internal capacity of the tube is low, and this additional feature makes it function efficiently as a radio frequency amplifier on low wavelengths.



THE MINIATURE WONDER WORKER

The new coil (at left) and tube (at right), reduced to half size, and the method of installation that increases the radio signals thousands of times in strength.

At a recent demonstration when a loop antenna was used with "radio audion" tubes, in the cellar of a brick building, with three stages of radio frequency amplification and three stages of audio frequency amplification, such as described above, weak signals from a far distant broadcasting station were amplified to such an extent that the music was deafening, and the electrical energy in the plate circuit of the last stage was so great that a serious shock would be experienced by anyone who would have placed his hands across the output terminals.

ADVENTURE IN THE AIR

WHAT is the biggest thrill YOU ever got over the radio? Have you ever picked up a call for help? Or located a lost friend—or helped to run down a fugitive, or listened in on a conversation of peculiar personal interest to yourself? For every anecdote, humorous or grave, ranging from 50 to 300 words in length, the Editor will pay upon acceptance. Address contributions to Editor, ADVENTURE IN THE AIR DEPARTMENT, *9 East 40th Street, New York City.*

I Find My Missing Pal By Wireless

TO the "romance of the sea," which has seized man's imagination from the days when our prehistoric ancestors dared not venture out of sight of land in their crude craft, has now been added the "romance of the air," filled with infinite possibilities. When these two elements combine to set a man in the path of adventure we get such experiences as this:

When Henry Marko sailed for the Mediterranean on the SS. *Princess Louise*, that was the last I heard of him. He had been my pal, but he had obtained his radio operator's license and away he went. Neither he nor the ship came back; they simply dropped out of sight.

Then came the first sea-going radio telephone set. It was installed on the SS. *Tyler* of the Old Dominion line, which has long since gone to her watery grave as a mine sweeper over in the North Sea. But at that time she was the newest and biggest ship of the line, and when her skipper heard that the first marine radio telephone was going to be installed on his vessel, he applied for another gold stripe for his sleeve.

It meant still more to me, as it was my first ship. Wireless operators were privileged creatures in those days, and naturally I was a proud youth when they fitted my uniform.

After we got the machine installed on the vessel and moving pictures had been taken of it, of the inventor, of myself and everyone else concerned from the Captain down, the *Tyler* got away from Pier 26, New York, and started to make her way down the coast.

As soon as we got outside the harbor, we began to establish radio telephone communication with the various wireless stations on the coast, and they answered us in the regular Morse code. Each station sent us messages of congratulation on the success with which we were able to transmit speech through the air. As we made our way down the coast, we tried for distance. Philadelphia answered and said he got us fairly well; that was about a hundred miles away. Later on that evening I began to pick up other ships.

Shortly before midnight I heard the "DDL" calling land. He sounded very faint, and I judged that he must be two or three days out. But he kept calling, and signing off "DDL, DDL." Some mysterious force led me to look up that call in the book, and I was amazed to find beside the letters DDL, the name of the SS. *Princess Louise*. It was Henry Marko's ship.

Hastily I started up our new machine and called the ship, speaking the name over and over again and adding:

"Is Henry Marko on watch?"

Then I shut off and listened in. Suddenly the DDL came back at me:

"Sure, Henry Marko is on watch; this is Henry now. Is that you, Jay? How are you, old man?"

I had not told him my name, but he had recognized my voice, although it later developed that he was several hundred miles away at the time. We sent messages back and forth which led to a reunion some months later in New York.

We will both remember the incident as long as we live. Henry told me that I nearly swept him off the chair when he heard my voice out there over the sea in the middle of the night.

Today Henry is holding down an important position in the Polish Radio Administration, and uses the radio telephone in the routine of his work over there in Warsaw.

E. JAY QUINBY

An Unrecorded Episode of History

A GLIMPSE into the routine life of a radio operator in the gonio stations behind the battle front is revealed in the dramatic experience of the writer of the following item—a man who won his commission as well as a citation for his work in the Radio Section of the Signal Corps:

In May, 1918, I was in charge of a radio compass station of the Signal Corps (known as a gonio station), at Menil-la-Tour. I had two operators with me, Corporal Helmick, and Private Clement; between us we maintained a constant watch during the day from 8 A. M. to 10 P. M. This period was considered sufficient for a gonio, as during this time practically every enemy station in operation would have transmitted, thus enabling us to secure its bearing from our station.

About the 26th of May an order came from our commander to keep a twenty-four hour watch at this station "until further notice." This was rather a difficult problem for only three men, but we decided to work four hours on and eight hours off until the emergency was passed, or until more men were sent to help us. It seemed rather an odd order, as there had been very little radio activity for the few days preceding and we could not understand the necessity of the extra duty.

The first twenty-four hours were monotonous. The next night I was on the watch from 10 o'clock to 2 in the morning. There was practically no transmission by the enemy. At 11 o'clock (midnight by enemy time), a high-powered station sent out the weather report as usual: I paid little attention to it. The minute he had finished, pandemonium broke loose; the air became a mass of buzzes and calls from every direction along the enemy front.

Naturally I was galvanized into action with a jolt as the foresight of our officers landed home with a crash. When 2 o'clock came, I rushed to our quarters and awoke Clement to relieve me; he was out of the door and on his way to the station in no time and the good work was continued.

In the three hours of this extraordinary activity, I had taken over 250 bearings; 150 to 200 bearings were considered a good day's work for the regular watch. At the end of the twenty-four hours, we had taken 670 bearings, averaged and forwarded them to the intelligence office at Chaumont.

We learned later that the order to maintain constant watch had been prompted by the drop in the curve of enemy activity, which was plotted from the number of bearings taken each day, at the G2 office at G. H. Q. On previous occasions it had been proved that there was a great decrease in transmission a day or so before an attack, and that was what happened in this case.

The enemy attack was on Seichprey, and the results are a matter of history.

FRANK W. BALLARD

The Radio Stops a Mutiny

"STONE walls do not a prison make" the poet tells us. Nor does a barricaded cabin or a vessel threatened by a rebellious crew necessarily keep its prisoner out of touch with help, as witness:

Sailing to Cuba has its compensations but the radio man on a sugar boat loading at a remote southern Cuban port is not always convinced of it. The only activity is at the loading pier; all there is to do is to watch the husky negro stevedores carrying the huge bags of sugar into the hold.

Not long ago a sugar boat was approaching one of these ports. The day was hot and the static exceptionally heavy. Suddenly the radio operator was startled by an S O S call.

It is a law of the sea that a ship must return to its home port at least once each year. One of the sugar boats loading at the port had been away from home for just that period. The captain had received orders by radio from the owners to take his cargo of sugar to Honolulu. His request to the crew to sign new articles had not been received in a kindly spirit. Instead, the captain found himself barricaded in his own cabin and his crew in mutiny. The stokers were starting up the fires and everybody was for going home, orders or no orders.

But the telephone between the captain's cabin and the radio station was in good working order. An S O S was sent out, and communication was established between the ship and the home office. The company authorized a bonus to the crew; new articles were signed, and a successful voyage to Honolulu resulted. Thus radio prevented a 2,500 mile voyage to the home port and back and enabled the company to realize a large profit on the cargo.

EDGAR H. FELIX

A Close Call for a Gonio Station

NOT all of a radio operator's adventures in the air reach him *via* wireless. Here is one, for example, that was literally delivered to the very door of a gonio station—by the air route, to be sure, if not by ether waves.

One of the most thrilling experiences I had while in France with the Radio Section of the Signal Corps was when the enemy shelled a railroad station which was about 500 feet from our barracks. The Germans were under the

impression that ammunition was stored there; the fact that it was not did not help matters any as far as we were concerned, and several 12-inch shells were dropped too close to us for comfort.

We were housed in a small wooden barracks building at Royaumeix. As we had no dugout nearby we had been ordered to seek shelter in the event of shelling. One day three shells came over in rapid succession; then the shelling stopped. Thinking it was over we returned to our barracks, and I began telephoning in my morning report of gonio bearings to the intelligence office at Toul. I jokingly told the man at the other end of the wire what had happened, and warned him if I should suddenly stop talking he would know the reason. The words were hardly out of my mouth when I heard the whizz of another shell, followed by an explosion which I knew was close. As I was indoors, however, I did not pay much attention to it; indeed, I did not realize how close it had landed, and I went on telephoning my report—incidentally remarking to the man at the other end of the wire that another shell had come over. He replied that he had heard the report through the telephone. The next minute there was another report, followed by a mighty crash; it seemed as though the building would fall in splinters around me. This was accentuated by the noise of our alarm clock, which was jarred off a shelf and fell to the floor.

Without telling the man at the other end, I put down the telephone and went outside to see what was going on; at the same time I got my mask ready in case any gas should follow the shells. When I came back to the 'phone the man at the other end was shouting excitedly, convinced that I was done for, as he had heard the crash through the 'phone. I assured him that we were all right, and finished my report.

When I looked around the building to see what damage had been done I found that one of the shells had landed about fifteen feet outside the barracks, and in a line with the length of the building; some of the shrapnel had passed straight through from end to end, about five feet back of where I had been sitting. In passing through the shrapnel had cut slices through four thicknesses of blankets on my cot, and also picked up my cap from the cot and carried it along to the end of the barracks. One of the operators who had been on a night watch had been sleeping directly in line with the course of the shrapnel, but fortunately he had been aroused beforehand and was sheltered when the shell landed. When we later dug the nose of the shell out, the hole was deep enough for a man to stand in up to his waist.

FRANK W. BALLARD

A Band Concert on a Barbed Wire Fence

IT is not often that a radio amateur looks upon a storm with a friendly eye. But here is one in Wyoming to whom a storm brought a real windfall:

Such a curious phenomenon happened to me one windy night that I thought either that the ether had suddenly changed its density or that a great comet must be passing by and was affecting electrical conditions.

I was alone in my attic station, and no doubt the lonesomeness combined with the roaring wind had some effect upon my imagination. My set was not expensive and my aerial was so short that I seldom heard any stations other than those about Cheyenne, most of them amateurs. At times the blast of the wind which swayed the house and moaned heavily in the eaves drowned out all sounds from my receivers. It was one of the few heavy winds of the year, one of those which burst plate glass windows here and there on exposed corners and removed unstable chimneys or played havoc with the trees in the way.

A sudden blast made my chair shiver. I glanced out of the window at the inky darkness as I waited for the wind to quiet.

In the following calm I heard a band playing, loud and clear. I knew that it was a broadcasted program from Denver—the fulfillment of one of my dreams.

Another blast of wind shook the house. I went to the window to see what strange change was taking place in the earth's atmosphere. Then I listened to my receivers again, and my curiosity finally drove me out into the black night.

I found that the wind had blown one end of my aerial down and that it had connected with a barbed wire fence which evidently was not grounded. The fence served as a fine long aerial.

A. E. WILKES

HOW THE SUN HELPS WIRELESS

In the next issue Dr. E. E. Free will tell about the "wireless screen" about the earth—a startling new theory evolved by Dr. Flemming, the distinguished British scientist. Dr. Free is himself a noted scientist, a consulting chemical engineer by profession and a member of a dozen learned societies. In the accompanying picture he may be seen as the central figure, about to set forth on a flight of fancy into the solar regions.

WHAT READERS ASK

THIS *department is conducted for the benefit of our readers who want expert help in unravelling the innumerable kinks that puzzle the amateur who installs and operates his own radio apparatus. If the mechanism of your equipment bothers you—if you believe that you are not getting the best results from it—ask* THE TECHNICAL EDITOR.

QUESTION: What radio equipment would you recommend for an amateur listener—to cost not more than $50.00?

DON HEROLD

ANSWER: The following list of materials and prices is given for your information:

One short-wave receiver	$35.00
" detector vacuum tube	5.00
" pair 3000-ohm phones	6.00
" 22 1-2 volt "B" battery	2.00
Four dry batteries	1.60
Total cost	$49.60

* * *

QUESTION: What is the correct size grid leak to use with a Radiotron detector tube?

R. T. OWEN

ANSWER: A 2 megohm grid leak is the correct size. This can be connected across the grid condenser or between the grid and the negative filament leads.

* * *

QUESTION: Which sends out the sharpest wave, a quenched spark transmitter or a modulated C. W. transmitter?

M. B. G.

ANSWER: The modulated C. W. transmitter has a smaller decrement or sharper wave.

* * *

QUESTION: What is the right size of transformer to use with a transmitter using two 5-watt tubes? The transformer should also have a filament winding.

A. SHARP

ANSWER: The two "5-watt" tubes will have a plate current of approximately 80 milliamperes on 350 volts. This is an input of 28 watts. The two filaments will draw 4.7 amperes at 8 volts; this is an input to the filaments of about 38 watts. The total energy required will then be 60 watts. In order to have a reserve capacity and allow for inherent losses in the transformer you should procure a 100-watt transformer.

* * *

QUESTION: What size of honeycomb coils should I use for a wave length of 360 meters? I have a 3-coil set but have no short wave coils, and I want to try the set on the broadcasting wave lengths.

L. DUGGAN

ANSWER: For the primary coil use an L-35, and for the secondary use an L-50, and for the tickler use an L-75. This will give you a wave length range from 180 to 800 meters with an antenna of average size.

* * *

QUESTION: My receiving set oscillates very nicely when I am listening on the detector alone, but when I use the 1st or 2nd stage of amplification, the set fails to oscillate and I cannot hear long distance C. W. Is there any way to rectify this fault?

CHAS. COOTE

ANSWER: This is because the reactance of the primary of the amplifying transformer is too high to allow the radio frequency currents to flow through it; therefor the set refuses to oscillate. Shunt the primary of this transformer with a .0005 mfd. condenser and your troubles from this source will be over. The function of this condenser will be to bypass the radio frequency currents around the transformer primary.

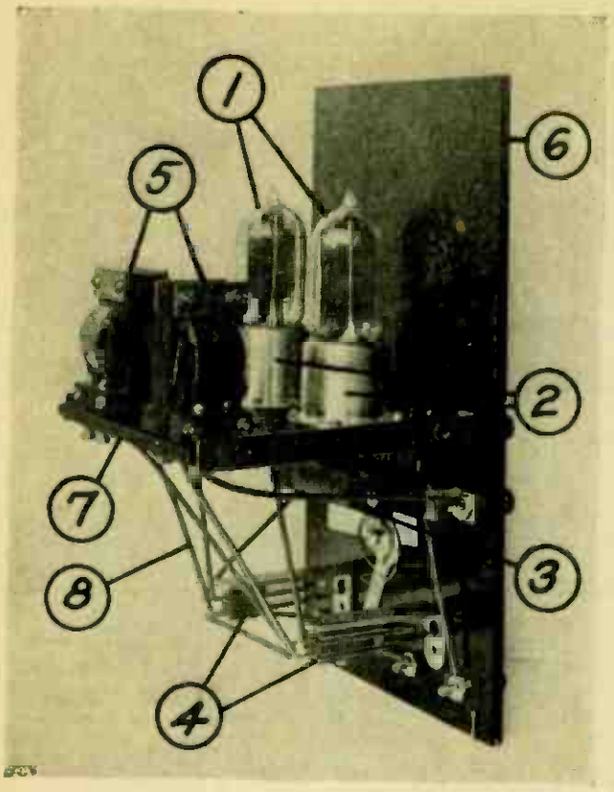


FIGURE 1: *The parts of a 2-stage amplifier.*

QUESTION: Will you give me a diagram of a good design or arrangement of parts for a 2-stage amplifier?

EDWARD LANCASTER.

ANSWER: The accompanying Figure 1 and Figure 2 shows a good design for a 2-stage amplifier. The parts are as follows:

1. Amplifying tubes.
2. Tube sockets.
3. Filament adjusting resistances.
4. Telephone jacks.
5. Amplifying transformers.
6. Front panel (Bakelite).
7. Instrument shelf.
8. Wiring.

* * *

QUESTION: What is meant by the initials "C. W.?"

L. S.

ANSWER: "C. W." is an abbreviation for Continuous Waves. Continuous waves are used in radio telephony and telegraphy and are different from the radio waves produced by a spark transmitter in that they are continuous; that is, the oscillations that produce them do not vary in their amplitude or strength. The waves from a spark discharge die out between each discharge, but the continuous or undamped waves keep up to the same value steadily. Continuous waves cannot be heard unless the receiving is regenerative or an external heterodyne is used. This is why you hear nothing between the words that are spoken into a radio telephone transmitting set, although the continuous waves are still going; it is also why, when you turn the knob marked "Regeneration," on your set, you hear a shrill whistling sound. When you regenerate you start a continuous wave in your own set that combines with the continuous wave of the transmitting station, and the two waves interfere, so to speak, and produce the whistle.

* * *

QUESTION: Sometimes, while tuning my set, I hear noises that sound like wind blowing. My wife suggested that probably the wind does affect the wireless. Is this so?

B. D. F.

ANSWER: The sounds that you heard were probably the continuous waves of a radio telephone transmitter. You were probably using too much regeneration while tuning in.

* * *

QUESTION: How far apart should I put the wires in my antenna? I wish to put up a four-wire antenna.

J. H. BOCK

ANSWER: The wires should be at least two feet apart. If you put them any closer together the additional wires will not give you any added efficiency.

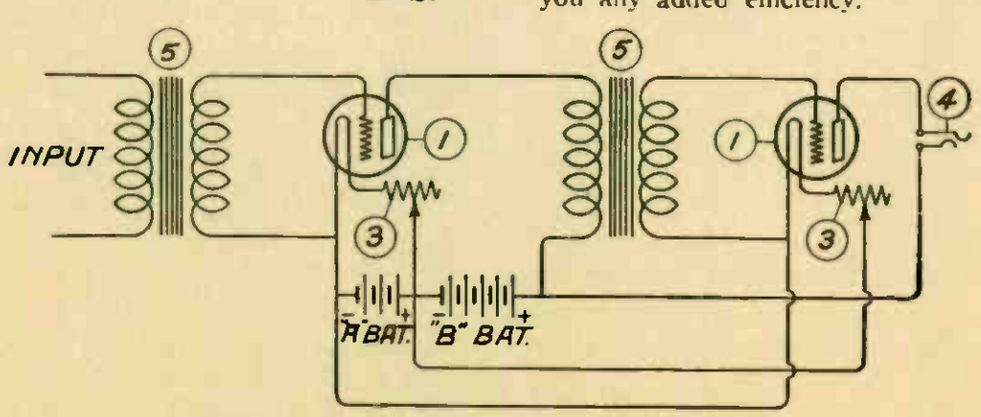


FIGURE 2: *A good design for a 2-stage amplifier.*

QUESTION: I have a number of radio instruments that were in use before the war; they include one loose coupler, a crystal detector (galena), one pair of 2000 ohm Marconi phones, and a 43 plate Murdock variable condenser. Can I make a set out of them that will enable me to hear the music that is floating around through the air these days? If so will you show me how to hook up the set?

E. A. P.

ANSWER: The diagram, Figure 3, answers your question. This set should receive a distance of twenty-five miles under good conditions.

* * *

QUESTION: What is the highest wavelength that an amateur is allowed to send out?

J. PELTON

ANSWER: Amateurs are now allowed to transmit on any wavelength on or below 200 meters. This regulation will be changed shortly to allow transmission by amateurs on wavelengths up to 275 meters.

* * *

QUESTION: I have tried the enclosed hook-up out of one of the daily papers without hearing anything at all as yet. Will you let me know if there is something wrong with my connections?

H. THORPE

ANSWER: The hook-up is correct in every detail except that the "B" battery is connected in the circuit in the wrong direction. This may seem unimportant but it makes all the difference in the world. Disconnect the "B" battery and switch around the connecting wires until you have the positive wire attached to the plate of the vacuum tube; then your set will work. The vacuum tube will pass a current in one direction only, therefore the battery must necessarily be connected so that the current will flow in that direction.

* * *

QUESTION: What time in the evening do the radio concerts start and how long do they last?

J. S. CONNERS

ANSWER: The radio broadcasting usually begins its continuous program at about 8.00 p. m. and it lasts till about 10.30 p. m. We would advise you to look in the daily papers as the programs of the broadcasting stations are regularly posted in their radio columns.

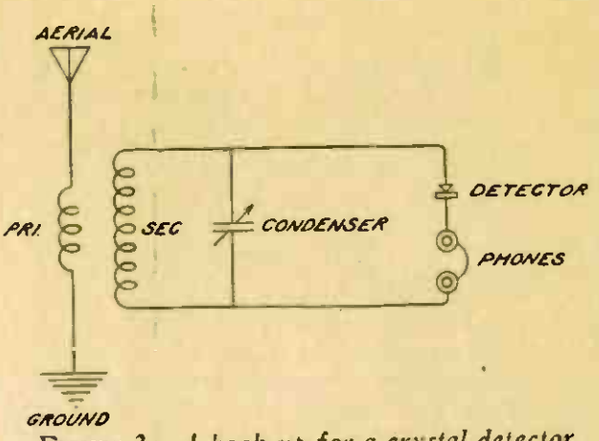


FIGURE 3: *A hook-up for a crystal detector.*

QUESTION: I now have a one-wire aerial, and I am wondering if I would get twice as good results if I were to put up two wires.

R. L. SMYTH

ANSWER: If you have a one wire antenna of 100 feet length or so, do not bother to put up another wire, as the results will be very slightly superior.

* * *

QUESTION: How many turns of wire and what size of wire and what diameter of cardboard tube would be correct to use for a one-slide tuning coil to receive up to 600 meters?

D. V. ESSEX

ANSWER: It would be best to use a Formica tube, 2½ inches in diameter, winding on it 60 turns of No. 18 enameled wire. The enamel can be scraped off where the slider is to run. A circuit diagram for this type of tuner and a crystal detector are shown elsewhere in this department.

* * *

QUESTION: What is the plate voltage necessary to have in my "B" batteries on my detector tube? I am using a Radiotron UV. 200 vacuum tube, and it sometimes gets bluish inside. Sometimes when I am getting loud signals it stops and then comes back again in a few seconds. Can you offer a beginner some suggestions?

R. DENTON

ANSWER: You have too high a voltage on your tube and consequently it "ionizes." The U.V. 200 requires between 16 and 22½ volts on the plate for most efficient operation. Get a variable "B" battery and vary the taps until you find the best setting. When your tube suddenly "shuts off" it is probably because you use too high plate voltages. Get a 2 megohm grid leak and connect it across your grid condenser and this trouble will be eliminated.

QUESTION: The filament of my audion has leaned over and touches the grid, and it will no longer operate. Is there any way to fix it or will I have to get another one?

D. ANDERSON

ANSWER: You may be able to jar the filament free from the grid by holding the tube in one hand and striking it on the opposite side of the tube from which the filament is bent over, against the palm of your other hand. The tube is worthless as it is, and sometimes the filament will jar itself free under this strenuous treatment although you will have to run the risk of breaking the glass bulb or the filament itself.

* * *

QUESTION: What is the most sensitive kind of mineral to use as a detector of wireless waves? I am now using Silicon and have been told that I might get better results from Perikon.

Jos. DAPHNE

ANSWER: The best mineral that you can use is Galena crystal. It is more sensitive and fairly easy to adjust. You may buy tested crystals which will guarantee you satisfaction for about 35 cents a crystal.

* * *

QUESTION: When I turn my variable condenser I get a scratching and scraping noise that is annoying. I do not know enough about electricity to be able to locate the trouble. What is the matter with it?

H. M. PICKEN

ANSWER: The trouble is probably in the condenser itself. Take the condenser out of the set, hold it up to the light and look through in between the plates and slowly revolve the knob; you will find that one of the plates attached to the rotor shortcircuits with one of the stationary plates. You can then straighten the crooked plate with a knife blade.

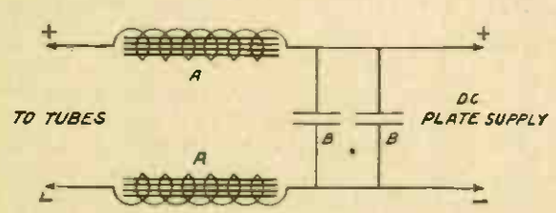


FIGURE 4: *A filter circuit for an alternating current radiophone.*

QUESTION: I wish to become affiliated with an amateur association that is national in scope and that has the interests of the country's young radio men at heart. Is there any such association? If there is how can I get in touch with it?

A. I. BEARD

ANSWER: The American Radio Relay League is an association of the amateurs, banded together for furthering the interests of citizen radio. You may get in touch with it by writing to the American Radio Relay League, Hartford, Conn.

QUESTION: The other night I forgot to throw my lightning switch and got up out of bed to do so; just as I threw the switch I noticed a little spark as the switch closed. I immediately opened the switch a little distance and sparks jumped across the switch regularly. I had no batteries connected to the antenna at all, and cannot see where the current came from. An amateur friend of mine told me that it was the static and I would make a better acquaintance with it some time during the summer. Was he joshing me?

E. R. ROYCE

ANSWER: What your friend told you was true. Static is natural electricity that accumulates in the different strata of the ether, and when your antenna is not grounded (or in other words, when it is disconnected), it acts as a condenser and charges up these natural voltages until a high voltage is accumulated. If the switch is not too far open this voltage will discharge to ground in regular intervals in accordance with the time it takes for the antenna to charge up to the voltage necessary to jump the gap at the switch.

* * *

QUESTION: Will you give me data for a good filter circuit for my new alternating current radio telephone?

ELMER HORLE

ANSWER: The filter circuit as described in Figure 4 will help you as it is simple and easy to set up, and good results will be obtained by its use. The materials you will need are:

A; 2. 1½ henry choke coils.

B; 2. 1 mfd. 1000 volt paper condensers.

This filter circuit should be connected directly across the plate voltage supply.

BROADCASTS

ITEMS *of general interest that you ought to know; bits of information of practical usefulness to every radio amateur.*

Three Amateurs in 200 Are Licensed to Transmit

Do you think that the "radio fan" is a new arrival? The fan himeslf can tell you otherwise—although it is only within the past few months that he has become so amazingly numerous. In 1920 there were about 10,500 licensed amateurs in the country; last year there were 13,560. Amateur radio stations that receive only are not included in the licensed list; of the latter it has been estimated that there are 600,000 to 1,000,000 now in existence, while a year ago there were not over 60,000. The pre-war peak was in 1916 when the number of licensed stations was slightly over 5,600. During the war there was a large drop in the number because all but official stations were prohibited. In 1904 the money invested in the production of radio telegraph instruments was only $114,050 and in 1919 the amount had risen to $7,600,698.

Can Radio Waves Start Fires?

THE mysterious fires at the MacDonald homestead near Caledonia Mills, Nova Scotia, thirty-eight of which fires started somehow in a single night, were *not* due to radio waves.

This is the verdict of Doctor Walter Franklin Prince, distinguished investigator of psychic phenomena. Following the wide newspaper publicity given to the alleged supernatural occurrences at the MacDonald farm, Dr. Prince was delegated by the American Society for Psychical Research to make a thorough investigation. He spent six days at the supposedly haunted house examining all phases of the reported phenomena. His official report to his Society is now available and disposes finally of the idea that radio had anything to do with the fires.

In addition to his final report, Dr. Prince has made the following statement especially for POPULAR RADIO:

> "The results of my investigation entirely exploded the idea that radio waves caused the fires in Antigonish, unless it be conceded that the waves were intelligent and had the power of transporting objects from one part of the house to another. A sofa cushion was carried downstairs before it was set on fire and pieces of cloth were stuffed into boxes and put into odd places before they were set on fire. The waves would also have to be discriminating enough to avoid setting fires unless persons were in the house and to avoid the upper part of rooms higher than a girl five feet tall could reach."

Dr. Prince concludes that the fires were set by humans; probably, as his formal report shows, by Mary Ellen MacDonald, foster-child of the family. Anyway, radio had nothing to do with it.

Radio fans will breathe easier for this conclusion. If the barn happens to catch on fire they will be able to blame it on father's pipe and exonerate their wireless. Yet there is one question which wireless enthusiasts must consider:

When the radio theory of the Anti-

gonish phenomena was printed in the newspapers most of the wireless experts, including Marconi, refused to commit themselves as to its impossibility. They were skeptical, but, with a few exceptions, they were not dogmatically against the idea. Does this mean that the idea is a possibility, that wireless waves, under any conditions, might set fire to homes or to anything else?

Probably not. No one knows of any way in which wireless waves could set fires or even produce the tiniest sparks, in wood or wall paper or brick, or in any ordinary building material. While it is true that the steel frames of office buildings might serve, theoretically, as receiving antennae, these frames are always well grounded and could not become charged to any significant voltage. The refusal of wireless men to say flatly that the radio theory for the Nova Scotian fires was absolutely impossible was merely a proper scientific caution in the face of unknown facts. In the light of general theory as well as of Dr. Prince's investigations, we need not be afraid of fires from stray wireless—at least until some new evidence comes to hand.

A $3.00 RECEIVING SET

A sixteen-year-old lad in Cincinnati made this miniature apparatus himself; he uses his umbrella as an aerial. It is reported to receive signals up to fifty miles.

The Radio As a Peace Maker

THE broad significance of the radio for bringing together into some semblance of mutual understanding the many and conflicting racial elements of the world—particularly during this trying period of readjustment following the war—is occupying more and more of the serious consideration of those in whose hands the destinies of the nations lie. Never before in history has it been more necessary to keep these many elements in touch with one another, and through a knowledge of one another inculcate an interest and friendliness and eventually that confidence upon which international amity must be based. And never before in history has the means been available to bring about such a condition so quickly and at so moderate a cost of money or labor as is offered by the radio.

Hawaii and the Philippines, to cite a case near to home, have sent urgent representations to Secretary of War Weeks and to both Houses of Congress, asking that the use of the naval radio systems for the transmission of press messages be extended for another five years. Both Territories maintain that a discontinuance of the service at this time would result in a serious curtailment of the news despatches sent to the islands, as the commercial rates today are practically prohibitive, with the result that communication between the United States and these two territories is reduced to a minimum at a time when it should be extended.

Great Britain, too, is planning a system of inter-colonial communication by radio that will link the homeland with her most remote dependencies. The Im-

GRAND OPERA IN THE ENGINE ROOM

Life on the tug boats in New York Harbor will lack monotony now that the New York Towboat Exchange has installed receiving sets on some of its craft. This picture was made on the good ship Nautic.

perial Wireless Telegraphy Commission has recommended that a series of thermionic valve plants be located at the transmitting stations of Great Britain, the Dominions of Canada and New Zealand, the Commonwealth of Australia, and the Union of South Africa; other stations located at such places as East Africa, Hong Kong and Singapore will have combined arc-valve transmissions. It is estimated that the thermionic valve sets will be able to transmit continuously ninety words a minute to a distance of 2500 miles, full power. The value of such a system to the Empire, in sending news and for the transmission of official and commercial despatches, can scarcely be overestimated.

The world is being brought together on a scale never before possible.

How to Talk on the Radiophone

To secure the greatest range and get the best results from speakers unaccustomed to talk over the radiophone, the Bureau of Engineering of the Navy is advising speakers who are to deliver addresses by broadcasting to observe the following rules:

1. Hold the lips about an inch from the mouth-piece of the phone and avoid turning the head away from this position while talking. If a manuscript is to be read, place it where it may be read without moving the head.
2. Speak in a strong, even tone.
3. Speak slowly, enunciate clearly and pause frequently. If the voice is naturally pitched low, raise it to a higher pitch when talking into the phone but do not shout. A strong steady voice pitched not too low, and a careful enunciation with slow speech carries best.

High Scores By the Navy Radio

THE proficiency of Naval radio operators was proven recently when a competitive radio drill was held among the destroyers of the Pacific fleet. Of the seventy-three ships represented, six squadrons secured 100 per cent, and one 99 per cent. Not one had a record below 83 per cent.

"How Far Can I Hear?"

A BUYER of a small crystal receiving set recently returned his purchase to the salesman of a New York retail store and demanded his money back on the plea that the apparatus did not function in accordance with the claims made for it. When his claim was refused he beat up the salesman—and the incident reached the newspapers by way of the police courts.

Laymen who have bought inexpensive little sets with the hope of listening in on broadcasting programs that come from any considerable distance will regard the item with sympathetic interest. The small crystal receiving set has its useful and proper purpose, but it also has its limitations; while it has occasionally received over two or three hundred miles under exceptional conditions it can seldom be relied upon to receive over twenty-five miles, and the virtues sometimes claimed for it by enthusiastic but misinformed salesmen will lead to disappointment if the words fall upon credulous ears.

It is but natural for the inexperienced customers in New York, for example, to inquire: "Will I be able to hear Pittsburgh and Schenectady if I buy this set?"

The question, however, is about as capable of a definite answer as; "How far can my voice be heard?" A man who speaks from the stage of the Metropolitan Opera House will be heard clearly in the rafters if he has the field to himself, but if he talks in competition with the orchestra his voice will be drowned out entirely.

Similarly the receptive powers of the radiophone are subject to innumerable external conditions. Given a clear night and an unusually free ether, the instrument may pick up messages from points that are far outside the normal range. On the other hand, an atmosphere surcharged with static electricity, the proximity of tall buildings or faulty construction of the antenna may prevent the proper functioning of the instrument.

The best way to even approximate the distance an instrument can receive is to hook it up and watch it closely for a week or so.

THE FIRST "RADIO BAND" IN THE WORLD

A group of engineer students of the University of Wisconsin carrying a receiving set equipped with horn amplifiers that gave out band music broadcasted from station 9XM on a phonograph.

Fotograms

WHAT ARE THE ETHER WAVES SAYING?

This youthful and distinctly modern Izaak Walton has something more on his line than a mere fish. A small and easily-transported aerial will solve the problem of many a lone fisherman now that the radio has come to help while away his spare hours

Radio from the North Pole

How would you like to listen to the messages of an explorer telling of his daily progress into the frozen north and perhaps finally talking from the North Pole itself? It is possible that the radio amateur may experience such a thrill in the not far distant future, for Captain Roald Amundsen, famed as the discoverer of the South Pole, announces that he will carry with him on his proposed expedition to the North some powerful radio instruments, with which he hopes to keep in communication with civilization—meaning certain parts of the United States and Canada.

Two thousand miles above the North American continent this descendant of the Vikings will sit at his transmitter in the cabin of his vessel, and may conceivably chat with his friends in Washington and Christiania, telling them of his adventures.

Amundsen's discovery of the magnetic pole several years ago was an achievement of moment in the world of electricity.

Will Radio Alter Our System of Weights and Measures?

WILL the constant use of the terms "meter" and "gram" by the radio amateurs of this country create a sentiment in favor of the adoption of the metric system of weights and measures? That is what the advocates of the Ladd-Britten bill believe; indeed, they regard the rapidly increasing number of radio fans as a factor to be reckoned with when the issue comes to a head as to whether or not the United States will use the same standards of measurement as are used in Europe. Curiously enough, all of the electrical units are based upon the units of the metric system instead of upon the more complex American and English systems.

Intercollegiate Debates by Radio

THE radio amateur may yet prove to be the connecting link between Harvard University and the Middle Western colleges which aspire to associate with New England's proudest institution of learning. Ashland College, located at Ashland, Ohio, has started the ball rolling by challenging Harvard to a series of debates to be carried on by radio, and it is reported that this contest may take place early in the autumn semester.

An Official Broadcasting Station for Uncle Sam

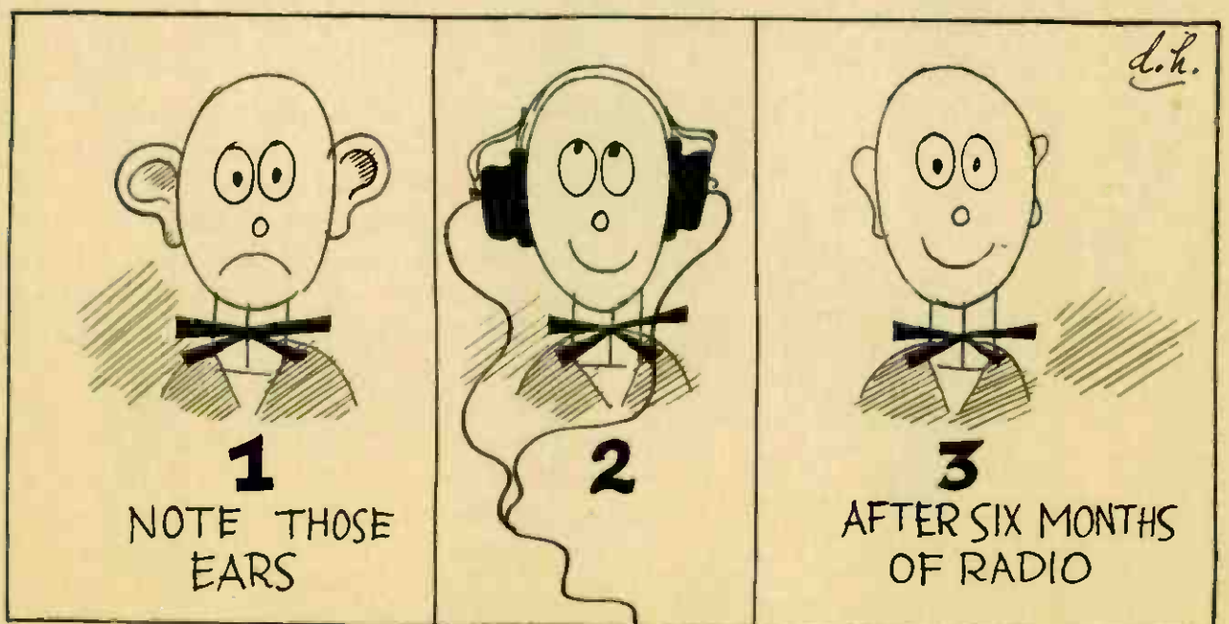
A POWERFUL radio-telephone sending set that will be able to carry the voice of President Harding and other governmental officials to practically all parts of the eastern and middle western United States is being installed in the naval radio station at Arlington. By the time this magazine is published it is expected that Arlington will have started a regular broadcasting program on a wavelength of 2650 meters.

Heretofore this large radio station which has day and night for years kept official Washington in touch with its navy and other outlying government functions. has not had radiophone equipment. The installation of the radio telephone became known only because of test messages that were sent; these messages were received perfectly as far away as New Orleans and Bar Harbor, Maine. Officials estimate that the ordinary range of the station is about 1500 miles, but it is expected that it will be possible to receive its broadcasting at much greater distances.

It has been intimated that Arlington, with the aid of this new equipment, will be the broadcasting center for important governmental announcements, such as presidential addresses before Congress, and it is even possible that the proceedings of Congress will be sent into the ether through this station.

The new Arlington set will be much more powerful than the Naval Air Service Station at Anacostia, D.C. which was used by Senator New in his famous speech to his constituents in Indiana. This station has only a normal range of 150 miles.

Arlington now sends out official U. S. Naval Observatory time signals at 10 o'clock each night with a spark telegraph set on 2650 meters, and its regular code working equipment is an arc transmitter on 3950 and 5950 meters.



One of the advantages of owning a radio set—as discovered by the well-known humorist, Don Herold.

THIS *department—conducted by a patent attorney of wide experience in radio work—will keep you in touch with the latest inventions of interest on which patent rights have been granted, and which are significant contributions to radio art.*

New Developments of Condensers and Variometers

Patent No. 1,408,738: Guy Hill, Washington, D. C., Electrical Condenser.

Patent No. 1,408,992: Joseph W. Doron, Hamilton. O., Variometer.

WHAT is a "condenser" or "capacity?" What is a "variometer" or "inductance?" Why are such devices always used for tuning radio circuits? What is their action? How many know that when we speak of "radio tuning" we mean in fact a tuning in the sense of or analogous to the tuning of a violin string?

We are all familiar with light waves and sound waves which are propagated in space and originate from vibrating particles or bodies. Then there are heat waves, X-rays, electromagnetic waves, all propagated by vibrating particles or by electrical oscillations. All waves, including electromagnetic or Hertz waves, follow laws which are similar, whether for light or electromagnetic waves or even for sound waves.

Such laws can be expressed mathematically by formulae, and from what is known about light or sound waves, facts may be deduced about other waves, such as the electromagnetic waves.

These electromagnetic waves can be sensed indirectly by their effects on sensitive instruments or apparatus; they cannot be seen or heard or felt. Can we picture in our minds electromagnetic or Hertz waves? Were we to attempt such a mental picture we would but see some tangible form of wave such as ripples on water.

As science, however, has studied electromagnetic waves by the effects they produce upon instruments and apparatus and as these effects are much like the effects and characteristics of water waves, sound waves and light waves with which we are more familiar, we may understand radio waves and answer the question above analogically in terms of sound waves and take as our example a vibrating violin string as representing a radio receiver.

The formula (and its explanation is simple) for a vibrating string is:

$$N = \frac{1}{2}\sqrt{\frac{T}{L\,M}}$$

All this formula means is, that, as determined by experiment, the frequency N (the number of vibrations per second) varies directly as the tension T on the string and inversely as the length L and mass M of the string. We all know that a higher note is obtained if the string be tightened and that the longer and heavier the string the lower the note. Another observation with which we are all familiar is that when the note C is sounded near a string tuned to the same note C, the latter will start vibrating also, but, if any other note is sounded the string will not respond. In the first case

the sound waves set up in the air by the transmitter (the voice) affects the tuned string (the receiver) and sets the latter to vibrating. This sympathetic response only occurs when both the transmitter and receiver are in tune as determined by their tension and mass so that their periods are identical and co-operative, thus producing resonance.

As the vocal cords vibrate and set up sound waves in the air, so a radio transmitter, by means of the electrical vibrations therein, generates electromagnetic waves in the ether (like light or sound waves). When these waves strike a receiving aerial they are transformed again into electrical vibrations in the aerial—if the latter be tuned to the pitch or the wave length of the transmitted impulses.

Just as the frequency N of a string is determined by its opposing or co-operating forces of tension, the tension T, and inertia, mass M, so also the frequency of a radio receiver is determined by the opposition or co-operation of electrical tension, capacity C (a condenser) and electrical inertia, inductance L. Hence when the square root of the product of the inductance and the capacity of the receiving circuit equals the square root of the product of the inductance and the capacity of the transmitter the two circuits will be in resonance or tuned to each other.

Thus it is evident that a receiving circuit may be tuned by adjusting either its inductance or its capacity or both.

Although any wire conductor has natural distributed inductance and capacity, yet it is preferable to insert in a receiving circuit lumped or artificial inductances and capacities, thus artificially securing the required relation of capacity and inductance by adjustment to receive different wave lengths.

All conductors that carry currents have self-induction, inasmuch as they are surrounded by magnetic fields and are therefore inductances. The production of this field creates an E M F or potential in the circuit in opposition to the potential or E M F that causes the current. This tends to retard the starting, change or stopping of a current in the circuit, which is a form of inertia. Coils have greater self-inductance by reason of their strong magnetic fields than straight wires, as is obvious from the extensive use of them as electromagnets; hence they are used in different forms as inductances in radio circuits.

Such inductances may be varied by several methods, such as by sliding contacts or switches, which are more or less complicated.

A variometer is one form of inductance which is continuously variable and which requires neither sliding contacts nor switches. It comprises two coils connected in series and mounted to rotate relatively to each other. When the coils are so positioned that their magnetic

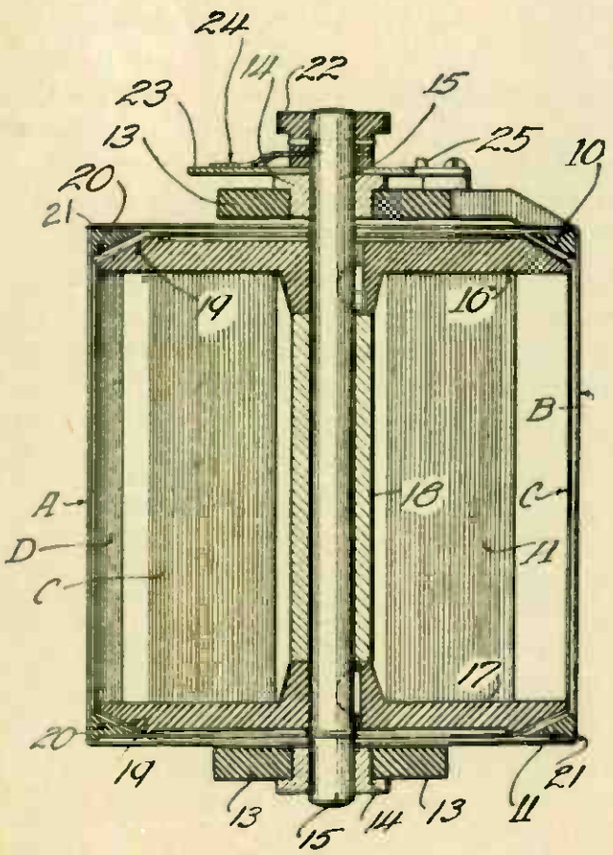


FIGURE 1.

A variometer is composed of a stationary coil and a rotating coil which can be turned so that its poles are either in the same direction as the stationary coil (thus giving the largest inductance value), or turned so that its poles are opposed to the poles of the stationary coil (thus giving the smallest value of inductance).

fields are opposed they will have substantially zero inductance and in the opposite position they will have maximum inductance. A variometer since it is continuously variable may be used to secure close tuning in a receiving circuit or it may be used as a combined tuning and coupling element.

Patent No. 1,408,992 illustrates a variometer of the above described type. This variometer as illustrated in Figure 1, comprises an upper fixed ring 10 and a lower fixed ring 11 having beads 21 on the upper and lower edges. Bridging members 13 are secured to the rings 10 and 11 and support the rotatable shaft 15. To shaft 15 are secured the plates 16 and 17 which are spaced from each other by means of sleeve 18. The plates 16 and 17 have beveled edges 19 which face similar beveled edges upon the inner surfaces of rings 10 and 11; these edges are sufficiently spaced to allow the coils to be passed between them. Coils A and B are wound around rings 10 and 11, engaging the fixed parts upon the beads 21 only. The coils C and D are wound around the plates 16 and 17 and engage the flanges 19. The coils A, B, and C, D, are connected in series with each other.

One feature of the variometer covered by this patent is the small air space or gap between the stationary and movable coils; another feature is that a minimum portion of each coil engages the supporting structures although the latter are of insulating material, thus insuring maximum inductive effect and low losses, while providing a simple and economical structure.

A tuning inductance such as the variometer here described increases the fundamental period of oscillation of the receiving aerial, making it responsive to longer wavelengths than that for which the aerial is designed. The insertion of a capacity or condenser in an aerial designed for a given fundamental wavelength, or the other hand shortens the fundamental oscillating period and makes the aerial responsive to shorter wavelengths. This is analogous to the violin string, because increasing the mass increases the period of vibration and increasing the tension decreases it. By "period of vibration" is meant the time required to make one complete vibration. Inductances retard the oscillatory movements while capacity accelerates them.

A condenser is a device for storing electricity in electrostatic form and which, when charged, becomes tensioned, a mechanical strain or tension being imposed on the dielectric. Because of this strain there is an opposing force developed tending to release the strain as the condenser becomes charged. In its simplest form a condenser comprises a pair of conductors separated by a non-conductor or dielectric. The well-known Leyden jar is one of the earliest examples of a condenser. Condensers may have a solid dielectric such as mica, a gaseous dielectric such as air or even a vacuum dielectric. Air condensers are valuable because they may be easily adjusted and hence are suitable for tuning receivers.

While variable air condensers have been used for years, nevertheless refinements of design are continually being made for the purpose of making them more sensitive and in order to minimize losses therein when used with the high frequency currents that are prevalent in radio.

In Patent No. 1,408,738, Capt. Guy Hill, of the Signal Corps, U. S. A., has devised for a condenser a form of bushing which prevents brushing or discharge and breakdown of insulation between parts at a difference of potential.

Such variable air condensers as are here illustrated generally comprise the metal end members or supports A and B, between which are supported the spaced fixed metal plates 12 mounted upon rods 11 and spaced by washers 10 in the usual manner. The movable metal plates 13 are secured to a rotatable shaft 20 and are spaced from each other by the washers

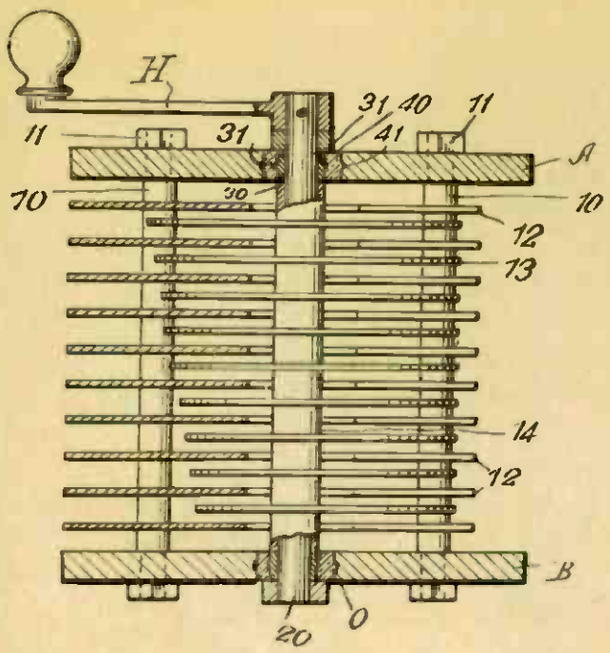


FIGURE 2.

A variable condenser consists of a number of stationary semi-circular plates that have a number of insulated rotating semi-circular plates spaced alternately between them. The capacity is varied by rotating the plates and thus varying the amount of surface of the movable plates exposed to the stationary plates.

14. The movable set of plates and shaft 20 must be insulated from the fixed set of plates and the mounting A B. Capt. Hill secures this insulation by interposing a moldable insulating material 40, such as electrose, between the bushing 30 in which shaft 20 is journaled and supports A B in such a manner as to secure intimate contact between the metal and insulating parts to the exclusion of air. This construction is obtained by serrating or roughening the surfaces 31 and 41 of bushing 30 and supports A B and then molding the bushing into place with moldable insulating material under pressure. When the bushings 30 are once molded into place they are held securely, making a strong mechanical construction. By the elimination of air from between the metal and insulating material, brushing and breakdown are prevented, as it has been found that a composite dielectric consisting of two different materials such as electrose and air is more liable to break down and deteriorate than a single good dielectric. This is exemplified in the manufacture of sheet condensers in which every expedient is used to remove the air from between the insulating sheets and foil. The construction proposed by Capt. Hill appears rather expensive to manufacture but it should be of value where high frequencies and high potentials are employed.

Just as the frequency or vibration of the violin string is caused by the tension of the string, tending to move it in one direction, and the mass of the string which by reason of its inertia (a characteristic of matter) tends to oppose this motion, so also the frequency of the electrical oscillations (the vibrations of the electrons) in a receiver is determined by the opposing electromotive forces of the inductance and capacity that tend to move the current in opposite directions, resulting in an oscillatory movement. The action may be likened crudely to two boys throwing a ball back and forth, the boys representing inductance and capacity (or inertia and tension) and the moving ball representing the oscillations or vibrations. A better example is the action of water in a U tube, oscillating back and forth under the opposing forces of gravity and inertia, the U tube representing the circuit and the water the electric current, and inertia representing the inductive forces and gravity the condenser forces.

The wave length of a Hertz wave, sound wave or light wave is equal to the velocity of the wave (which is a constant and approximates in the case of a Hertz wave the velocity of a light wave, 300,000,000 meters a second) divided by the frequency or oscillations a second. The greater the frequency of the oscillations a second the less the period of vibration and *vice-versa*.

Thus, when the receiver has its capacity and inductance properly adjusted to those of the transmitter, it is in tune and responds to the oscillations of the transmitter.

Become a Radio-trician©

Learn at home the greatest profession of to-day and the future. Become a master of radio installation, operation, maintenance, repair, mechanics, design, inspection, salesmanship and invention.

THE world is aflame with Radio. Never before in the history of the country has an industry leaped to the forefront as rapidly as this great, new science. Hundreds of thousands of radio receiving sets are in operation—tens of thousands of sending stations will be erected—and this enormous craze is permanent. Even to-day manufacturers are months behind their orders! Improvements are being made every day which must increase the demand for radio equipment to even *greater* proportions than now.

Men of foresight, men of vision know what this means. Never before has there been such an opportunity. Radio-tricians are needed to-day everywhere. More and more will be needed as the demand for radio installation, radio operation, radio maintenance, radio repair, radio salesmanship becomes greater and greater.

Wherever you go, there are hundreds of radio sets to be installed—wherever you go, thousands upon thousands of dollars worth of radio equipment is being sold—wherever you go, there are radio sets to repair; and if you seek adventure, there are radio sending stations calling to you from ships and land stations all over the world.

The Pioneer School

The National Radio Institute has a record of over 8,000 students. It is the pioneer school. It teaches every phase of radio from the ground up. It teaches by means of actual practice, actual assembling of a radio outfit, actual operation of radio equipment. It teaches by problem and principle so that National Radio-tricians are in demand everywhere.

Here is a profession which is paying enormous earnings to men all over the country to-day—a profession that will make hundreds of men wealthy—a profession far more lucrative than that of any other technical or mechanical employment you can secure.

What will you do?

The world is aflame with radio. What are you going to do to "cash in" on the demand for men, for equipment, for experience? Are you going to sit idly by wondering what it is all about, or are you going to make the most of this, the greatest opportunity presented to men of ambition in 50 years.

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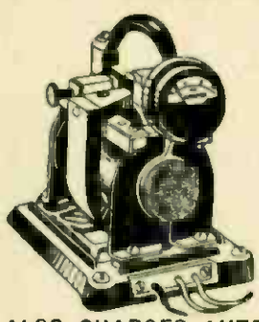

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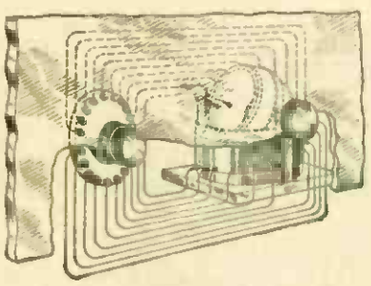
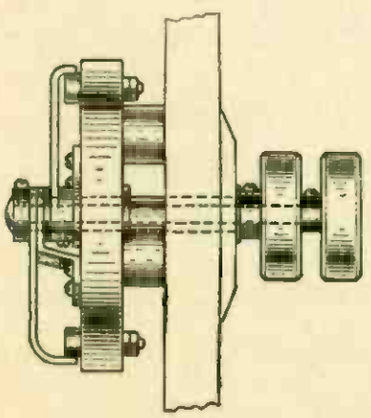


Installation with Variocoupler



Side view showing mounting on panel

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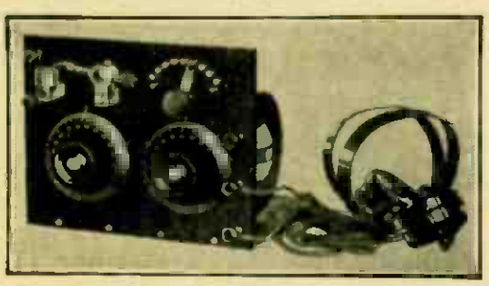

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How to test your pair of telephone receivers.
How to test out a variable condenser for short circuits
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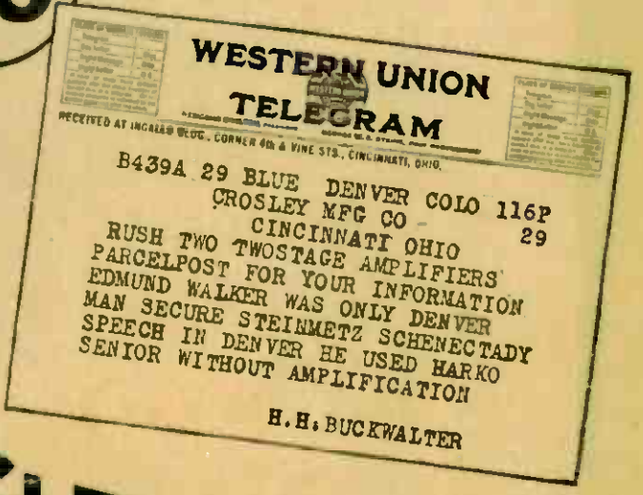
This Harko Senior receiver (pictured) in Denver, Colorado, without amplifier picked up Dr. Chas. Steinmeiz lecture in Schenectady, N. Y.



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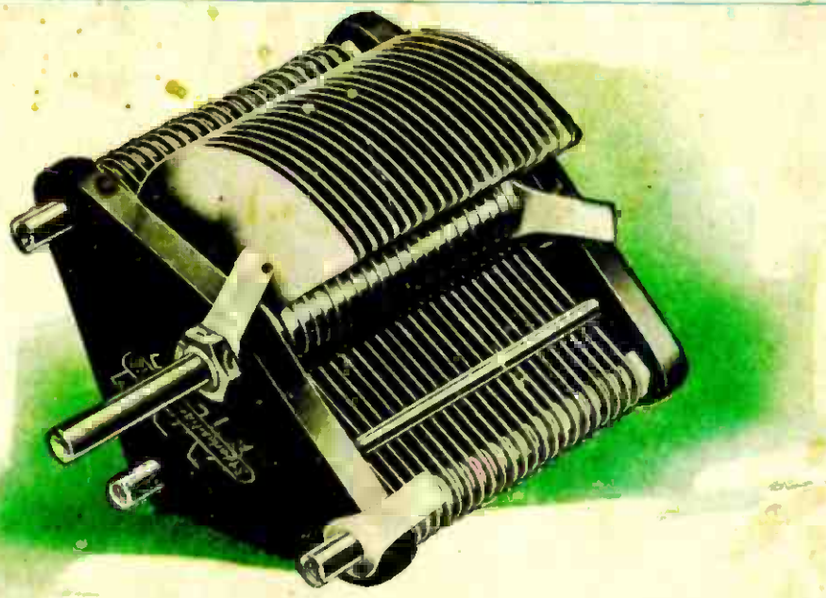

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