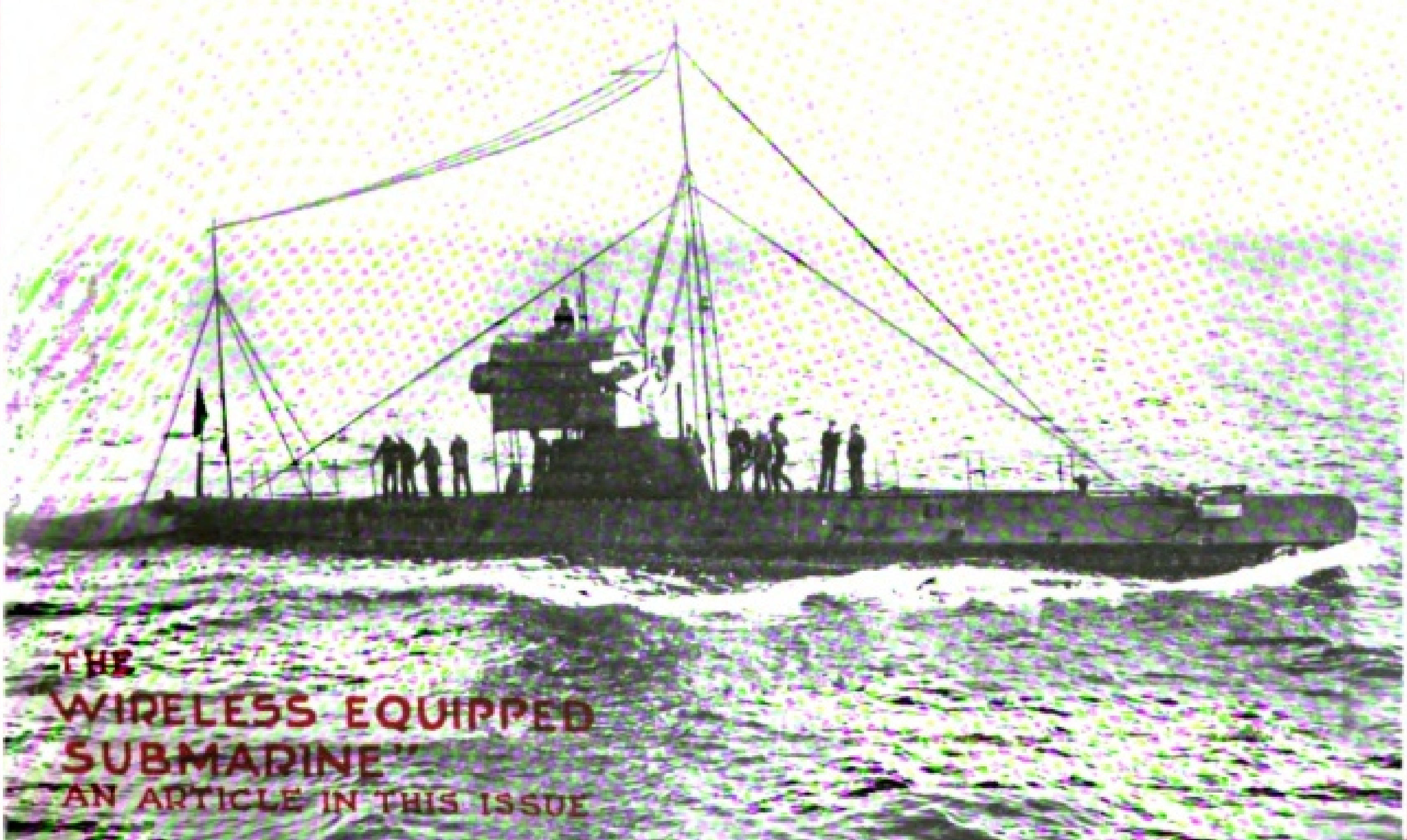
15 Cents

June, 1916

THE WIRELESS AGE



Books on Wireless

A list of some of the best books pertaining to the wireless art. We have made arrangements whereby we can supply our readers with any book on wireless published in America at regular published price. We can also import on order any book published abroad. *Send us your orders. They will receive prompt attention.*

	Pub. Price Post-paid	With one Year's WIRELESS AGE
YEAR BOOK OF WIRELESS TELEGRAPHY (1915) pp. 1000. Contains a yearly record of the progress of wireless telegraphy; complete list of ship and shore stations throughout the world, their call letters, wave-lengths, range and hours of service, and articles by the greatest authorities on vital questions	$1.50	$2.00
HOW TO CONDUCT A RADIO CLUB, pp. 128, 116 illustrations, E. E. Bucher. Describing Parliamentary Procedure indoor and outdoor experiments. 5,000-mile Receiving Set and many other features	.50	1.75
HOW TO PASS U. S. GOV. WIRELESS EXAMINATION. 118 Actual Questions Answered. 72 pp. E. E. Bucher. The greatest wireless book ever published for amateurs and prospective wireless operators	.50	1.75
LIST OF RADIO STATIONS OF THE WORLD, 220 pp. Compiled by F. A. Hart, Chief Inspector of Marconi Wireless Telegraph Company of Am., and H. M. Short, Resident Inspector U. S. A. Marconi International Marine Com. Co. The only complete authoritative call list published	.50	1.75
THE ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY, new and revised edition, pp. 160. Bangay, R. D., explains in the simplest possible manner the theory and practice of wireless telegraphy. Arranged for use as a reference book for amateur students and Boy Scouts	.50	1.75
THE BOOK OF WIRELESS, pp. 222, 219 illustrations; Collins, A. Frederick. An excellent book for amateurs, contemplating building their own stations, gives cost of installing ready built equipment and also cost of material for building your own equipment. Special chapters on amateur long distance receiving sets, with costs both ways	1.00	2.25
HAND BOOK OF TECHNICAL INSTRUCTIONS FOR WIRELESS TELEGRAPHISTS, pp. 295, Hawkhead, J. S. Covering principally the practice of the Marconi Co. abroad and elementary explanation of the underlying principles	1.50	2.50
TEXT BOOK ON WIRELESS TELEGRAPHY, pp. 352. Stanley, R. A text book covering the elements of electricity and magnetism, with details of the very latest practice in wireless telegraphy in European countries—recommended to all workers in the art of radio telegraphy	2.25	3.25
AN ELEMENTARY MANUAL OF RADIO-TELEGRAPHY AND RADIO-TELEPHONY FOR STUDENTS AND OPERATORS, pp. 360. Fleming, J. A. A splendid treatise for students and practical operators. New and revised edition (Sept., 1915). The author is at the front with the English army	2.00	3.00
WIRELESS TELEGRAPH CONSTRUCTION FOR AMATEURS, pp. 200, Morgan, A. P. The construction of a complete set of wireless telegraph apparatus for amateurs' use. Recommended to beginners	1.50	2.50
PRACTICAL USES OF THE WAVEMETER IN WIRELESS TELEGRAPHY. Mauborgne, J. O. Originally compiled for the Officers of the U. S. Signal Corps; comprises an explanation of the use of the wavemeter, the most complete publication on the subject so far produced	1.00	2.25
WIRELESS TELEGRAPHY AND TELEPHONY, pp. 271, Kennelly, A. E. One of the Primer Series giving in simple language an explanation of electro-magnetic waves and their propagation through space, also fundamental facts about wireless telegraph equipments	1.00	2.25
EXPERIMENTAL WIRELESS STATIONS, pp. 224. Edelman, Philip E. A book for amateurs. The design, construction and operation of an amateur wireless station in compliance with the new Radio Law	1.50	2.50
EXPERIMENTS, New, pp. 256. Edelman, Philip E. Practical, up-to-date information for building simple, efficient apparatus at small cost, for conducting tests and experiments and for establishing a laboratory	1.50	2.50
MANUAL OF WIRELESS TELEGRAPHY FOR USE OF NAVAL ELECTRICIANS, Revised and enlarged, 1915. 220 pp., 120 illustrations, by Commander S. S. Robison, U. S. Navy. Text Book and practice of wireless as used in U. S. Navy. Invaluable to prospective Navy Radio Operators and Electricians	1.50	2.75
LESSONS IN PRACTICAL ELECTRICITY, pp. 507. Swoope, Walton C. Published by the Spring Garden Institute for use in its evening classes in practical electricity. It is one of the most popular works on practical electricity covering as it does principles, experiments and arithmetical problems,—404 illustrations	2.00	3.00
THE WIRELESS TELEGRAPHISTS' POCKETBOOK OF NOTES, FORMULAE AND CALCULATIONS, pp. 347, Dr. J. A. Fleming. Bound in full flexible, rich blue leather, stamped in gold, with round corners and gold edges. A book of practical working formulae and calculations for the student of radio telegraphy. Bound to be considered an indispensable part of the working equipment of every wireless student	1.50	2.50
WIRELESS TELEGRAPHY, pp. 443, 461 Illustrations, by Dr. J. Zenneck. Translated from the German. The work is the most scientific and thorough that has appeared on this subject. It covers all phases from physical principles to finished commercial apparatus	4.00	5.00
PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS, edited by Dr. Alfred N. Goldsmith. Nos. 3 and 4—1913; Nos. 1, 2, 3, 4,—1914, and Nos. 2 and 4 for 1915 sold singly at $1.00 each. (Vols. '14-'15 Buckram bound, $5.00 each.) Sub. by yr. 6 Nos	6.00	7.00

Send Orders to **The Wireless Age,** **450 4th AVENUE, NEW YORK, N.Y.**

THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

JUNE, 1916

Some Problems in Antenna Construction

PART I

By A. S. Blatterman, B.Sc.

IN constructing a wireless telegraph aerial the engineer is confronted with two problems. The first of these relates to the mechanical strength of the antenna and its supports; the second to the electrical components. These two problems subdivide themselves, as follows: Under the first heading we consider the strength of the wires with the concomitant sag and tension and the pull imposed on the supporting structures, the stresses produced therein and the deflection under load, wind pressure, ice and sleet; in the second case, we must incorporate into the antenna a certain electrostatic capacity, and consideration must be given to the potential of the system in regard to losses through corona or brush discharge, and to some other points which will be discussed later.

It is of prime importance to make the antenna mechanically strong. In the design of a span of wire two problems are presented:

1. At what tension (or sag) must the wire be strung in order that the tension in the span may not exceed a definite limit under the worst conditions of temperature and extra mechanical loading (due to ice and wind)?

2. What will be the maximum vertical sag of the wire for a given variation in loading and temperature?

The important factors which enter into these two problems are the following:

1. *The length of the span.*
2. *The material of the wire.*
3. *The size of the wire.*
4. *The coefficient of linear expansion of the wire.*

For copper this coefficient is 9 by 10^6 and for aluminum 12.8 by 10^6, the temperature being expressed in degrees Fahrenheit. For phosphor-bronze it is 17.7 by 10^6.

5. *The modulus of elasticity of the wire.*—The modulus of elasticity is the increase in tension in pounds per square inch that is required to produce an elongation of one unit in every unit of length of the material (if the material did not change its properties during the process). Thus, for a copper wire whose cross-section is one square inch, it requires from 12 by 10^6 to 16 by 10^6 pounds to cause an inch of the wire to stretch one inch, depending upon the quality of the wire and upon whether the wire is stranded or solid. We may take $M = 12$ by 10^6 for copper, $M = 14$ by 10^6 for phosphor-bronze, and $M = 9$ by 10^6 for aluminum.

6. *The maximum tension in pounds per square inch to which the wire may be subjected.*—The maximum allowable tension is usually taken as one-half the ultimate tensile strength of the wire, or about 30,000 pounds per square inch for copper, 55,000 pounds per square inch for phosphor-bronze, and 14,000 pounds per square inch for aluminum. The tension in pounds per square inch is, of course, the total pull on the wire in pounds divided by the cross-sectional area of the wire in square inches.

7. *The maximum external load to which the wire may be subjected due to the collection of sleet on the wire and the pressure of the wind against it.*—It is usual in the northern part of the United States to assume the maximum loading as that due to an ice coating of 0.5 of an inch thick all round the wire, plus a wind pressure of eight pounds per square foot of the projected area of this ice cylinder. (See Fig. 1.) The wind pressure in pounds per square foot of projected area is calculated by the formula:

$$P = 0.0024\ v^2 \quad \ldots\ldots\ldots\ldots (1)$$

where P = pressure in pounds per square foot.
V = actual wind velocity in miles per hour.

Thus, for a 60-mile wind,
P = 8.65 pounds per square foot.

8. *The minimum temperature at which the maximum external load occurs.*—Of course, for a given span, the wire is shorter and the tension greater at low temperatures than at high ones. However, it is a fact that sleet seldom exists on a wire when the temperature is much below freezing; nor, for that matter, is it usual to have a heavy sleet on the wire, together with maximum wind velocity.

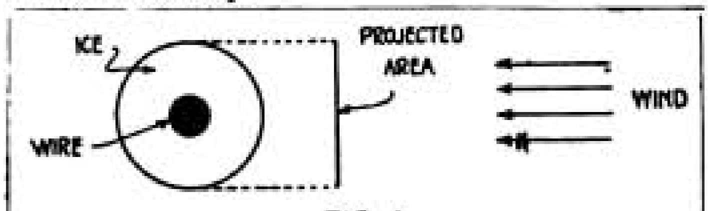


FIG. 1.

9. *The temperature at which the wire is to be strung.*

10. *The maximum temperature to which the wire is apt to be subjected.*—It should be noted that the temperature of a wire exposed to the sun is considerably higher than the temperature of the surrounding air.

The following formulas take into account all of the various quantities mentioned above in a comparatively simple yet accurate way. For a development of the formulas the reader is referred to a paper by Dr. Harold Pender, Proc. A. I. E. E., July, 1911.

Supports at the same level.—We will consider first the case in which there are two supports so arranged that the two ends of the wire are at the same elevation. (See Fig. 2.)

The symbolism is as follows:

w = weight of wire per foot (pounds).
d = diameter of wire in inches.
i = ice thickness in inches.
v = wind pressure (pounds per square foot).
K = a constant depending on the loading.

$$= \sqrt{\left\{1 + \frac{1.24\, i\,(d+i)}{w}\right\}^2 + \left\{\frac{v\,(d+2i)}{12\,w}\right\}} \quad \ldots\ldots (2)$$

If ice is neglected then

$$K = \sqrt{1 + \left(\frac{vd}{12\,w}\right)^2} \quad \ldots\ldots (3)$$

Again if

m = weight in pounds of bar of conductor 1 foot long and 1 square inch in cross-section.
T = tension in wire (in thousands of pounds per square inch).
D = deflection in feet.
$p = \frac{100\,D}{L}$ per cent. deflection.
K′ = value of K when there is no wind.
= 1 when there is no ice.
M = modulus of elasticity.
α = coefficient of expansion.
t_0 = lowest temperature in winter.
t = highest temperature in summer.

We have:

$$D = \frac{KmL^2}{8000\,T} \quad \ldots\ldots (4)$$

$$P = \frac{KmL}{80\,T} \quad \ldots\ldots (5)$$

Taking into consideration the temperature effects:

$$\left(P^2 - \frac{3.75\,T\,10^6}{M}\right) - \left(P_0^2 - \frac{3.75\,T_0\,10^6}{M}\right) = 3750 \quad (t - t_0) \quad \ldots\ldots (6)$$

where

$$P_0 = \frac{K_0\,mL}{80\,T_0} \quad \ldots\ldots (7)$$

T_0 = tension in thousand pounds per square inch at temperature t_0.

K_0 = value of K for the loading assumed at temperature t_0.

Hence, when the tension T_0 at temperature t_0 and the loading factor K_0 are known, the tension at any other temperature t and loading factor K may be determined by solving equation (6) for T, after substituting for p and p_0 their values as calculated by (5) and (7). The following example illustrates the use of the foregoing equations:

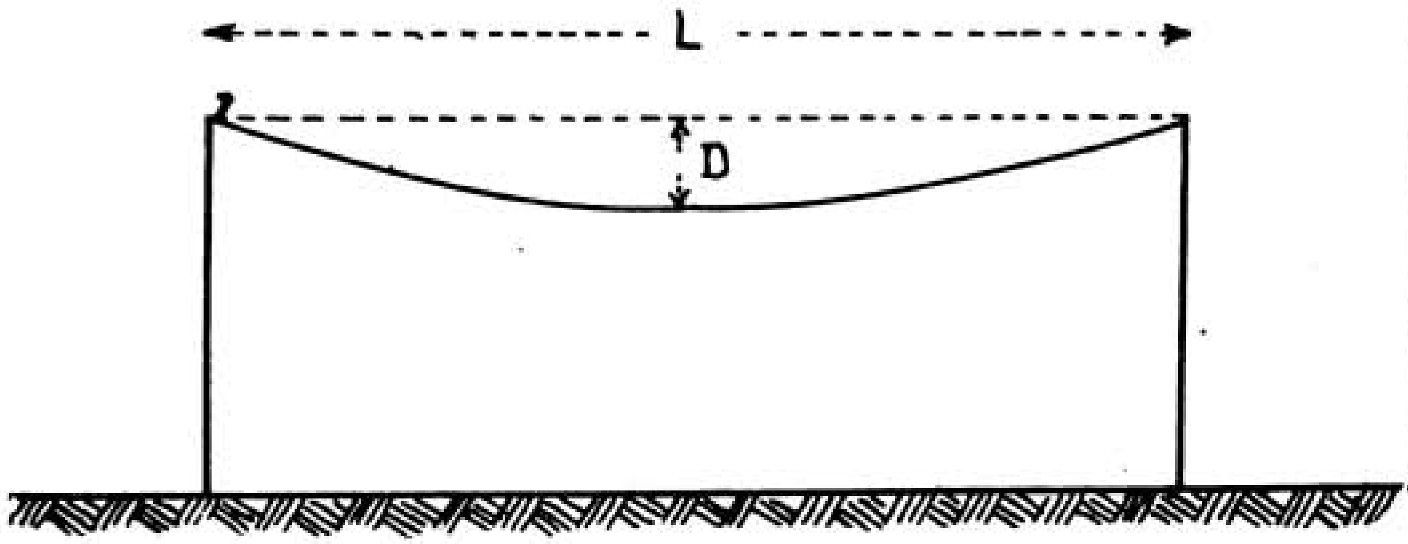


FIG. 2

Wire: 7 strand, No. 20 phosphor bronze.

$L = 320$ feet.
$w = 0.0189$.
$d = 0.121$.
$v = 10.5$ pounds per square foot (corresponding roughly to a 65-mile wind).
$m = 3.71$.
$M = 14 \times 10^6$
$\alpha L = 17.7 \times 10^6$
$t_0 = 0°$ F.
$t = 100°$ F.

Ultimate tensile strength of conductor = 110,000 pounds per square inch.

At 0° F., no ice and no wind, allowing a factor of safety of 10, the allowable tension in the wire will be taken at 11,000 pounds per square inch. Hence,

$$T_0 = 11$$

and by (4):

$$D = \frac{1 \times 3.71 \times 320^2}{8000 \times 11} = 4.32 \text{ ft.}$$

Now for any other condition of loading we proceed as follows:

If we have ¼-inch ice and a 65 mile wind at the temperature 30° F., formula (2) gives:

$$K = \sqrt{\left\{1 + \frac{1.24 \times 0.25\,(.371)}{0.0189}\right\}^2 + \left\{\frac{10.5\,(.121 + .5)}{12 \times .0189}\right\}^2}$$

$$= 8.9$$

By (7):

$$p_0 = \frac{1 \times 3.71 \times 320}{80 \times 11} = 1.35$$

By (5):

$$p = \frac{8.9 \times 3.71 \times 320}{80 \times T} = \frac{132}{T}$$

$t - t_0 = 30°$
and from (6):

$$\left(\frac{132^2}{T^2} - \frac{3.75\ T10^6}{14 \times 10^6}\right) - \left(1.35^2 - \frac{3.75 \times 11 \times 10^6}{14 \times 10^6}\right) = \frac{3750 \times 17.7 \times 30}{10^6}$$

$$\frac{17420}{T^2} - 0.268\,T = 0.865$$

from which

$T = 39.2$ or
39,200 lbs per sq. in.

This stress occurs at 30° F., ¼-inch ice, 65-mile wind, and is well below the elastic limit for phosphor-bronze, viz., 55,000.

The deflection under these conditions is by (4):

$$D = \frac{8.9 \times 371 \times 320^2}{8000 \times 39.2} = 10.8 \text{ feet}$$

Now, if we take as the worst condition of loading ¼ inch ice, 65 mile wind at temperature 0° F., then

$$p = \frac{132}{T},\ p_0 = 1.35 \text{ (as before)}$$

$$t - t_0 = 0$$

by (6):

$$\left(\frac{132^2}{T^2} - \frac{3.75\ T10^6}{14 \times 10^6}\right) - \left(1.35^2 - \frac{3.75 \times 11 \times 10^6}{14 \times 10^6}\right) = 0$$

$$\frac{17420}{T^2} - 0.268\ T = -1.12$$

$T = 41{,}500$ pounds per square inch.

The deflection is:

$$D = \frac{8.9 \times 3.71 \times 320^2}{8000 \times 41.5} = 10.4 \text{ ft.}$$

We see thus the effect of temperature.

With max. ice and wind load at 30°.......... $D = 10.8$ feet

With max. ice and wind load at 0°........... $D = 10.4$ feet

Also the effect of ice and wind load:

With ice and wind at 0°

$D = 10.4$ feet. $T = 41.5$

Without ice and wind at 0°

$D = 4.32$ feet $T = 11.0$

The increased load has raised the tension and stretched the wire, thereby increasing the sag.

Supports at different levels.—We now consider the case where the supports are at different levels. (See Fig. 3.)

T = tension at lowest point of span (*i. e.* at o),

L = length of span: horiz. dist. between supports,

h = difference in level of supports,

L_0 = dist. to lowest point of span from lower support.

$$K' = 1 + \frac{1.24\, i\, (d + i)}{w} \qquad (8)$$

As before, K'_0, K_0, T_0, p_0, are the values of these quantities when the temperature is t_0.

When the supports are at different levels we have:

$$\left(p^2 - \frac{3.75\ T10^6}{M}\right) - \left(p_0^2 - \frac{3.75\ T_0 10^6}{M}\right) - 3750\ \alpha \left\{(t - t_0) - \frac{h^2}{2\ \alpha L}\left[\left(\frac{K'}{K}\right)^2 - \left(\frac{K_0'}{K_0}\right)^2\right]\right\} \qquad (9)$$

We also have:

$$L_0 = \frac{L}{2} - \frac{K'h}{4\,KD} \qquad (10)$$

D is the deflection corresponding to the same length of span, same tension, and same loading, *but the two points of support are at the same elevation.* Also:

$$D_1 = D\left(1 - \frac{K'h}{4\,KD}\right)^2 \qquad (11)$$

In stringing the conductors it is necessary to know the temperature, the wind velocity (usually the work is done, if possible, when there is no wind

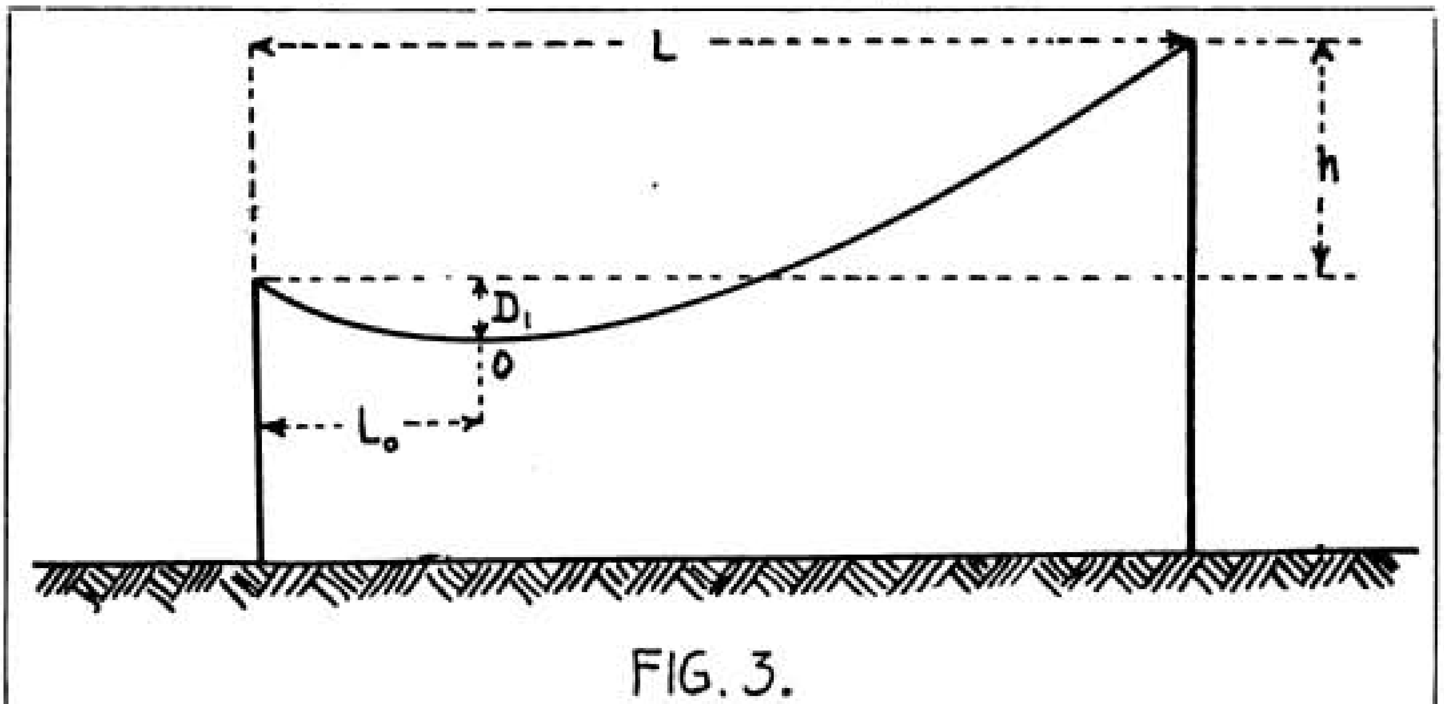


FIG. 3.

and no ice on the wires), and the tension or sag that must exist under the given stringing conditions in order that the allowable tension and sag under the extreme maximum conditions of temperature and loading, after the wires are up, will not exceed specified limits. For this purpose a table is calculated by the use of the foregoing formulae, giving the tension and sag at various temperatures, and if desired a curve drawn from these data showing the tension to place on the wires or the sag to allow when the stringing is carried on at different temperatures.

The following table is calculated for the example for different temperatures assuming conditions of no ice and no wind.

Temp. t° F.	Tension lbs. sq. in.	Pull lbs.	Sag. ft.
80°	6100	34.2	7.29
60°	6900	38.8	6.88
40°	7800	43.8	6.10
20°	9100	51.1	5.22
0°	11000	61.7	4.32

The third column is the pull in the wire; it is the tension in pounds per square inch times the cross-sectional area of the wire in square inches. If the wires are strung at 60° F., then a pull of 38.8 pounds must be used to put the wires in proper tension, this being such that under the worst condition of loading, namely ¼-inch ice, 65-miles wind, at 0° F., the tension will be 41,500 pounds per square inch, which is below the elastic limit. A dynamometer or some form of spring balance can often be used for this purpose.

If the antenna is composed of, say, eight wires, then the total pull on the supports at the temperature 60°, no ice and no wind, is 8 by 38.8 = 310 pounds. At 0°, no ice and no wind, it is 8 by 61.7 = 494 pounds. At 0°, ¼-inch ice and 65 miles wind, it is 1,865 pounds, and as this is the severest loading to be expected, the supporting structures must be designed to withstand this load.

Wind Velocity.—It is well to distinguish between indicated and true velocities. The United States Weather Bureau observations are made in such manner that the velocity indicated on the instrument is not the actual velocity. The true velocities corresponding to definite indicated velocities, as given by the United States weather reports, are as follows:

Velocity: Miles Per Hour

Indicated.	Actual.
10	9.6
20	17.8
30	25.7
40	33.3
50	40.8
60	48.0
70	55.2
80	62.2
90	69.2
100	76.2

In calculating wind pressures the actual velocity must be used.

Summary

1. Assume tentatively the allowable value of T_0 about 1-10 of the ultimate tensile strength of the conductor, at 0°, no ice, no wind.

2. Then assume maximum ice and wind loading, and temperature t at which these occur. Calculate p, p_0, K, K_0, K′, K'_0.

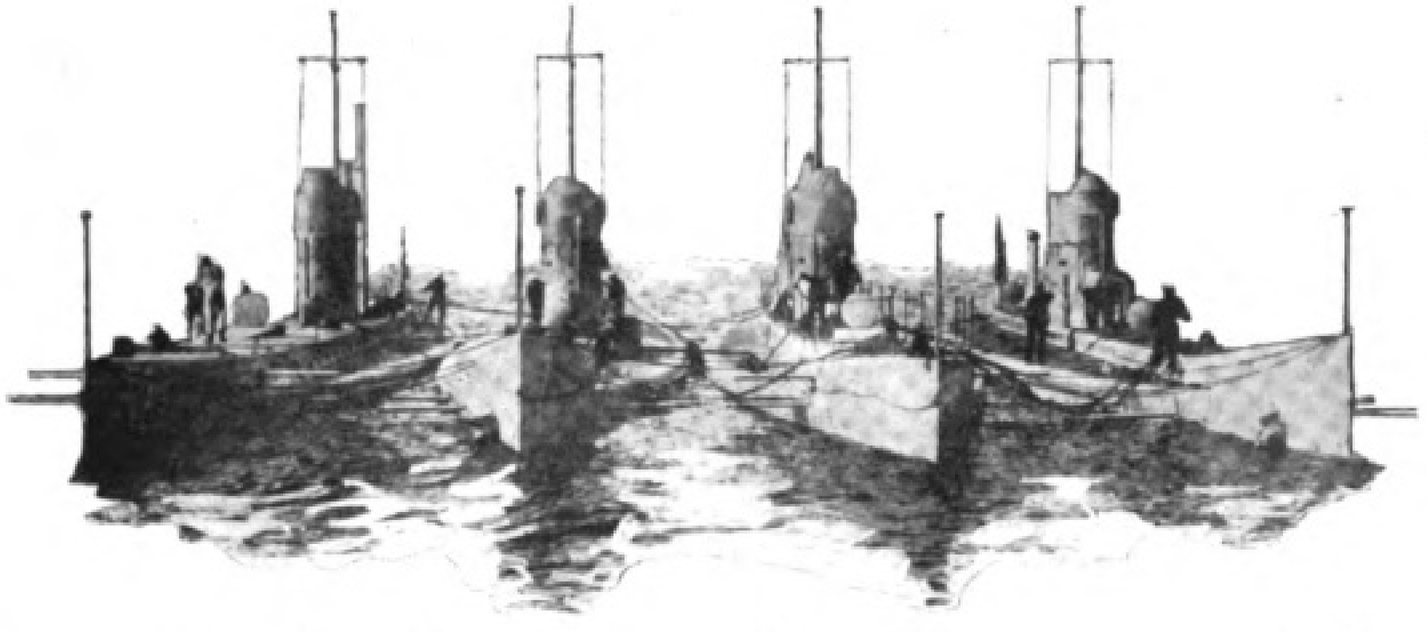
3. Substitute in equation (6) and solve for T. This is the tension under the load conditions at temperature t.

4. If this is above the elastic limit of the wire a lower value T_0 at 0°, no ice, no wind must be used and the calculations repeated.

5. Calculate a table for different temperatures giving the pull in the wires to be used in stringing, or the sag, or both.

These determinations having been made, we shall discuss the matter of aerial supports.

(To be concluded)



German U-boats of an early period, with the wireless aerials strung port to starboard instead of fore and aft

The Wireless Equipped Submarine

"IT'S pretty good to be alive," observed a quiet looking man seated at an inconspicuous table in a restaurant in Longacre Square. He looked about him with enjoyment. A lively orchestra was in action; the scene was gay and animated, and its novelty pleased him. He was in civilian clothes. Nobody suspected that here sat a submarine lieutenant of one of the warring powers who, only a few weeks before, had lived through a vivid romance of the sea.

"Yes, it's great," resumed the speaker. "But do you know to what I owe my life today? Ether waves—in other words, the wireless." He leaned toward his companion over the table, and, lowering his voice, he told a remarkable story.

Only three weeks before, on a beautiful moonlit night, the submarine which he commanded was cruising "somewhere" in the war zone. The men on deck were watching, far in the distance, a handsome three-master under full sail. Suddenly the ship sank, and so quickly that they thought their eyes had deceived them. Then came the crash of a great detonation under water. Instantly the vanished sailing ship came up out of the water with masts and decks aflame. Thus she floated until the fire destroyed her.

"When we finally reached the scene of the wreck," continued the lieutenant, "I found one of our companion craft, and her commander explained the amazing performance.

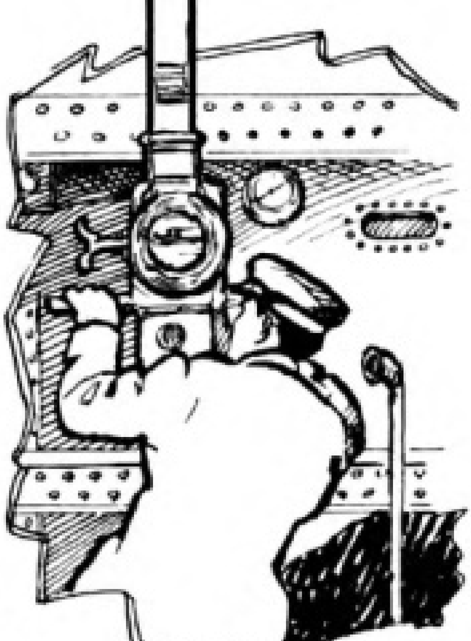
"The sailing ship had refused to stop on signal, and he sent a shell into her. The vessel was loaded with a cargo of calcium carbide, he learned later from two members of the rescued crew, and when she sank the water action caused an explosion in her cargo of chemicals, the force of which sent the sailing ship to the surface again, setting her on fire and eventually destroying her."

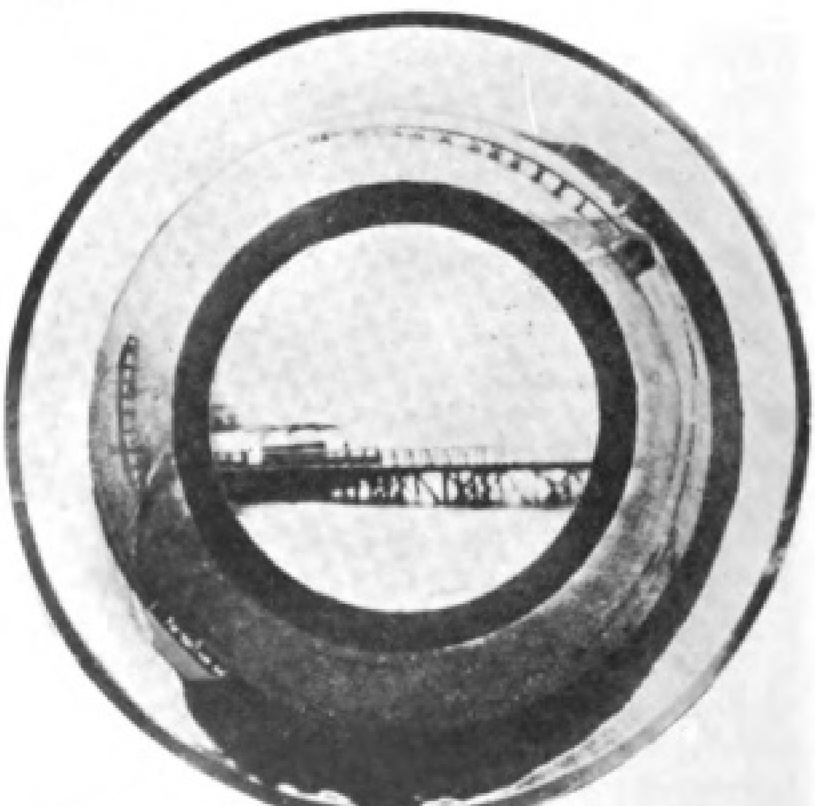
The quiet speaker then related more of his submarine experiences. While the officers of the two undersea boats were talking of the effects of the explosion, the wireless operator on board the

lieutenant's vessel was "listening in" on a wireless message which he had picked up. He at once reported that a steamship was not far away, which, judging from her wireless call, must be a transport. Use was made of the direction finder, and the two submarines at once parted company to go on a scout for the supposed transport.

"Towards evening," continued the lieutenant, "the bridge sighted a vessel without flags or lights, and nearby was a destroyer. The two craft were exchanging light signals, and observations made of the steamship betrayed her as the supposed transport. We dived at once, and from a distance of 300 meters shot a torpedo. Two strong detonations told the story that the target had been struck. When we rose to the surface, the destroyer had vanished, but far off we saw the transport in a sinking condition. We made all speed, but before we could arrive at the scene, she had gone down."

The lieutenant was silent for a moment. "We didn't distinguish her name at the time, but only recently she was reported by a certain Government as missing. We know now who she was."





The circular photograph shows the view through a submarine's periscope. The drawing shows method of operation

The two fellow submarines were in the meantime keeping in wireless communication. They learned that, owing to their combined activities, a destroyer flotilla was on the way to hunt them down. "Two hours later," added the lieutenant, "my wireless operator reported that active wireless messages were being interchanged by enemy craft, which were trying to locate us. That caused us both to leave for a safer field of operations."

The lieutenant, however, only ran into a new danger and lost his boat. "How did it happen?" The officer shrugged his shoulders. "You'll have to excuse me. I haven't made my report as yet. At any rate, we lost three of our men, and the rest of us were picked up by a neutral steamer."

Through the grace of the friendly skipper, the men from the wrecked submarine were included as members of his crew, and eventually landed at Galveston. They later made their way to New York, and soon expect to be on their native soil again.

"Yes, we'll soon be back in the war zone, I hope," added the lieutenant. "But as I said, the wireles saved us, for if we had ever run into that destroyer flotilla it would have meant good-bye."

It is not so unusual for the sailors from the air and ocean fleets of the belligerent countries who have lost their vessels, to pass through New York on their mysterious journeyings. The lieutenant's story was simply told. But it was eloquent in showing that probably no application of wireless telegraphy in warfare has proved so valuable as that which is installed on the submarine.

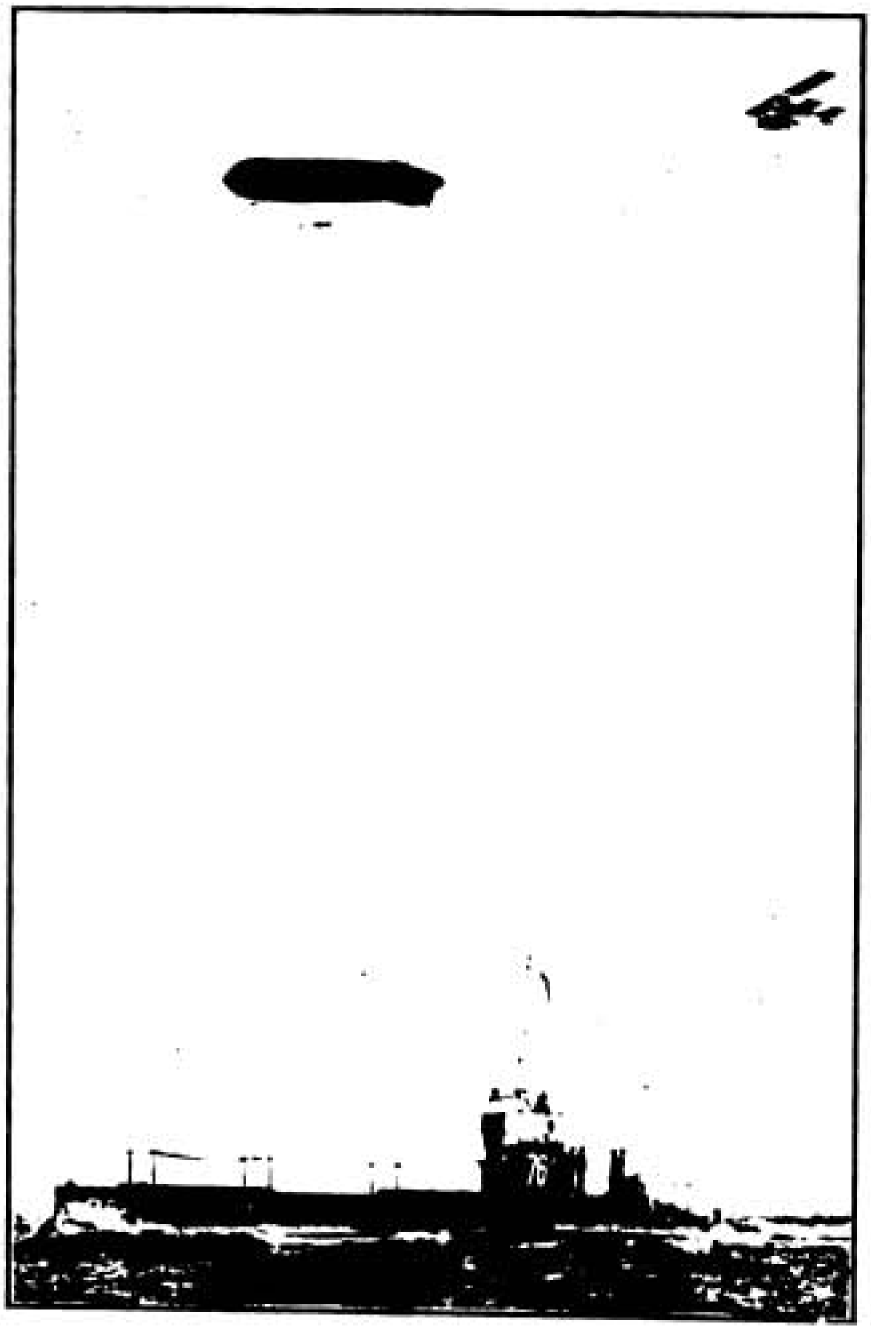
In this it supports the widely recognized fact that the wireless equipped submarine is regarded by America's naval strategists as the principal sea-scout and guardian of our country's coast line. In this it is the comrade of the wireless equipped aeroplane, which fulfills a similar duty in warding off danger from the ocean outposts of our national defenses.

The submarine and the aeroplane are American inventions. It is appropriate, therefore, that these two engines of offense and defense should be utilized in the protection of our Atlantic and Pacific coasts from any menace to the national life.

This conception of the value of the wireless equipped submarine was ably handled by First Lieutenant Meade Wildrick, of the Coast Artillery Corps, recent winner of a prize offered for an essay on the effect and development of the submarine upon measures for coast defense.

"The coast defense submarine," said Lieutenant Wildrick, "although more closely connected to our problem of coast defense than the fleet submarine, is also essentially a naval weapon. This type of submarine is, however, more or less dependent upon the existence of our permanent seacoast defenses in that they protect the navy yards and provide the submarine with a safe base from which to operate. The vessels assigned to this duty would probably be selected from the latest types of coast defense submarines in commission. To effectively perform their duties, they would be divided into divisions, with the necessary auxiliary ships, and stationed at strategic points along our coast and in our outlying possessions. Their duty would be to guard the coasts of the United States and vigorously attack any hostile expedition approaching our coasts. These submarines cannot, as some ardent admirers would have us believe, sink every hostile ship that threatens our shores. Nevertheless, their presence would undoubtedly have a great moral effect upon an enemy and, when acting in conjunction with our other weapons of coast defense, they should certainly inflict considerable damage upon any hostile expedition.

"The distribution and operation of these coast defense submarines in guarding our coast is, of course, exclusively a naval problem. In performing this duty the naval authorities should, however, work in conjunction with the War Department to develop such a system that would enable the United States to meet a hostile landing at any point by an immediate concentration of



The submarine and the aeroplane are American inventions. It is appropriate, therefore, that these two engines of offense and defense should be utilized in the protection of our Atlantic and Pacific coasts. The value of the wireless equipped submarine is explained in this article

all its forces, namely, coast defense submarines, complete units of the mobile army, and heavy mobile batteries of coast artillery. To accomplish this result it would, of course, first be necessary to develop the coast patrol of scout aeroplanes and fast patrol boats. This patrol should have a complete wireless system of its own, that it may be able to discover the approach of the enemy a day or even two days before it could attempt to force a landing. The enemy will be at the greatest disadvantage when he is disembarking his troops and covering his landing operations. This is the first time, therefore, that we must be prepared to attack him from both land and sea with all the energy and strength we can command.

"The duties of the harbor defense submarines would, in general, be as follows: first, to attack hostile ships, whether in the vicinity of our coast defenses, or when they are attempting to enter our harbors; second, to reconnoiter the water areas in the vicinity of our coast defenses, and to discover the position and movements of the hostile ships. This information would be specially valuable to our coast defenses at night or in foggy weather, when the water approaches to our harbors are invisible from the shore. Timely information of sudden attack or run-bys under these conditions would be invaluable to the coast defenses in repelling such attacks."

In the rôle thus to be played by the harbor defense submarines, it is self-evident that their wireless equipment would be an important factor in the transmission of timely information of enemy movements. Such craft may best be described as pickets, in constant communication with shore stations by means of wireless. This view of their utility is also held by Simon Lake, creator of the Lake submarine.

Mr. Lake is one of those geniuses of distinctive American type, the pioneer explorers into the unknown regions of natural forces, such as Morse, the Wright brothers and Holland. Considerable authority therefore attaches to the words of Mr. Lake when he expresses the opinion that, after twenty-two years of continual study and experience in designing and building submarine boats and appliances in the United States and abroad, that these boats are to take a place, to which they are rightfully entitled, as the mainstay of our national defense system.

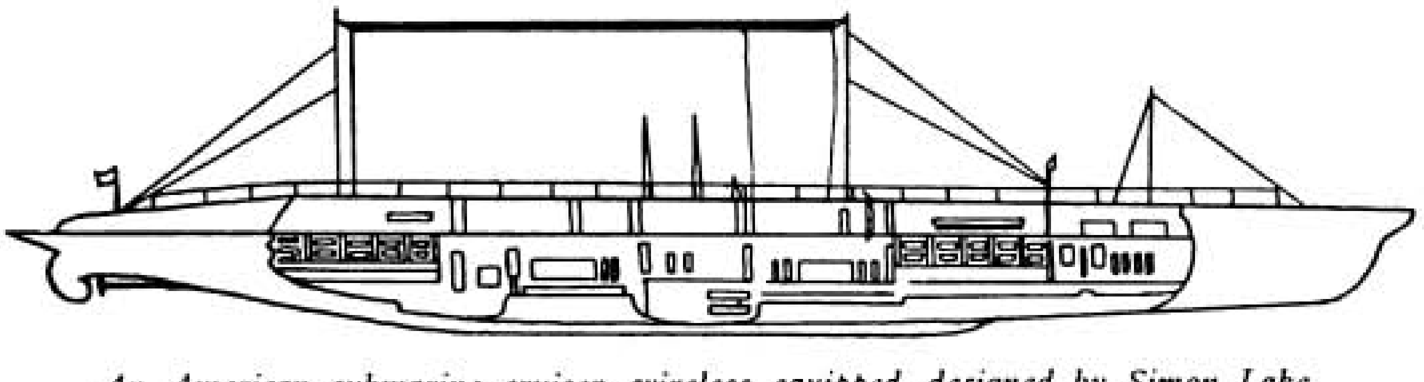
"Coast defense submarines," says Mr. Lake, "will probably be found to be the most important adjunct to any navy in every country whose policy it is to defend its own coast lines, rather than to become an aggressor. Vessels for this purpose do not need to be of great tonnage, nor of high speed. It is possible to get a speed of 14 or 15 knots in a submarine of about 500 tons displacement and at the same time have comfortable living quarters for the crew. A boat of this size may carry eight Whitehead torpedoes, each torpedo being capable of destroying a fifteen million dollar battleship, and as a 500-ton displacement submarine can be built for about a half million dollars and is capable of carrying eight Whitehead torpedoes, potentially good for eight $15,000,000, or a total of $120,000,000, worth of capital ships, it seems as if that would be sufficient to ask of one little submarine boat.

"A two and one-half million dollar boat for the defense of harbor entrances or seacoast cities would not carry as many torpedoes as five of the 500-ton boats. A torpedo fired from a small boat is fully as potent as one fired from a two and one-half million dollar boat. These small boats could be located at five different points on our coast, and the chances are that at least two of these smaller boats could reach an objective point on the coast line under their protection in shorter time than one large high-speed boat would be able to do. At the same cost, they could cover the same area of coast line to a much better advantage as there would be five of them distributed over that area instead of one."

Mr. Lake assumes for purposes of illustration that the Sandy Hook entrance to New York harbor is to be defended. He strikes a fifteen mile radius from Sandy Hook point, running from the Long Island to the New Jersey shore, and has four submarines take station on that radius line about five miles apart. "No ship," he says, "could pass that radius line without coming within the range of vision of the commander of the submarine. The oscillators, or microphones, now installed in all submarines, would readily detect the approach of a surface ship or ships. Communication by the Morse code, or other special codes, may be carried on by these between submarines up to a distance of several miles. It would be possible for groups of submarines on station, or picket duty, so to speak, to be in constant communication with shore stations, either by submerged telephone connections, or by wireless. In that way the submarines can be kept in constant touch with the country's scouting fleet of high-speed surface vessels or aeroplanes and immediately be notified of the approach of an enemy's fleet or ship.

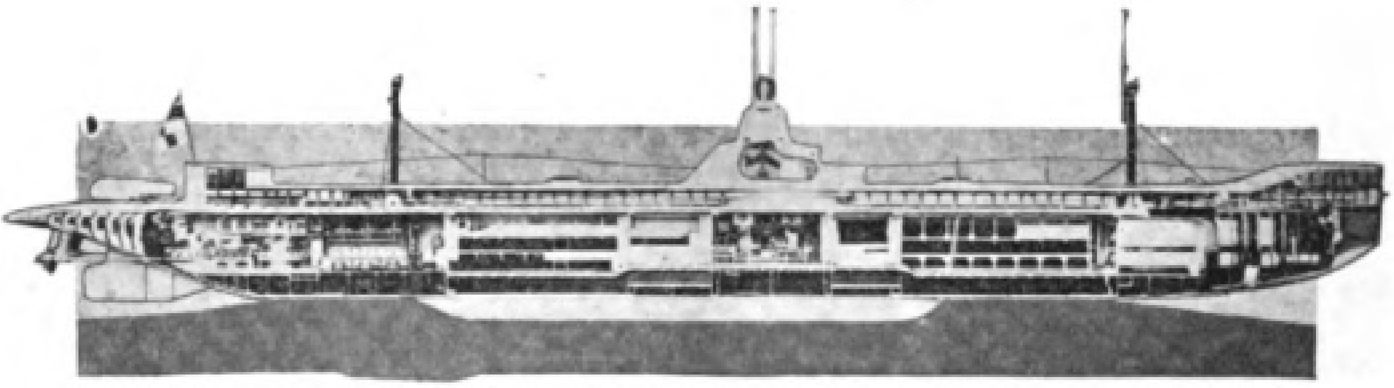
"A ship to enter Sandy Hook, therefore, would have to run the gauntlet of five or six submarines without it being necessary for them to leave their stations."

The wireless installation on the small submarines thus described, intended as coast scouts and harbor protectors, differs as a rule from the wireless equipment of the larger types of undersea craft. The coast patrol submarines of the German Navy have a wireless equipment similar to the portable wireless apparatus used by the armies in the field.



An American submarine cruiser, wireless equipped, designed by Simon Lake

The aerial is strung from telescopic masts, and is made of bronze, so that it may not be corroded by sea water, the apparatus being located in the interior of the vessel. When the submarine makes preparations to submerge, these masts disappear from the deck, being wound up by the interior mechanism. In fact, about everything disappears from the deck, in this eventuality. A German, describing his trip on a modern U-boat, said: "On boarding the U-boat, the first object meeting the eye is a tower-like structure, one meter high, in which several windows are fitted. This is the conning tower, which permits entrance to the boat's interior. Fore and aft a flat, rather narrow deck joins this tower. The forward deck is somewhat higher than the afterdeck. When floating on the water, this deck is about one and one-half meters above the surface, and is surrounded by a low railing. Besides the tower, one also may observe on the deck a signal mast, the antennae of the wireless station, a flagstaff and several tubes, which serve as ventilators for the interior of the boat, and as vents for the escape of motor gases. All these objects, even the railing, are removed before the boat submerges and are stored below deck. Only the conning tower remains in its place."



A cross section of a German submarine of an early type, the U-1, the first submarine of the German navy. Photograph of the model in Munich. The wireless mast was attached to the forward ventilator tube

On the larger U-boats, however, even the tower is telescopic in its upper part, and is partly withdrawn before the craft is submerged. On these larger U-boats, the wireless equipment consists of large collapsible masts, which are placed flush with the deck, or fastened to the sides of the vessel. The six German submarines completed during 1913-14, comprising U-25 to U-30, were vessels of 900 tons submerged displacement, with heavy-oil engines of 2,000 horsepower and electric motors of 900 horsepower. They had wireless telegraph apparatus on board and were specially constructed with long superstructures and high, collier-like bows to enable them to keep at sea in almost any weather. This type, however, since the war, has been greatly enlarged both as to size, motive power and radius of action.

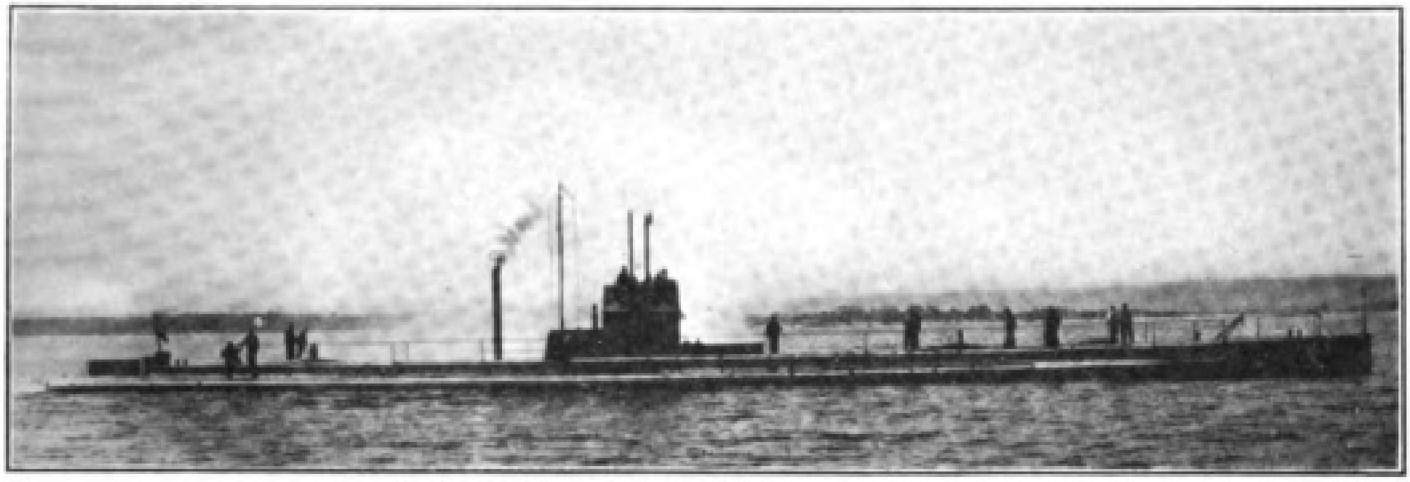
Wireless adaptations on the German U-boats have been subject to a great variety of changes since the war began. The various modifications may be indicated in part in some of the photographs published with this article. In the picture of a cross-section of a German submarine of an early type, the U-1, the first submarine of the German navy, taken from the model in the German Museum in Munich, one may see the collapsible ventilator tube on the forward deck, to which was attached a wireless mast. This is one of the type in which not alone the ventilator but also the wireless mast, structured of bronze, is wound up into the interior of the boat before the process of submersion. It may be seen that the prow has a superstructure, intended to protect the compartment carrying the torpedo tubes, so that these might not be damaged in the event of collision or ramming. The principle on which German submarines have since been built has been to accentuate the length of this bow, so that in the U-boats up to date it has been greatly extended, affording further protection to the room in which the torpedomen are stationed.

In another photograph of a German U-boat are shown the collapsible tower and the collapsible masts of the wireless equipment. In a third photograph are shown four German U-boats of an early period, and of two different types, all supplied with wireless masts. Contrary to the principle adopted by other nations, the aerials are not strung from fore and aft, but from port to starboard.

It is a fact, however, that the German U-boats of the latest and most powerful types, those of 1,500 tons and a cruising radius of 6,000 miles, have adopted wireless masts fore and aft of the conning tower. Another system of aerial has since been adopted, which has never before been made known. It is one by means of which the U-boat, small as the craft may be, is enabled to receive communications from its home port in any part of the world. Two balloons, with a stiff rod between them, are sent into the air to a height of at least 2,000 feet. These gas bags are painted partly white and blue, to make them indistinguishable from the sky. With an aerial at this height, naturally, there is no limit to the scope of wireless communication. When an enemy vessel is sighted, the wires controlling the gas bags are slipped down by means of an electrical windlass. To this arrangement may be attributed many of the remarkable achievements of the U-boats in warfare.

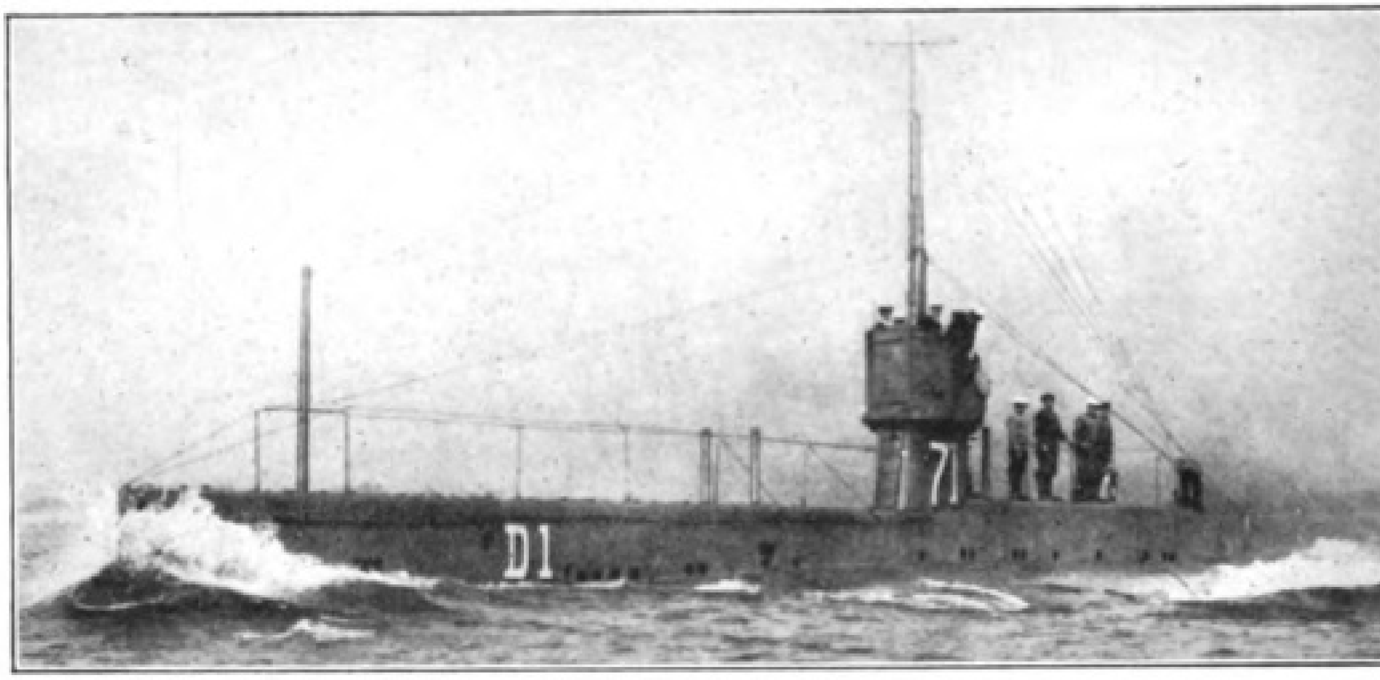
The British submarines of the "E" type, completed during 1912-14, are fine ocean going craft. More powerful than their predecessors, and also equipped with wireless apparatus, they are able to keep at sea in almost any weather.

In the American type of Holland boat, when preparation is made for a diving operation, the Kingston valves—or air-pressure valves—are tried, to see that they are in working order; meanwhile the deck is cleared of stanchions, and the wireless mast is turned down out of the way. As a rule this mast is lashed to the sides of the boat. All hatches are closed and water is admitted to the tanks until the deck, which is just below the base of the conning tower, is at the level of the water.



The modern German U-boat, officially designated as the latest available photograph of the new type of submersible with a cruising radius of several thousand miles. The recently constructed German submarines, photographs of which could not be obtained, have wireless masts fore and aft of the conning tower, instead of centered as in this illustration

The larger submarines, denominated as fleet submarines, of the Lake type, are high speed craft, considered valuable as commerce destroyers and for carrying on offensive warfare. This type of vessel is designed to carry torpedoes firing in line with the axis of the ship both fore and aft; it also carries torpedo tubes in the superstructure, which may be trained to fire to either broadside. These vessels are fitted with wireless and sound transmitting and detecting devices.



The British submarine, a fine ocean going craft, wireless equipped with aerial strung fore and aft, pyramid fashion

Electricity plays a part of growing importance in engines and apparatus designed for the conduct of warfare. Electrical apparatus of every conceivable kind is being utilized by the armies in the field and aboard the vessels of the navies of belligerents. The submarine more particularly has adopted innumerable electrical devices. It is a case where necessity is the mother of invention, since for its preservation when it dives beneath the water, the undersea craft depends upon storage batteries for power, light and heat, and when afloat, a further use of electrical energy is made in its application to the wireless equipment.

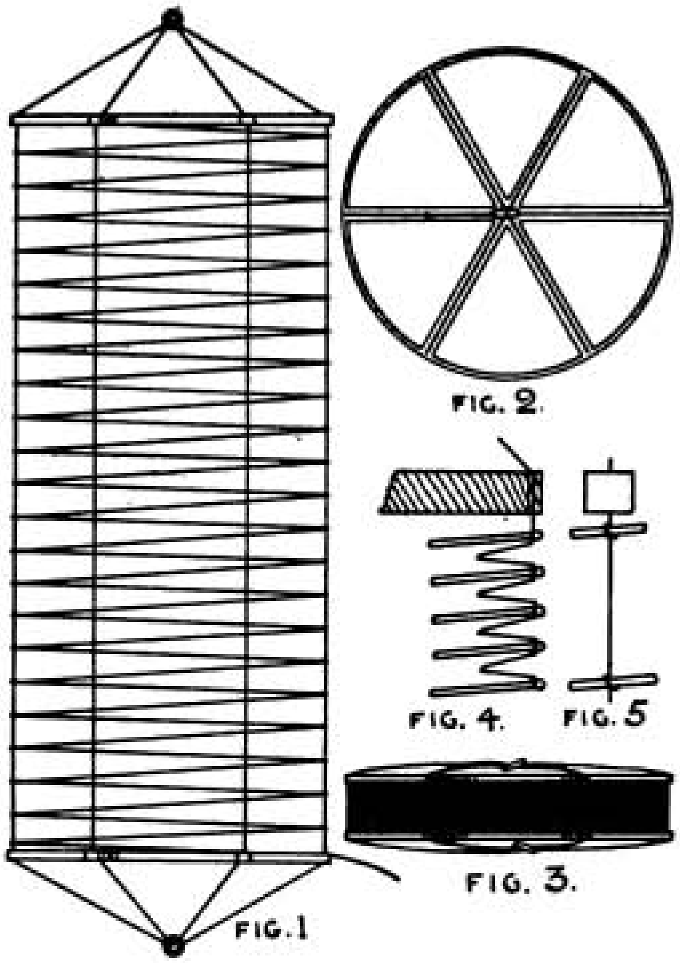
An English engineer, W. O. Horsnaill, recently gave an interesting description of the many applications to which electricity was put in the mechanisms of the undersea boat. The most important of all, he says, is naturally the application of electrical power for the propulsion of the vessel under water, when it is impossible to obtain the air needed for running the oil engines.

Many types of motors are installed in submarines, which are used for air-compressing, pumping, ventilating, heaving up the anchor, and other needs. All Cooking is done by electricity. In a 1,500-ton submarine no less than twelve electric motors are utilized, and this does not include the wireless equipment and the gyro-compass with which the under sea craft are now generally fitted. This exhaustive electrical equipment includes motor starters, switch gear and instruments.

In the design of wireless telegraph equipment for undersea craft, the widest diversity of invention appears in the antenna or aerial features. Aside from the mast-strung and balloon suspended wires already described, there are conducting surface deck plates, floats and collapsible towers of various kinds, some of which have been used experimentally and some not at all.

A portable and collapsible antenna which is now receiving favorable attention is the invention of an American, illustrated in the accompanying drawings. Fig. 1 shows an elevation of the antenna partly extended; 2 is an end view; 3 is an edge view, showing the antenna collapsed and ready for storage; 4 is an enlarged fragmentary detail showing the antenna partially collapsed; 5 is an enlarged detail in elevation.

The feature of this device is that the antenna may be of any desired length and, the wire being wound spirally, may be collapsed into small compass, as seen in Fig. 3. By attaching a rope to one of the insulators the antenna is quickly hauled up the mast or tower and put into immediate use. The members are formed of flexible but non-elastic material, such as oil silk.



A portable and collapsible antenna now receiving favorable attention

In the design of apparatus suitable for submersibles, the Marconi Wireless Telegraph Company of America leads with a new type of radio apparatus, a ½ k.w. 500 cycle panel set, made especially for submarines, the power being measured at the transformer primary terminals. This new submarine panel set is of the noiseless quenched gap type, the objectionable feature of noise in the operation being eliminated. It has also the high pitched penetrating musical note which is produced by high frequency apparatus and can be read through static when low frequency notes are unreadable.

A detailed description of the equipment is as follows:

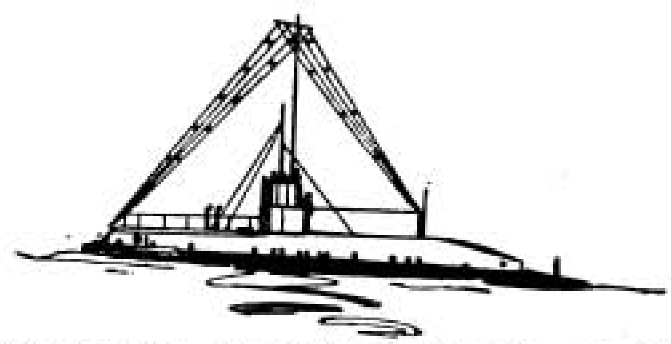
The set is a ½ k.w., 500 cycle, with quenched and rotary spark, and consists essentially of a complete transmitting apparatus and a complete receiving apparatus, together with the necessary accessories for operation and control.

The transmitter consists of a transmitting panel on which are mounted the measuring instruments, a variable inductance, a fixed inductance and a movable inductance, a spark gap and various switches and rheostats for controlling the wave-lengths and power emitted.

Two spark gaps are provided with the set. The quenched gap is mounted on the forefront of the transmitting panel. The rotary gap is mounted on the end of the motor generator. A switch is provided so that either gap can be used at will.

To operate the motor generator, an automatic starter is used in conjunction with a remote control switch. The latter can be installed at any convenient place readily accessible to the operator while on duty. If the noise from the motor generator interferes with his reception of signals, he can start and stop the machine from his table, thus eliminating the necessity of leaving his post to perform this duty. A dynamic brake is used in connection with this starter, so that when the current is shut off a resistance is connected across the motor terminals in such a manner that the machine is stopped in a comparatively short period of time.

The automatic starter mechanism and its appliances, together with a D.C. line switch, a generator field switch and an A.C. generator switch, is mounted on a panel just below the main transmitting panel. Marked terminals are provided for all wires



Detail view of aerial construction on the British submarine shown on the preceding page

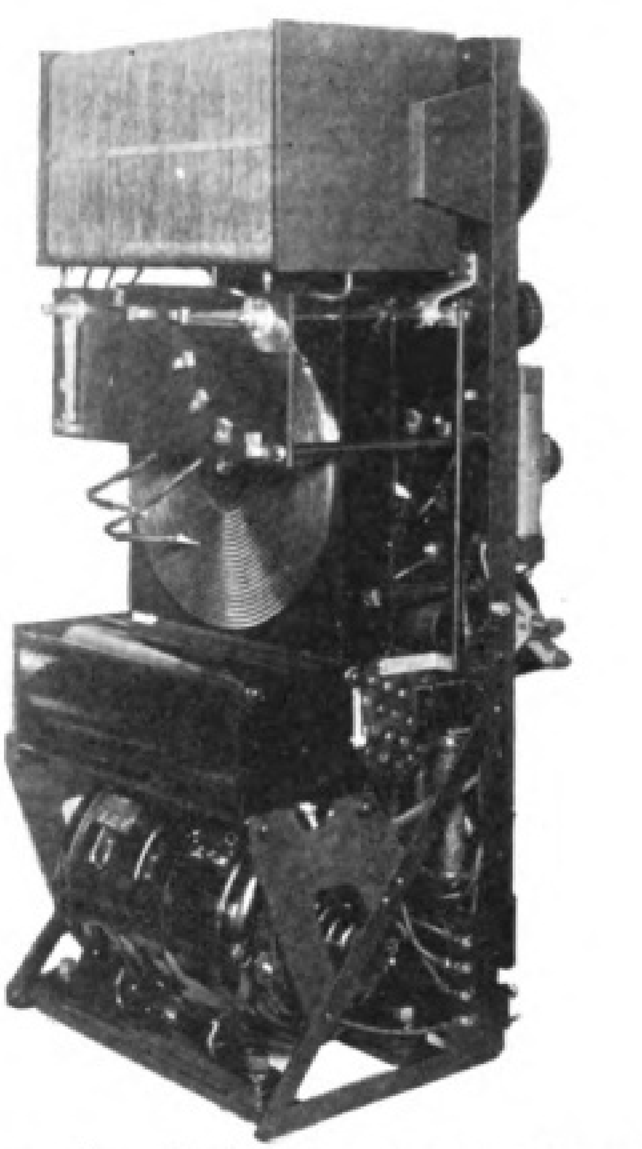
running from this board to other apparatus. The motor generator is mounted on a framework platform in the rear of the control panel, and the starting and stopping resistance is bolted on just beneath it. The starting and stopping resistance is contained in a separate sheet steel box, and is connected to the control panel by lead covered wires grouped together and called "Resistance Group."

The motor generator consists of a 110 volt direct current motor directly connected to a 120 volt, 500 cycle A.C. generator. The motor is so connected that it will operate on voltages varying from 95 to 115 volts with very little variation of speed from a normal speed of 2,500 R.P.M. A field rheostat is mounted on the transmitter panel for regulating the speed of the motor within narrow limits.

The generator is of the inductor type and has a normal open circuit voltage of approximately 350 volts and a working or load voltage of 120 volts. The voltage can be varied by means of a rheostat, which is mounted on the transmitting panel. The rheostat is in series with the generator field and permits varying the current through the field, which is excited from the D.C. line.

Six protective condensers are provided for the purpose of protecting the motor generator and transformer from excessive potentials, caused by the operation of the transmitting apparatus. These condensers each have one of their terminals connected together, and to the frame of the machine, the frame being connected to the ground. The other terminal of each condenser is connected to a terminal of the motor generator in such a manner that each terminal of the motor generator is connected to the ground through its respective condensers. The motor generator is connected to the control panel by means of lead covered wires in two groups, viz., "Motor Group" and "Generator Group." The lead covering of these wires is connected together and grounded to the machine frame and panel frame. The six protective condensers are mounted on and in the rear of the control panel.

The transformer is of the closed core type and is immersed in non-liquid oil. The primary is connected to the control panel by means of lead covered wires, which have their covering grounded to the transformer case and to the panel frame. The secondary of the transformer is brought out through two insulators on which the terminals are



Rear view of the Marconi submarine set, mounted on a single panel and generating ½ k.w. power

mounted. A protective gap is provided which permits a discharge to take place when the potential becomes excessive. The secondary terminals of this transmitter are connected to the terminals of the high potential condenser of the transmitting circuit. The elements of the transmitting circuits, with the exception of the spark gap, are all mounted on insulators back of the transmitting panel, and in such a manner that all changes or adjustments can be made by means of handles on the front of the panel.

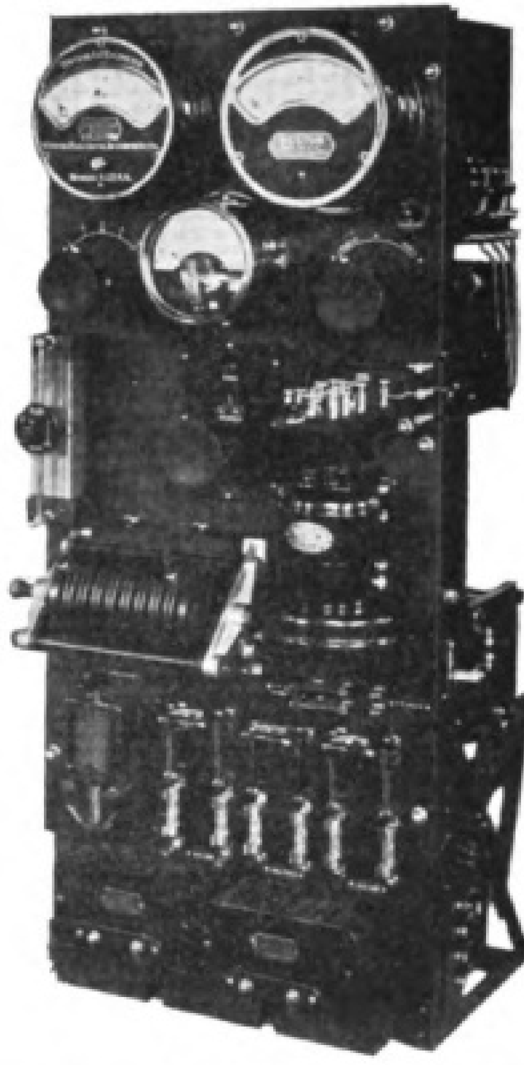
The transmitting circuit consists of a closed oscillating circuit and an open or radiating circuit, known as the "aerial circuit." These two circuits are inductively coupled. This coupling can be varied by means of a handle (marked "coupling") mounted on the front of the panel. The transmitting panels are so constructed that three different wave-lengths can be transmitted, viz.: 300 meters, 450 meters and 600 meters. The capacity in the closed oscillating circuit consists of a high potential condenser, the total capacity of which is .004 m.f. This condenser consists of four Leyden jars mounted on insulating supports, just below the top and in the rear of the transmitting panel, so that they can be easily removed when replacement is desired. The change of wave-length is made by varying the amount of inductance in the closed oscillating circuit. A switch handle marked "Wave-length" adjusts the closed circuit and at the same time indicates on the scale the wave-length setting.

The condenser jaws are calibrated for a capacity of .001 microfarad each. The amount of inductance in the closed circuit is fixed permanently at the factory and requires no further adjustment. The coupling between it and the aerial circuit is varied by moving the secondary coil in and out by means of a handle marked "Coupling."

The open or aerial circuit consists of a secondary inductance, loading inductance and aerial tuning inductance. These are all connected in series. The secondary inductance is movable relative to the panel. The loading inductance is variable by any desired amount by means of contact clips; and the aerial inductance is variable by means of a handle marked "Aerial Inductance." The outer end of the secondary inductance is connected to the earth through the thermo element of the radiation ammeter. Taps are taken of this inductance, at the necessary points, which, in turn, are connected to a switch controlled by a handle which varies the wave-length. This switch is for the purpose of varying the wave-length of the aerial circuit, and is called "Wave-Length Switch."

Another set of contacts is provided which connects with points on the loading coil of the aerial inductance. The inner terminal of this inductance is connected to the movable arm of the variable inductance. The outer terminal of the variable inductance is connected to the aerial circuit through the antenna switch. The object of these connections on the wave-length switch is to provide means for varying the amount of inductance in the aerial circuit, and at the same time maintain the necessary coupling between the primary and secondary circuit, without varying the distance between the two inductances. This permits changing the wave-length by throwing a single lever. A "Lightning Switch" serves to ground the aerial during atmospheric disturbances.

A change-over switch is provided in



Front view of the ½ k.w. 500 cycle panel set, designed by the American Marconi Company's engineers for submarines

the closed oscillating or primary circuit, which permits either the quenched gap or the rotary gap to be used at will. When the switch is thrown in position for using the rotary gap it is necessary to short-circuit the quenched gap. This is done by means of the clips which are connected to the same plate.

The receiver consists of a type 106 tuner and crystal detectors. This receiver consists of a primary circuit which has its inductance variable. One end of this inductance is connected to the antenna through the type S. H. switch. The other end of the inductance is connected to the ground through a variable condenser which can be short-circuited or inserted in the circuit at will. The secondary circuit is so constructed that its inductance can be varied, and also its inductive relation with the primary circuit can be varied. A variable condenser is provided which permits a variation of wave-length and also the variation of the ratio of capacity and inductance while maintaining the same wave-length. A battery and potentiometer are provided which permit controlling the current through the detector. A pair of head telephones is used for receiving the signals, while a buzzer is provided which permits the local excitation of this receiver so as to determine its condition of sensitiveness; also a battery which furnishes current for both the detector and the buzzer.

A type S. H. antenna switch is provided which, when in sending position, protects the receiving circuits from being excited by the transmitter, and when in receiving position cuts out the transmitter and connects in the receiver for reception. This antenna switch also has three auxiliary contacts which start and stop the motor, open the A. C. field, preventing disturbance from the generator, and also open the transformer primary circuit, so that signals cannot be transmitted while the switch is in receiving position. A single pole flush switch called the control switch is provided which, when closed, keeps the motor generator runinng continuously. This switch can be kept closed when the noise from the motor generator does not interfere with the reception of signals. When this switch is open the motor generator will start and stop as the switch is thrown from transmitting to receiving position.

A key is connected in series with the primary of the transformer. A series condenser is inserted in the aerial circuit between the aerial inductance and the type S. H. antenna switch, the object of which is to shorten the wave-length of the aerial for the operation on the 300 meter wave-length. If the natural period of the aerial is below 250 meters this condenser is not needed. It is short-circuited on other wave-lengths, viz.: 450 and 600 meters.

The radiation meter furnished with these sets is of the thermo type and consists of a wire heated by the aerial current which, in turn, heats a thermo junction, which latter operates a direct current instrument. The heating wire is connected in series in the aerial circuit and the indicating ammeter is connected to the thermo-junction by means of lead covered wires, the coverings of which are grounded.

A wattmeter indicates the power consumed in the transformer circuit. The current coil of this instrument is connected in series with the transformer primary and the potential coil is connected across the terminals of the transformer primary. This meter, therefore, indicates the power being consumed in the primary of the transformer.

To meet the Government requirements, provision is made for transmitting at a low power. This is accomplished by throwing a fixed resistance in series with the field, which, in turn, reduces the potential of the generator. In order to achieve this end, a switch marked "low power" is opened, at the same time connecting in one gap only of the quenched gap. This low power condition cannot be obtained when using the rotary gap.

The foregoing is a general description of the apparatus, and its object is to give a general idea of its type and functions.

The previous descriptions of the uses and utilities of wireless equipped submarines may have given a faint conception of the value to undersea craft of their radio installation. But what the radio set really means in all its bearings to the boat that floats under and over sea is known probably only to the commander and his operator. It represents the ears and even the eyes of the craft, the guardian that preserves it from danger, and the herald that announces the approach or proximity of its enemy. Through it, the undersea fighter has doubled in efficiency, the proof of which is contained in the daily news of raids and escapes directed by the unseen hand at a crackling key on shore.

How to Conduct a Radio Club

(Especially Prepared for the National Amateur Wireless Association.)

Receiving Detectors for Wireless Telegraphy

By Elmer E. Bucher

ARTICLE XXIV

THE members of a newly formed radio club frequently do not fully understand the properties, functioning, relative sensibility or the general instruction for the working of the various types of receiving detectors in use today. Hence they are not able to easily decide on the type of receiving detector best suited for the local requirements. For beginners in this class, there follows a description of the more important types of receiving detectors, together with additional advice for adjustment and operation.

Electrolytic Detector.—A receiving detector that has rapidly fallen into disuse since the discovery of the sensitive crystals is the "whisker point" electrolytic responder, although in the early days of wireless telegraphy in the United States it played an important part. The essential elements of this detector are indicated in Fig. 1 and the correct circuit for its operation in connection with an inductively coupled receiving tuner, in Fig. 2.

Referring to Fig. 1: The upright binding post, M, has the extended arm, R, through which is screwed rod A. The latter has soldered to the lower end a piece of platinum wire, W, having a diameter varying between .0001 and .000038 of an inch. This wire is known as "Wollaston wire" and was formerly used for another purpose. It is coated with silver to permit easy handling.

The fine platinum point dips into the glass cup, C, which need only be large enough to hold eight or ten drops of a 20 per cent. solution of nitric acid—the electrolyte. In the base of the glass cup is placed a small sheet of platinum, E, about 3-16 of an inch square, which is connected to the binding post, C, by means of a connecting wire placed under the hard rubber base.

Circuits for the Electrolytic Detector—The preferred circuit for this detector is indicated in Fig. 2, the important part of the diagram being the connection of the potentiometer and the local battery. The battery, B, should be one of five or six volts shunted by a wire wound potentiometer, P-2, of 300 to 400 ohms resistance. The telephones, P-1, may vary from seventy-five ohms to 2,000 ohms, the point of importance here being that they are well constructed and sensitive. The positive pole of the battery, B, should be connected to the fine wire point of the detector. The variable condenser, C-2, should have at least a maximum value of .0025 microfarad.

Operation—To adjust this detector to a sensitive condition, two rules must be observed. First, the fine wire platinum electrode must just touch the acid, in fact barely make contact with it; second, the silver must be removed from the platinum wire.

The silver coating may be removed by three methods: First, an abnormal value of battery current from the local battery, B, may be sent through the electrolyte with the platinum point slightly submerged. A hissing, grumbling sound is heard which, after a period of two or three minutes, tends to cease. The current from the local battery, B, is then reduced until a buzzer tester indicates a loud response. The second method is to remove the fine wire electrode from the holder and place it for a moment in a very strong solution of chemically pure hydrochloric acid, the point being removed at intervals and examined by the aid of a magnifying glass to determine the degree to which it has been "trimmed." If an extremely fine "whisker" is observed, the point is ready for use and to prevent further action of the hydrochloric acid, it should be dipped in fresh water. The third method is to heat a small amount of mercury over a Bunsen burner. If the platinum point is dipped into the hot mercury, the silver is immediately removed.

The support for the holder of the fine point, W, is preferably of another design, in fact the holding rod, A, had better be a square one entering the arm, R, through a square hole. The rod, A, is then moved in a vertical position by means of a rack and pinion. Since this design demands rather elaborate construction, the holder, shown in Fig. 1, is considered sufficient for amateur requirements, but it is of advantage to have a holder that prevents the platinum point from rotating during adjustment.

The amount of acid in the containing cup and the area of the surface of the lower electrode of the cell are unimportant with the exception that the upper point and the lower electrode should be separated by a distance of no more than ¼ of an inch.

It was the custom at commercial stations for a number of years to employ glass coated electrodes. The small platinum wire was sealed in a glass jacket with only the extreme tip exposed, and since the remainder of the wire was covered with glass, the depth to which the platinum electrode was lowered in the solution had no effect on the degree of sensibility obtained. The process of sealing the fine platinum wire in the glass is a little difficult for the experimenter inexperienced in glass-blowing, but one familiar with work of this nature should meet with no difficulty in constructing an electrolytic point of this type.

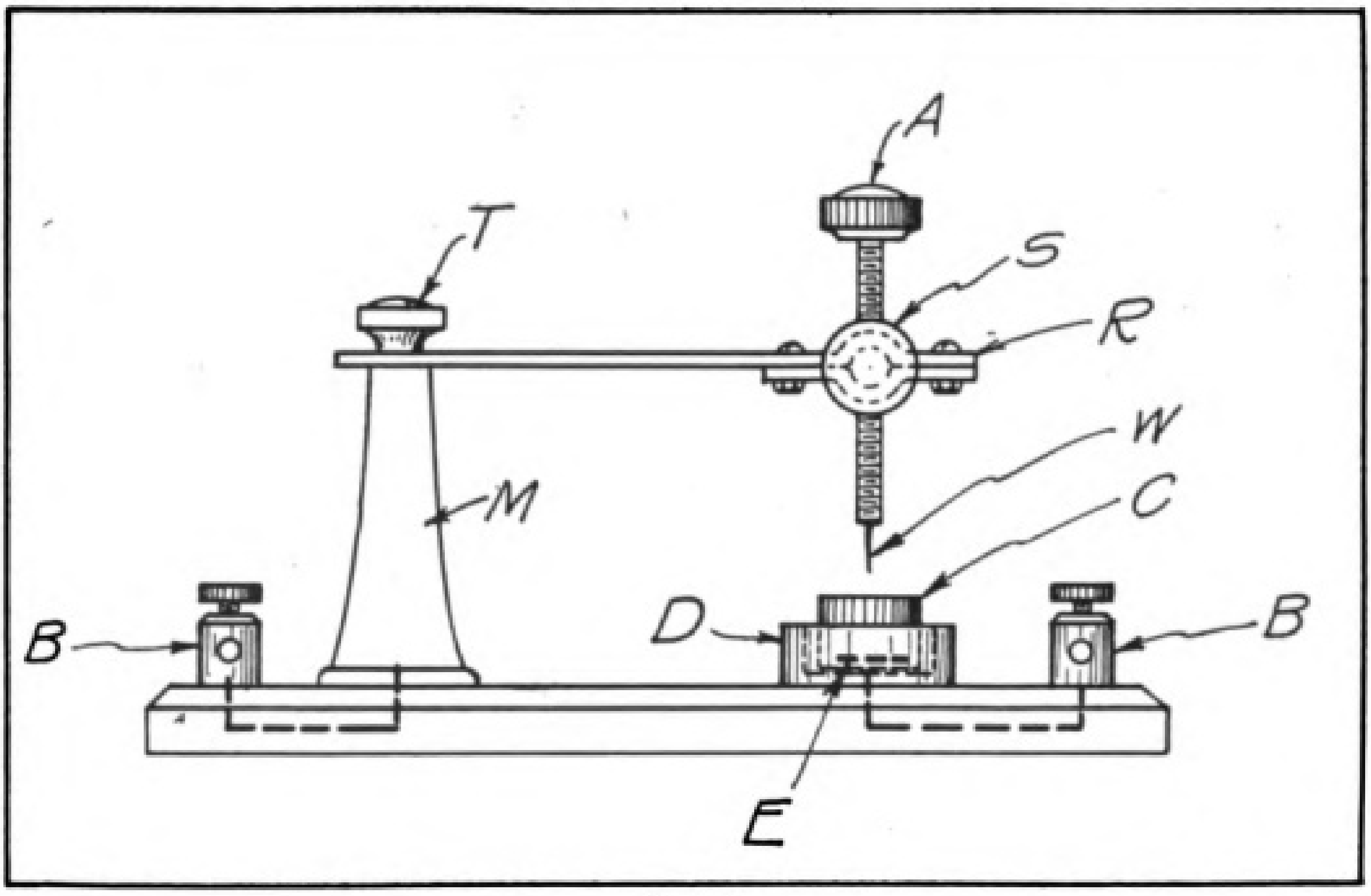


Fig. 1

Good results have been secured with the electrolytic detector by the use of a super-saturated solution of caustic potash, but the acid solution is more generally favored.

Several theories have been advanced regarding the action of the electrolytic detector; the subject is still a

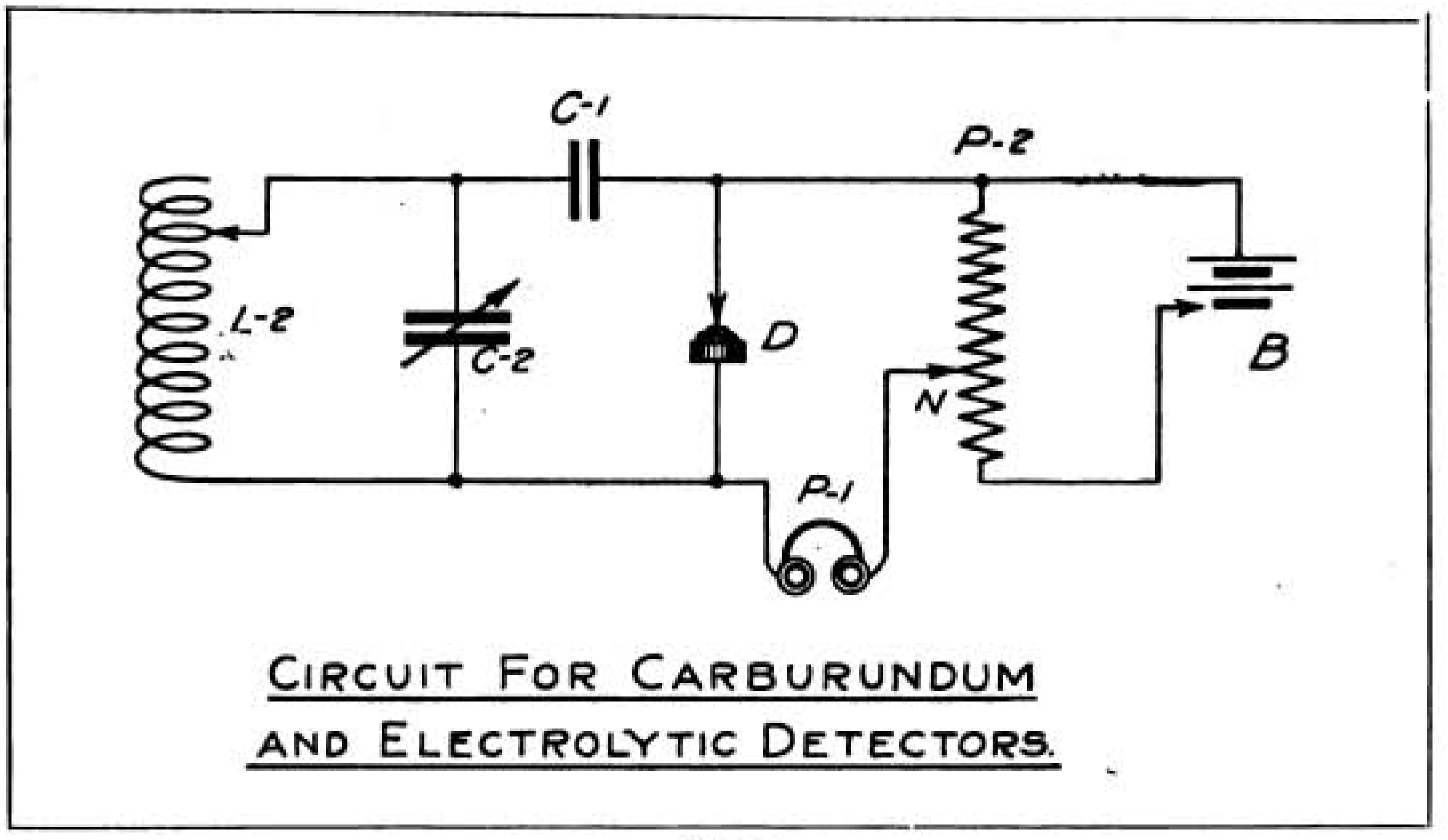


Fig. 2

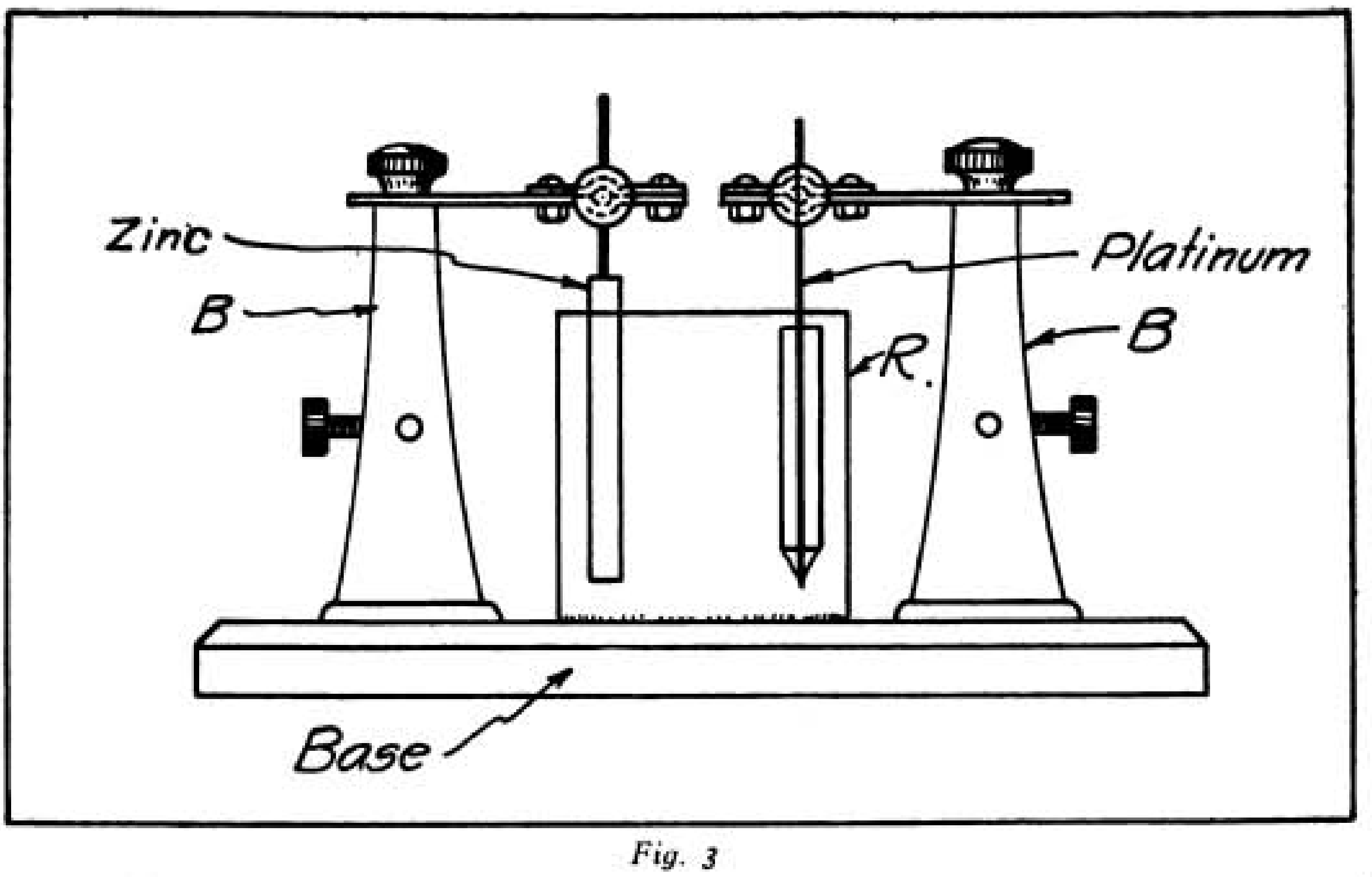


Fig. 3

matter of argument, but it seems to be the general opinion that the energy picked up by the antenna wires, which is transferred to the local circuit, causes a variation of the current from the local battery which, of course, results in the production of a note in the head telephones. For further discussion of the operation of this detector the reader is referred to some of the more important text books on wireless telegraphy.

It may be of interest to some experimenters to know that signals from the electrolytic detector can be amplified by means of a single vacuum valve. (See the book "How to Conduct a Radio Club.")

Primary Cell Detector—Another form of electrolytic detector, sensitive and reliable in operation, is known as the primary cell detector or the "Shoemaker Electrolytic." In addition to performing the function of a detector, it has the added property of generating its own battery current; in fact, it is nothing more than a small chemical battery constructed so it can be adopted for use as a wireless telegraph receiving detector.

The details of the device appear in Fig. 3. To a hard rubber base are fitted two upright binding posts, B, and the hard rubber or glass cup, R, having a capacity of about four or six ounces of electrolyte. The left hand element of the cell is a small piece of amalgamated zinc about one-third the size of that usually employed in dry cells. The right hand element is a small platinum electrode having a diameter of .001 or .0001 of an inch, sealed in glass, with the tip of the wire only exposed to the acid. The electrolyte is a twenty per cent. solution of sulphuric acid in which the two elements are immersed. If a telephone is joined across the two terminals of the primary cell a decided click is heard, indicating that an electric current is being generated. In fact, such cells have often shown an electro-motive force of 0.5 volt.

Circuit for the Primary Cell—The correct circuit for the primary cell detector appears in Fig. 4. The telephones, P-1, are joined across the terminals of the primary cell and may have a resistance of 1,000 to 2,000 ohms. The condenser, C-3, should be variable in capacity and possess a maximum value of .005 microfarad. Good results can frequently be obtained by connecting the head telephones in shunt to the condenser, C-3. Owing to the simplicity of this detector, preliminary instructions are not required. It is only necessary to insert the elements in the acid and carefully adjust the tuning elements of the receiving tuner until response from a given station is obtained. The only difficulty experienced with the detector is the fact that the platinum point will polarize rather rapidly which has the effect of reducing the sensitiveness. The accumulation of gas upon this electrode can, however, be destroyed by shaking the point, or the action is automatically performed by a severe discharge of atmospheric electricity at any given station. Occasionally it is necessary to remove the zinc electrode from the solution for a thorough cleaning, after which it should be coated with amalgam of mercury.

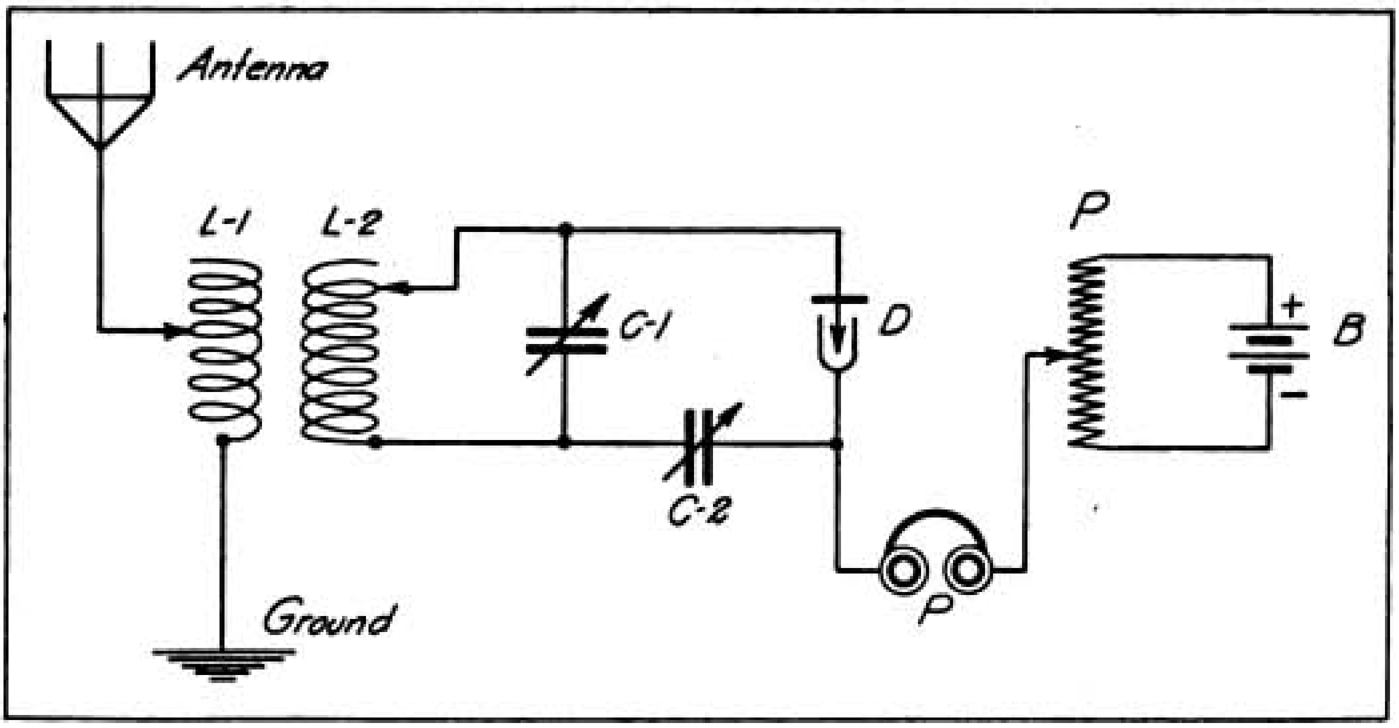


Fig. 4

A bare electrode of the type used in the "whisker point" electrolytic may also be employed for the primary cell, but, of course, the depth to which the electrode is immersed in the solution must be very carefully gauged. Experiment seems to prove that both of these receiving detectors require a secondary winding of rather low resistance, hence a receiving tuner employing No. 24 or No. 26 S. S. C. wire for the secondary winding may give the best results.

Both types of detectors are sensitive, particularly the "whisker point" electrolytic, which, when properly adjusted, compares very well with the sensitive type of mineral detectors. It is, however, not so rugged as crystals of carborundum and possesses the added disadvantage that severe discharges of atmospheric electricity burn off the fine wire point, putting the detector completely out of operation until a new point is prepared.

(To be continued)

EDITOR'S NOTE.—In the July issue of this magazine the author will continue the description of modern receiving detectors together with the details of the circuit best adapted for use with each. It is expected that beginners in the amateur field unable to obtain complete data on the subject will welcome the information given therein.

THE MACQUARIE ISLAND STATION CLOSED

The wireless station at Macquarie Island, located south of New Zealand, has been closed. Employed largely as a distribution point for meteorological reports, the station had a greater value than is generally known. New Zealand was approximately 600 miles distant from Macquarie Island and it took about one and a half days for a storm approaching from the island to reach the dominion. Therefore the Macquarie station was enabled to give New Zealand at least thirty-six hours' warning. Similar conditions applied to Australia. Melbourne, 1,200 miles away, received word of approaching storms three days before they reached the Australian coast.

The meteorological information obtained on Macquarie was also of considerable value in connection with the weather conditions of the world as a whole and for research work. The locality of Macquarie, it is said, has never been charted meteorologically. The anemometer recorded on one occasion a blow of seventy-six miles an hour.

The station is 4,000 feet above the sea level and, in order to avoid the ascent of the hill in stormy weather, F. J. Henderson, the operator, constructed a small receiving station at Eastern Harbor. The Macquerie station was frequently in communication with Awanui, Auckland, 1,500 miles away.

5,073 STATIONS IN THE U. S.

The Bureau of Navigation, Department of Commerce, has issued the 1915 edition of "Radio Stations of the United States." This list shows that there are now 5,073 wireless stations in the United States, an increase of 1,139 since 1914. They are classified as follows: Government and commercial land stations, 224; government and commercial ship stations, 895; special land stations, 118; general and restricted amateur stations, 3,836.

ILLINOIS MILITIA TEST SETS

To test the efficiency of its portable wireless telegraph instruments and to conduct experiments with its wireless field telephone, the headquarters detail of the Second Battalion, Field Artillery, Illinois National Guard, recently went on a two-day hike from Chicago to Willow Springs and back. The detail consisted of twenty-eight men, mounts, two wagons to carry instruments and wagons of the commissary department.

With the Amateurs

One evening recently the atmosphere over Indianapolis, Ind., was unusually crowded with wireless signals. It seemed that almost every one of the seventy-five local amateurs with sending outfits licensed by the government, was bent on saying something to somebody. Much of this, as is the case on any evening, was inconsequential, although it was dashed off in good style at a speed and with abbreviations, standard and improvised, that would make a good operator keep busy copying.

On this same evening the local militia companies were demonstrating their preparedness to visitors at the armory. Included in the program was the operation of a field wireless set. Some time after nine o'clock all local operators who were listening in began to hear this field set, easily recognized by its strange, high, wailing note. The militiaman in charge made several attempts to get in touch with local stations, which he evidently heard working. That he found all too "hot" for him was plain when he finally let out the following despairing cry through the ether, a confession not so much of unpreparedness, perhaps, as of nervousness under fire:

"I am demonstrating this set for visitors. For the love of Pete send slower, as they have put me on this job and I don't know a thing about it.

"(Signed) COMPANY A."

The Radio Club of Framingham has been recently formed at Framingham, Mass. The following officers were elected: President, Lawrence Potter; vice-president, Francis Twombly; secretary-treasurer, J. Louis Reynolds. Those interested in the club have been asked to communicate with the secretary at No. 20 Gordon street, Framingham, Mass.

The St. Paul's Amateur Radio Association, of Rochester, N. Y., is about to install at its headquarters one of the largest and most complete amateur wireless sets in the western part of New York state. The set that has been in use since the organization of the association will, in the future, be used for experimental purposes only. A new seven-strand phosphor-bronze aerial will be erected for the apparatus.

It is planned to have many residents of the city who have a knowledge of wireless telegraphy give lectures at the meetings of the association. It now has a membership of twenty-two persons, of whom nine hold licenses issued by the United States radio inspector at Cleveland.

The meetings of the association are held Friday evenings at St. Paul's Annex, No. 13 Vick Park B. Applications for membership should be made to E. Lewis Alexander, No. 34 Asbury street.

More than thirty amateur wireless operators met on the evening of April 25, in the rooms of the Central Y. M. C. A., at Albany, N. Y. Plans were discussed to co-operate with the U. A. Army in the event of war, and arrangements were made for a permanent organization. There are forty stations in Albany and about one hundred all told in the vicinity. It is planned to erect a powerful station at the Central Y. M. C. A., which will be the headquarters of the new organization.

Several of the amateurs operate powerful apparatus. J. Kenneth Hewitt, of No. 92 Willet street has an apparatus on the car house of the United Traction Company in Quail street which is capable of receiving a distance of 1,200 miles or more.

The club expects to affiliate with the National Amateur Wireless Association.

Larger and more convenient quarters for the Central Y. M. C. A. Radio Club, of Trenton, N. J., are being arranged in the Y. M. C. A. building. The apparatus will be taken from the third floor and installed in the older boys' reading room on the second floor, which is directly below the aerial.

This change will enable those who are not members of the club to see the work being done, and will also give the members a better chance to operate the wireless. At the present time the equipment is located in dormitories and certain times are set aside for its use.

At a recent meeting of the organization, John Pritchard was elected president. He is now engaged in installing a rotary spark gap.

Under the new arrangements there will be a bench on which there will be sufficient space for four phones, enabling four members to listen in and receive messages at the same time.

Following the regular weekly meetings each Wednesday evening, experiments are conducted, during which time each member makes an effort to improve his ability as an operator.

This feature is in the form of a contest, and the one showing the greatest increase in speed at the end of the month receives a prize.

A meeting of the Amateur Marconi Radio Association, of Troy, N. Y., was held on the evening of April 15, at the Y. M. C. A. Receiving practice in the wireless code was resumed. Plans were made for the installation of a high-power station in the Y. M. C. A. building. The matter of holding an exhibition in wireless during the Troy centennial celebration was discussed and several interesting pictures were shown by means of a projecting machine. Thomas Halloran of the United Traction Company spoke on "Transformers."

The Flatbush Signal Corps attached to St. Stephen's Evangelical Lutheran Church, Newkirk avenue and East Twenty-eighth street, Brooklyn, N. Y., has recently become affiliated with the National Amateur Wireless Association, whose membership comprises practically all of the government licensed amateur wireless operators in this country. Captain G. H. Smith, commanding officer, has been made a member of the military committee of the association, some of the other members of the committee comprising radio officers of the U. S. Army and Navy and others prominent in wireless work. Lawrence Barriett has been detailed by the National Amateur Wireless Association to take charge of the electrical work of the corps.

The corps has seventy-three members now and three platoons have been organized, with Lieutenant Barriett in command of the Third, or Electrical Platoon, which will include a complete radio set with a high-power apparatus and a field buzzer section, with full equipment to maintain actual lines of communication in the field.

A few weeks ago, the corps gave an exhibition drill of semaphore, buzzer, wig-wag and radio, in the Forty-seventh Regiment Armory.

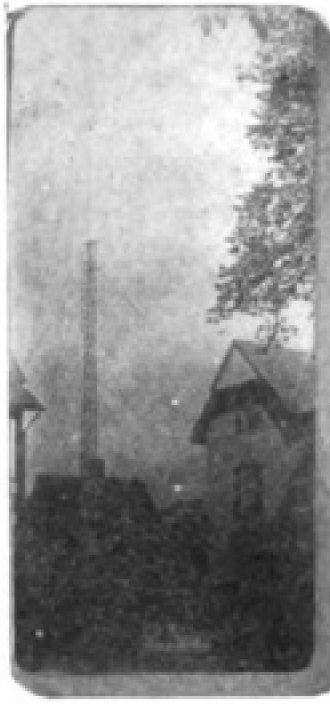
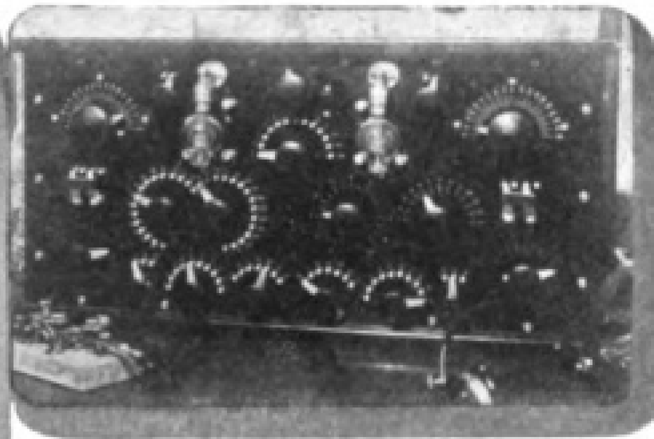
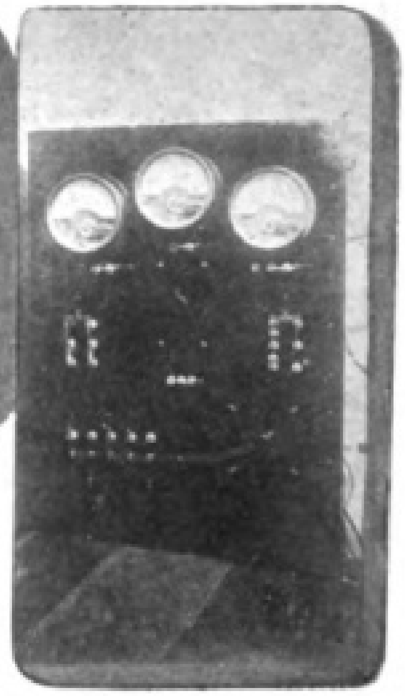
The corps expects that a number of its members will take the Government wireless examinations soon. More than thirty recruits have joined the organization recently.

The Wireless Club of the Bayonne, N. J., High School met on April 3, and discussed recent wireless activities.

The Holyoke Radio Club has been organized in Holyoke, Mass., with fourteen members. At future meetings a blackboard lecture will be given by one of the members and these lectures will deal with the vital points in the art such as the principles, construction and care of simple wireless instruments. Practice of the Continental code will also be an integral part of each meeting.

Correspondence is solicited from those who are interested. Letters should be addressed to P. H. Bloom, No. 9 Adams street, who is secretary of the club.

Members of the Watertown, N. Y., Radio Association who are checker enthusiasts took part recently in nightly long-distance games of checkers. This odd diversion has a number of devotees, and plans are now being made for a general tournament in which the entire per-

George U. Readio's well equipped station in Springfield, Mass. The call letters are 1-ZS. This equipment, according to description, is a good example of the standard which has been established by some amateurs

sonnel of the organization will participate.

In playing checkers by wireless, two boards, instead of only one, are used. The squares on these are numbered, while each set of men is lettered. By this system the various moves are easily designated and the game pursued without delays. Three hours were consumed in playing the first game some time ago. Now, however, it requires only a little more time to play off a wireless game than one contested in the usual way.

A good sized audience greeted Charles E. Apgar at the High School, at Westfield, N. Y., when Mr. Apgar repeated the lecture which he recently gave. He had added a number of experiments to those previously shown. Following the lecture Mr. Apgar presented to the school the greater part of the apparatus used.

The second class in wireless telegraphy met in the Gloversville, N. Y., Y. M. C. A., on April 19, and received instructions and code practice from Grant Patterson and Richard Sanford. The following have enrolled as members: Grant Patterson, Leonard Edick, Richard Sanford, Raymond Brown, Louis Cregg, Jay Enich, Leslie Frye, Samuel Morein, Leslie Satterlee, Maurice Sandler and Tony Rossi.

Though there are a large number of amateur wireless telegraph stations in Massachusetts, Foxboro is distinctive in having a wireless plant on and in a church parsonage. The pastor of the Congregational Church is the Rev. W. Elsworth Lawson, author and lecturer, as well as minister. His son, Elsworth Lawson, is responsible for the supports, aerials and wires that have been erected on the minister's home. One of the aerial supports rises in the shape of a 14-foot joist from the high ridgepole of the parsonage room, near the front; the wires are strung over the building to another support on the barn adjoining.

One room has been set apart in the second story of the parsonage for the operator's apparatus. Every night he receives weather predictions and time from Arlington, and picks up many messages sent from other stations.

Many members attended the last meeting of the Washington Radio Association of Trenton, N. J., at the headquarters in the Washington Market Building. Following a short business session, Edward Knowles read a paper on "The Correct Operation of the Loose Coupler Tuner." He made a thorough explanation of the proper adjustment and advantages of the loose-coupler. Amery Parichy talked interestingly on aerials, grounds and some freak experiences. Frank Silvers told of the various apparatus used in the United States Naval Radio Service. President Martin Pillsbury spoke of the Brooklyn Navy Yard Radio School and explained a receiving ticker by showing the instrument in operation. Following these talks the members practiced receiving and sending on the apparatus in the club room. Every member is now licensed; half of the members have second-grade operators' licenses and one has a first-grade commercial license; the other members have first-grade licenses for amateurs. A blackboard has been placed in the club room with which to explain diagrams.

Meetings are held every Monday and Thursday evenings.

The Minnesota Wireless Association, formerly the Minneapolis Wireless Club, recently offered to transmit messages by amateur relay for experimental purposes. As a result messages poured in addressed to China, most of the United States and various parts of Mexico. Messages received up to April 10 were sent, but the club then decided to withdraw its offer.

Most of the messages contained greetings. Seattle, Tacoma, and other cities were reached successfully, demonstrating that the amateur wireless system of the country could be used in an emergency.

The "Wireless Bugs' Union" was organized at a meeting of the association held on the evening of April 7 to inject "pep" into the association's membership campaign. Its first work will be to organize all amateur wireless operators in Minnesota and provide them with code calls. A code book is being prepared.

A meeting of the association was conducted by wireless on April 3. Claude Sweeney, president, is radio operator for the International Milling Company at New Prague, Minn. He presided at the Minneapolis meeting.

Dots and dashes told Sweeney that motions were being made and seconded in Minneapolis. He responded in his official capacity by wireless. Paul Johnson, chief operator, received Sweeney's signals.

George Pope of the Greenpoint Radio School, of Greenpoint, L. I., has offered his services to organize and recruit a signal and radio corps for the Fifth Regiment, United States Boy Scouts. He will instruct members in signaling and wireless.

C. C. Langevin addressed the members of the Radio Club of Hartford, Conn., recently in the rooms of the Automobile Club of Hartford. Besides relating incidents on the peace ship Oscar II, Mr. Langevin described other voyages. One of the most eventful of these was the trip to Stockholm last November of the Standard Oil tankship Baturia. In addition to exceedingly rough weather, the voyage was marked by several incidents of interest. The climax of the trip was reached when a British cruiser brought the vessel into Kirkwall, where it was detained for three days before it was allowed to proceed across the North Sea to Stockholm.

At the meeting of the club it was announced that a first class wave-meter had been bought, and that Theodore Newhouse would devote two hours a week to helping members of the club tune up their wireless sets to 200 meters, in accordance with the requirements of the United States government for amateur stations.

For the purpose of organizing a state radio association, the wireless operators of North Dakota met in convention at the State University at Grand Forks, on April 21 and 22. Thirty-nine stations, representing twenty-two cities of the state were represented.

The matter of meeting government requirements has been taken up by many stations and a large percentage of operators in attendance at the convention were able to present government licenses. The convention was called by R. T. Jacobson, Fargo; C. D.

Curtis, Pembina; A. L. Smith, Fargo; P. H. Teal, Devils Lake; Dr. A. H. Taylor, Grand Forks, and M. E. Todd, Wahpeton.

Fargo leads in the number of radio stations, having ten; Grand Forks has six and other towns having stations are Aneta, Bismarck, Carrington, Devils Lake, Edgeley, Harvey, Havana, Hatton, Hope, Jamestown, Kathryn, Mandan, Mayville, Minot, Pembina, Russell, Tioga, Wahpeton, Washburn and Williston.

The first class in radio telegraphy recently met at the Y. M. C. A., in Gloversville, N. Y., and received instructions from members of the Gloversville Wireless Association.

The Inter City Radio Association of Allentown, Pa., held a meeting in the Y. M. C. A. on April 11. Several new members were admitted. In the absence of the regular presiding officer, the secretary, William J. Kreis, acted in his place.

Station of J. Weiss, Port Washington, N. Y., an excellent type of a high-grade amateur equipment

At the present time the association has eleven active members, about half of whom hold licenses to operate wireless outfits. A movement is now on foot to enlist all those in the vicinity who are interested in wireless. All interested should communicate with D. H. Goodling, at the Y. M. C. A., any Monday after fifteen minutes after eight o'clock in the evening.

The Radio Club of New Britain, Conn., held its weekly meeting in the Y. M. C. A. on April 11. President Mulvihill presided. The club has displayed much interest in the theory of sound, and Mr. Yuon, who has been investigating the subject, made a report of his findings.

The club has been looking over a list of lectures on wireless subjects, and has arranged to have Clarence D. Tusku of Hartford appear before it in the near future.

All of the committees reported progress in their work, the committee on publishing the club's book stating that the publication will go to press soon.

Elwood Littlefield, who has an amateur wireless telephone station in his home, at Sheepshead Bay, Long Island, recently picked up a call that he believes came from Montauk Point, according to a newspaper.

"Want to hear something on the graphophone?" queried a man's voice.

Some station, being without a wireless telephone transmitter, replied in the telegraph code. The answer must have been in the affirmative, for presently the air was filled with "Tipperary." At the conclusion of the concert warm thanks—in code—were projected from half a dozen stations that had been "listening in."

Under the direction of the Radio Club of Rochester, N. Y., a wireless outfit will be installed on the roof of the Y. M. C. A. building at Gibbs street and Grove Place. This was announced at a meeting held April 23, in the association building. The apparatus will be of 1 k.w. power.

The Eastern District Young Men's Christian Association of New York City has organized, in connection with its wireless telegraph school, a new radio club, to be known as the Eastern District Marconi Club.

This club is a member of the National Amateur Wireless Association, and will enable many amateurs to make interesting experiments, carry on communication at stated intervals and aid radio service generally.

The long-distance receiving set, about to be installed, has taken messages from Nauen, Germany; Glace Bay, Nova Scotia; Key West, Florida, and other distant points.

E. E. Bucher, instructing engineer of the Marconi Wireless Telegraph Company of America, who is honorary president of the club, will explain and adjust the apparatus for the uniniated before or after regular class sessions, Monday and Thursday evenings.

Members of the Radio Club have invited other amateurs to join the organization. Henry Flack is vice-president of the club and Ralph Greenmann is secretary and treasurer. Additional information regarding the organization can be obtained by addressing the secretary at No. 158 Berkeley place, Brooklyn, N. Y.

The members of the Pilgrim Boys' Club of Attleboro, Vt., which was organized and elected officers recently, have announced that they intend to begin immediately the work of collecting funds to purchase a wireless outfit.

At a recent meeting of the Binghamton Progressive Radio Association of Binghamton, N. Y., the following officers were elected: President, William Simons; vice-president, Mr. Adams; secretary, LeGrand Bush; assistant secretary, A. Hollister; treasurer, Roland Beers; assistant treasurer, Mr. Cowperthwaite; sergeant-at-arms, Richard Bush.

Mr. Kingsbury, the former president, was elected honorary president and made a brief address.

The club has a large membership, owns its own clubhouse and is rapidly growing. It has experimented with several types of wireless apparatus and is now installing a high-grade radio set. Persons wishing to communicate with the club should address the secretary, LeGrand Bush, No. 255 Main street, Binghamton, N. Y.

A convention of the amateur wireless operators of Snohomish county, Washington, was held recently at Harvey Bancroft's station, No. 3024 Kromer avenue, Everett, when the Snohomish County Radio League was organized. The president of the new league is Kennil of Monroe; Harrington of Startup, is vice-president; Arthur B. Cook of Everett, secretary; Arthur Dailey of Everett, treasurer, and Harvey Bancroft of Everett, inspector. The purpose of the new organization is to bring about better communication among amateurs.

The club will meet the first Saturday evening of each month. The club hopes to include every amateur in the county in its membership. The charter membership list will be kept open for three months. All interested in wireless are invited to attend the next meeting of the club.

A wireless apparatus has been set up in the high school at Poughkeepsie, N. Y., with aerials on the roof of the building. It is used by a class in physics, of which Carlton B. Olds is teacher.

Wireless experimenters and amateurs throughout the South have organized for the purpose of offering their service to the United States government in the event of war. The men have formed an organization, which is know as the Fifth District Radio Club, because the South is known in the commercial radio field as the fifth district in the United States.

The members of the club are being trained in government requirements. They have at their disposal a modern equipment, including an aeroplane.

At the first meeting of this organization, held recently, Walter A. Taylor was elected president and C. Ashley Coe, secretary.

The headquarters of the club have been established in the instruction rooms and office of the school for the training of commercial operators, located in the Y. M. C. A. building, No. 815 St. Charles street, New Orleans, La. Warren C. Graham and T. George Deiler, instructors of this institution, have been made honorary members. The club is not connected with the training school.

Not only does the club contemplate assisting in the preparedness movement of this country, but it proposes to join organizations throughout the North and South and co-operate in the transmission of amateur messages across America. The newly formed club is described as the first of its kind to be organized in the South.

As soon as the club is placed on a permanent working basis, Secretary of the Navy Daniels will be called upon to accept the services of the club.

The Radio Association of Maryland was organized in October, 1915, with the object of developing the less advanced members into licensed operators. Since its formation the membership has nearly tripled. The association is planning to buy a wave-meter and a hot wire ammeter.

Correspondence should be addressed to the secretary, Rudolf Dimling, Bancroft Park, Md. The association's call letter is 3ARK.

The Radio Club of Rochester, N. Y., held its second meeting of the month at the Y. M. C. A. building on April 22. About forty members of the club were present, and several matters of interest to radio enthusiasts were discussed.

The club has extended an invitation to amateurs to attend its meetings. The object of the club is to instruct the future operators in such a manner that, if it should be found at any future time that the country is in need of radio men, they will be able to acquit themselves creditably.

The club is planning to install a 1 k.w. set of apparatus in its club rooms as soon as sufficient funds can be obtained.

The Radio Club of Irvington, N. Y., which recently received its charter from the National Amateur Wireless Association, gave a benefit performance at the Liberty Theater in that village on May 2. A feature of the performance was a demonstration of wireless telegraphy made by the vice-president. By means of an amplifying arrangement attached to a panel set designed and built by Harry L. Dearborn of Lincoln, N. H, the audience heard the weather and time signals sent out by Arlington.

The club has received requests for another demonstration. The aerial—400 feet long and sixty-four feet high—which was erected especially for the event, will be left in position, the organization having planned to install a receiving set for baseball scores and weather reports to be flashed on the screen. The members of the club are preparing to produce a play that will require the use of a complete sending and receiving set.

How Wireless Has Served the Sea

Part II

Stories of Vessels That Were Rescued After They Had Been Wrecked on Rock and Shore

Operators Who Have Distinguished Themselves by Acts of Heroism in Time of Peril on the Ocean

"BIG White Star Liner Baltic Aground In Fog!"

One day, nine years ago, this alarming headline was paraded on the front pages of all the New York newspapers. The news of a great passenger vessel being aground in a busily frequented channel embraced all the potentialities of danger. For years such accidents had been sources of deep concern to those whose loved ones were aboard outbound or inbound ships. Mishaps of this nature so frequently had dangerous consequences.

But scarcely had the newspapers sent word of this happening broadcast on May 8, 1907, when all alarm for the safety of the vessel and its passengers was suddenly banished. The Marconi wireless message had sent its cheering note ashore, asking assistance for the distressed vessel, and giving the public assurance of the well-being of all on board.

The Baltic had left the foot of West Eleventh street, New York, bound for Liverpool, but two hours later she had gone aground while passing out of the Swash Channel. News of the grounding was at once received in the White Star Line offices, and passengers began to use the wireless to notify their friends that the vessel was fast in the mud and could not proceed, but that there was no need for worry since help was coming and safety was assured.

Captain Smith, the marine superintendent of the White Star Line, and several officials were already on their way on a tug to inspect the distressed vessel, and found her hard and fast on the shoals off Sandy Hook. The wrecking tug William E. Chapman was also proceeding to the Baltic, and soon the great passenger steamship was set afloat and steamed without further mishap to her port across the ocean.

Of all sea happenings, probably the most numerous are those in which vessels strike submerged rocks, or are stranded on the everchanging sands of narrows or treacherous bays and coasts. Here also, as in the case of fire at sea, or collision in midocean, or other casualties braved by floating ships, the Marconi system has stood the test with honor, the wireless never failing to bring aid to craft and crew and passengers. And the men of the Marconi service here also unhesitatingly face danger and death, living up to the fine unbroken tradition of efficiency that typifies the service.

It was only several months before the mishap to the Baltic that, at a foreign port, a like service was rendered to a distressed vessel, when the steamship Preston, on January 20, was stranded in similar fashion on Courtown Gays, St. Andrews Island, about 170 miles from Port Limon, Costa Rica. Assistance was summoned by wireless and all on board were rescued.

An accident of like nature also happened to the steamship Seminole of the Clyde Line, on March 25, 1908, when she ran ashore at Point Pleasant, N. J., in a dense fog. The Clyde liner was in a more precarious position than the Baltic, however, for she began to pound heavily on the bottom, to the great alarm of the passengers. The distress call was sent out along the Jersey coast, speedily bringing wrecking tugs and life-saving crews to her assistance.

The United States revenue cutter Mohawk would probably have been pounded to pieces on the rocks of Hell Gate, on February 26, 1909, had not the appeals for help sent out by her wireless operator met with a prompt response. After having been buffeted by heavy gales and seas for six days, while searching for a derelict off Nantucket Shoals, the Mohawk, while on her way to Tompkinsville, struck on the Little Hogback, one of the rocks in Hell Gate off Ward's Island, and remained there leaking badly, her bow resting on two dangerous rocks, which threatened to tear a hole in her bottom with the fall of the tide. News of the accident was flashed to the Brooklyn Navy Yard by the wireless operator aboard the cutter a few minutes after the vessel struck. On behalf of Captain Landry, Commander of the Mohawk, he asked that the Navy Yard tug Powhatan and a transfer lighter be sent to the wreck as soon as possible. A second message was afterward sent to the Navy Yard for the Merritt-Chapman Company, requesting that two pontoons and a diver with a lighter be dispatches to the Mohawk without delay. A vessel situated as the Mohawk then was, could not possibly have summoned such varied and expert assistance in any other way than by wireless, which made her salvage possible.

The dense fogs that drift along the New England coasts are prolific sources of danger to coastwise steamships that creep their way through them, sounding their sirens. The steamer Massachusetts, owned by the New Haven Railroad and bound from Boston to New York, was suddenly in a precarious plight on the morning of March 11, 1909, when she grounded near Cedar Tree Neck, Vineyard Sound, Mass., while groping her way through the thick fog. She struck on the rocky bottom, and her forward compartments immediately sprung a bad leak. Her wireless operator quickly sent the calls for help to the Point Judith station, through which they were transmitted to Newport and New York. The revenue cutter Acushnet, stationed at Wood's Hole, went to the steamer's assistance shortly after dawn, and her passengers were safely transferred.

Loren A. Lovejoy, whose quick wit facilitated the rescue of the Hanalei's people

The quick summoning of aid by Stanley Coles, Marconi operator on the Cunarder Slavonia, on June 10, 1909, resulted in the rescuing of 410 lives, which would undoubtedly have been lost had it not been for the wireless message service. The Slavonia, then one of the crack carriers running from New York to the Mediterranean, went ashore on a reef off the southwest end of the Flores Island, one of the Azores group. The steamer Princess Irene, of the North German Lloyd, was 180 miles away when she picked up the

Men attached to the Bolinas station helped victims of the Hanalei wreck to reach shore

help call—C Q D. Her operator answered and immediately received a reply, stating that the Slavonia was ashore and where, and asking the Princess Irene to come to her assistance. Calls had in the meantime been heard also by the Hamburg-American Line steamship Batavia, and 300 passengers were transferred to her. The other passengers and the crew were saved before the Slavonia became a total wreck.

Then within a few weeks of each other, two vessels went ashore, one on the Atlantic and the other on the Pacific coasts, in each case both ships and cargo being saved by the summoning of aid by radio messages. On June 29 the steamer Mackinaw, of the Schubach-Hamilton Steamship Company, ran aground on the Yukon Flats. A wireless message to the steamship managers at St. Michael brought lighters to remove a portion of the cargo, after which the vessel was floated. On August 14 the steamer Helen, of the Atlantic Fruit Company, went ashore off Poplar Island, Chesapeake Bay, while heavily laden with a perishable cargo of bananas. The Helen was not equipped with wireless, but was sighted by the tug Savage, which at once sent out a distress call, bringing the necessary aid.

Less than two weeks later, on August 26, occurred off the coast of Alaska one of those ocean tragedies in which it falls to the lot of one man to sacrifice his life for the others who are dependent on his efforts for their rescue. The hero of this disaster was George C. Eccles, wireless operator, who stuck to his post in the radio room of the sinking ship until passengers and crew were assured of safety.

The steamer Ohio of the Alaska Steamship Company, while en route from Seattle, Wash., to Valdez, Alaska, via what is known as the inside passage, struck a rock at Steep Point, at the northern end of Finlayson Channel, British Columbia, sinking in thirty minutes. Two hundred lives were saved, and five lost, among the latter being Eccles.

Eccles, the operator, had been in wireless conversation with Booth, the operator at Ketchikan, Alaska, just before the Ohio struck a rock. Suddenly Eccles interrupted the inconsequential talk with Booth to flash this message: "Ohio struck a rock—steamer sinking—send aid immediately or everybody will be lost."

Booth and Eccles at once sounded the S O S, to which responses came soon from two steamers, the Humboldt and the Rupert City.

Then came another message from Eccles to Booth: "Ohio sinking fast—can't hold out—passengers being taken off in small boats—Captain and crew will stick to last."

After a pause came a third message from Eccles to Booth: "Passengers all off and adrift in small boats—Captain and crew going off in last boat—waiting for me now. Goodbye * * * * *."

They were the last words that Eccles ever addressed to a fellow being. He went down with the vessel while the Captain and crew were waiting for him.

Next three vessels at short intervals ran ashore on the South Atlantic coast and managed to gain assistance by means of wireless. The steamer Zeeberg, on September 25, ran ashore on the south jetty of St. John's Bar, near Jacksonville, Fla., and was pounding on the rocks when the Clyde liner Arapahoe, which was equipped with radio apparatus, sighted her distress signals, and sent out calls which brought the much needed aid. On November 20 the steamer Breakwater, of the Atlantic Fruit Company, ran ashore in a gale six miles from Diamond Shoals lightship. The wireless station at Cape Hatteras received the distress messages from the lightship and summoned the wrecking tugs Merritt and Coley, which took off all thirty persons before the vessel was ground to pieces by the shoals. The third accident occurred on December 1, when the steamer Nueces of the Mallory Line, while bound from New York for Key West and Galveston, ran aground on French Reef, off the Florida coast, in a thick rain squall. Wireless distress calls sent through the Key West station brought the Lampasas and the Government tug Osceola to her assistance.

Donald C. Perkins, wireless operator on the wrecked steamship State of California

It would almost appear that whether through fortutious circumstances or elemental disturbances, stranding accidents are prone to occur in groups on similar coast lines. The next four accidents of this character took place on the Pacific coast of North America. The first of this series occurred on October 28, 1910, when the steamer Charles Nelson of the Charles Nelson Lumber Company went ashore a few miles north of Point Arena, Cal., in a thick fog. The sending of a wireless call resulted in bringing the United States revenue cutter McCullough to the rescue. Then, on December 1 the steamer Northwestern of the Alaska Steamship Company was wrecked off Falee Bay, San Juan Island, Wash., while bound from Seattle to Cordova, Alaska. The steamer Teos responded to the S O S call and all on board were saved. Nine days later the Olympic, also of the Alaska Steamship Company, was wrecked on a reef off Bligh Island, Alaska. In this instance Government launches answered the S O S call and 123 persons were saved. The fourth of the series occurred on January 26, 1911, when the steamship Cottage City of the Pacific Coast Steamship Company was wrecked on a reef off Quadra Island, North British Columbia, in a blinding snowstorm and heavy fog. The S O S call brought aid from Victoria, British Columbia, and Port Townsend, Wash., and all on board were rescued.

In another Pacific catastrophe, on April 11, wireless aid was responded to by Japanese and Chinese ships when the Asia of the Pacific Mail Steamship Company sank off Finger Rock, South China. Her wireless distress signals were answered by the American Maru and the Chinese vessel Shang Siu. The passengers, crew and mails were saved.

The last two stranding events during 1911 occurred at widely distant points. The steamship Prinz Joachim, on November 22, struck rocks at Atwood Bay, Samana Islands. Wireless communication was established direct with New York City, and all on board were carried to safety. On December 13 the steamship Delhi was reported in distress off Cape Spartel, on the coast of Morocco. Assistance was obtained by aerial messages, and eighty-six passengers, 235 members of the crew and 3,500 tons of general cargo were saved.

In the year 1912, as though by a compensatory dispensation of Providence, owing to the great tragedy of the Titanic, there were comparatively fewer sea tragedies. Only two stranding accidents were recorded, and these, thanks to the wireless, were not of a serious nature. The Pleiades on August 16, ran ashore at Magdalena Bay. The operator, G. Bennett, summoned aid by aerial message, and all on board were taken off. On December 5 the steamer Easton, of the United States & Dominion Transportation Company, struck on Iroquois reef in Lake Superior. Wireless calls were answered by stations at Port Arthur, Ont., and Duluth, Minn. Tugs sent to the assist-

George C. Eccles, hero of the steamship Ohio disaster

ance of the stranded steamer released her from her predicament with slight damage.

During the following year, however, many vessels were driven ashore and were wrecked on rocks, with heavy losses in life and property, but notwithstanding the year was a notable one in demonstrating the humanitarian value of the Marconi service and the promptitude and heroism of its vigilant operators. The Pacific coast of North America took an unusually heavy toll of the year's casualties, beginning on January 7, 1913, when the steamship Rosecrans was wrecked. Despite the distress calls which were sent out by L. A. Prudhunt, Marconi operator, only one life could be saved, while thirty-eight were lost. Then the Robert Dollar, while crossing the Columbia River bar, struck heavily, but, not locating any damage, proceeded on her voyage to Japan, only to find, when 100 miles off shore, that her stern post and rudder had broken off close to her counter, leaving her helpless in a big sea and a high wind. The Marconi operator on board established communication with shore, and a tug was sent to the aid of the helpless steamer within a few hours.

Quick action in summoning aid by wireless on the part of C. F. Hutchins and E. G. Bicak, Marconi operators on board the steamship Yukon, on June 13, when the vessel struck a reef off the Alaskan coast and sank, resulted in the saving of all who were on the wrecked vessel. The same efficiency on the part of the Marconi operator, R. H. Brower, six days later, resulted in the rescue of all on board the steamer Riverside, when she was wrecked and sunk off the California coast.

Another Alaskan reef, this time one in Gambier Bay, caused the loss within three minutes of the steamship State of California. Donald C. Perkins, the Marconi operator on the vessel, stuck to the sinking ship long enough to send out the S O S call, which was picked up by the Jefferson of the Alaska Steamship Company which fortunately was only a short distance away. The Jefferson saved seventy persons found in life boats and on rafts, although there was a loss of thirty-three lives in the disaster.

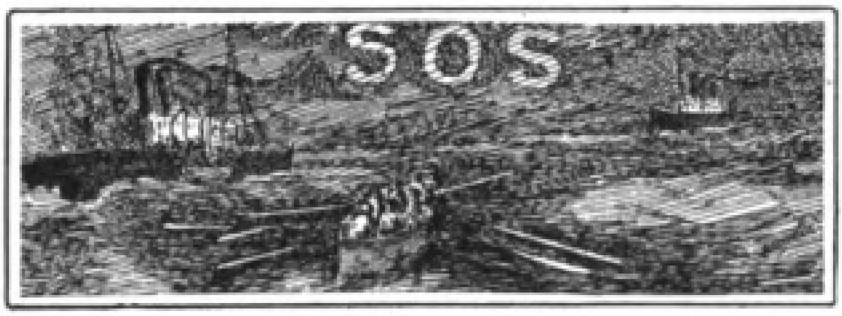
The steamer Spokane on October 3 went ashore on the beach off Cape Lazo, B. C., and the Marconi operator on board promptly summoned the freighter La Touche to the scene. Other vessels, the Dolphin, the Alki and the Minnesota also responded, but not until after the survivors of the stranded vessel had been picked up from the life boats.

Again, when the steamship Merced was wrecked off Point Gorda, Cal., on October 15, Marconi Operator Phair pluckily remained in the wireless room, sending out the S O S until he had received responses from three vessels, which sent word that they were hastening to the relief of the stranded steamship. Not until then did Phair leave the Merced. All on board had already taken to the small boats, and after the Marconi man joined them the ship was broken to pieces by the surf. Of the three rescuing steamships, the Atlas was the first to arrive, and took all the survivors on board.

Similar bravery was displayed by Marconi Operator Orth on the Stanley

Dollar, when that vessel, on October 23, struck the Viti rocks on the Pacific coast. Orth kept sending out distress calls from the wrecked vessel until he received replies from the Tahoma, which sped to the rescue. The latter vessel two days later succeeded in hauling the Stanley Dollar off the rocks.

It is not only the ocean travelers on passenger liners, the crews of freighters or tank steamships that base their hope for aid on the Marconi service when the hour of trouble comes. Many a pleasure yacht, sailing southern waters, struck by squalls or run ashore in a tempest, has to thank the wireless for the boon of safety when danger threatens. On November 13, the yacht Wakiva ran ashore 180 miles south of Galveston. In response to the S O S call from the wireless operator on board, the Galveston station of the Marconi Company promised immediate aid, and soon after sent the tug Senator Bailey to the rescue of the yacht. A similar timely rescue was effected when the Vanderbilt yacht Warrior ran aground near Savanilla, on the coast of Colombia, on January 26, 1914. The wireless call was answered by the United Fruit Company's steamship Fruitera. Eight of that vessel's lifeboats were crushed like eggshells or overturned in the sea in vain attempts to reach the yacht. Then the steamship Almirante, forty miles distant, was summoned, and she succeeded in taking off all the Warrior's passengers, among whom were Mr. and Mrs. Frederick W. Vanderbilt, the Duke and Duchess of Manchester and Lord Arthur George Keith-Falconer.



Nearly two weeks previous to this, on January 13, the Royal Mail Steamship Cobequid lost her bearings in a blinding blizzard and stranded on Trinity Rock, in the Bay of Fundy. Thirty-six hours after the first wireless appeal was sped over the waters, the 108 persons on board had been rescued. Help came to the vessel just as the cannonading of the terrific seas was beginning to break her to pieces. The crash had come just before dawn, and a few minutes later the S O S was flashed out by the Cobequid's chief operator, J. W. Hitchner, who was unable to give her exact location, since no one on board knew it definitely. The flood tide and the gales broke the vessel's back and flooded the engine room, putting out the fires and interrupting the wireless service. The Westport, a coastal steamship, was the first vessel to reach the stricken craft, and in conjunction with another rescuer's timely arrival, all on board were saved as by a miracle. The rescue was one of the most remarkable known to ocean history, and it was remarked at the time that, since wireless telegraphy first triumphed over the forces of nature, its effectiveness was never more forcibly demonstrated. In the circumstances of the wreck, every other manner of signaling device would have proved inefficacious. Sirens could not have made themselves heard nor could "flare-ups" have been seen through the thick blanket of fog that lay on the water.

This year—1914— was one also notable for the numerous casualties due to the stranding ships. One of the most perilous adventures was experienced by the Roma of the Fabre Line, bound from Marseilles for Providence and New York, with 427 passengers and a crew of 100 aboard. The vessel was in peril for hours on No Man's Land, south of Gay Head, Martha's Vineyard, when, on February 16, she struck in a blinding snowstorm. No Man's Land loomed ahead, and suddenly the vessel was ashore. The Captain directed the operator to send out a wireless call, asking that a towboat be sent to the scene. The revenue cutters Acushnet, Itasca and Gresham, as well as towboats at New London, were rushed to the aid of the steamer, which was soon freed from her perilous position.

While seas were threatening to demolish the Red Cross liner City of Sydney, which ran on Sambro Rocks, twenty-five miles east of Halifax, N. S., March 17, wireless messages brought the tug Rosemary and other vessels to the rescue of those on the stranded craft. Fifty-three persons were taken from the ship and landed at Halifax.

Marconi Operator Dickow, on the steamship Pectan, managed to save that vessel from a dangerous predicament in April, when she ran aground off Adam's Cove, Cal. Dickow sent a wireless call for assistance to the Argyl. This vessel and the Lansing promptly arrived at the scene, but to the general dismay it was found that the rescuing ships were too large to enter between the perilous rocks on the coast. The wrecker Iaqua was then summoned and succeeded in pulling the distressed vessel off the rocks.

Two Marconi operators on the Northland of the Maine Steamship Line, H. Bondeaux and Carl Krech, were prompt in taking measures to save the passengers aboard the vessel when she ran hard aground on the rocks of Bartlett's Reef in Long Island Sound in the fog on the morning of June 5. The passengers were taken off by the Tasco, an ocean-going tug, which responded to the wireless summons from New London, Conn.

Wireless again saved all the passengers and crew in a midsummer wreck when the Prince Albert, on August 17, went ashore on Butterworth Rocks during a dense fog. Then in October, the Almirante of the United Fruit Company, the steamer which played the part of rescuer to the Vanderbilt yatch Warrior in October of the previous year, herself was stranded at Cartagena Harbor. Through the use of her wireless, the sixty-six passengers and ninety members of the crew were rescued, not a single life being lost.

Marconi Operator H. C. Rodd was of prompt service to his ship, the Lakeland, which went ashore eight miles from Alpena, Lake Huron, on November 10. Rodd sent out distress signals, which were answered by Marconi shore stations at Cleveland, Buffalo and Tobermory. The tug Favorite was informed of the accident and was quickly on hand to aid the distressed vessel. Constant wireless communication was maintained between the tug and the Lakeland while the former was on her way. The Lakeland was later towed into Port Huron.

Loren A. Lovejoy and Adolph John Svenson, Marconi wireless operators, distinguished themselves by unusual heroism on November 23, during the wrecking of the steam schooner Hanalei, which struck a reef opposite the transmitting station of the Marconi trans-Pacific service at Bolinas, Cal. Pounded by seas until the wireless cabin was washed away and the apparatus was placed out of commission, the vessel broke up almost in the very shadow of the Bolinas towers. Svenson, who had stuck to the wireless cabin to the last, managed to have his S O S picked up by the Marconi station at San Francisco, and the revenue cutter McCullogh and the oil tankers El Segundo and Richmond were soon at the scene of the wreck. But heavy seas and the surrounding reefs prevented their going to the relief of the distressed vessel. Darkness came on and communication with the shore was cut off. But the quick wit of Lovejoy found a way to overcome this difficulty, and for many hours through the night he managed to signal to the watchers on the beach by means of his pocket flashlight. Through his efforts the work of rescue was considerably facilitated and the courage of those on the wreck was strengthened.

When the vessel was abandoned Lovejoy had a thrilling experience on a raft, but was picked up and saved. His fellow operator on the Hanalei, Svenson, was not so fortunate. Svenson, who had remained in the cabin to the last, sending out the S O S call that summoned the steamers, and who later did all he possibly could do to prevent loss of life, was hurled into the sea when the ship broke in two and was drowned.

The Marconi men on shore were not idle during all this time. The flashlight signals of Lovejoy were answered by Manager Baxter of the Bolinas station. He and others from the station waded into the surf, and while the seas were demolishing the ship, they snatched drowning folk from the waters. Bonfires were kindled on the beach to warm and cheer the rescued, and the Marconi Company's hotel was thrown open as a refuge. There were sixty-three persons on the Hanalei, of whom forty-three were saved.

The year wound up with an accident to the steamship Isthmian, on December 19, when the vessel struck the rocks off San Benito Island. In response to the S O S call, the cruiser West Virginia, torpedo boat destroyer Perry and the Navy tug Iroquois arrived and effected a rescue.

The shipping disasters of the year 1915 opened on January 1, when the steamship Obidense struck the Shipwash Sands. The call for assistance was sent by radio, and several ships responded, resulting in the saving of the entire crew, numbering forty-two persons. Then a week later, another accident occurred to the steam yacht Wakiva, which went on the rocks off the Tampico, Mexico, breakwater at night. The vessel was abandoned and those on board were rescued by means of the breeches buoy. Marconi Operator P. Daniels was in charge of the wireless on board the yacht. He at once sent out the S O S which was picked up by the operators on several vessels. Guy H. Hawkins, the Marconi operator on board the Brabant, bound from Tampico for New York, received the S O S. The Brabant reached the wreck just as the breeches buoy had been rigged up from the foremast of the yacht and anchored to a large concrete rock at the end of the jetty. This enabled all on board to reach the shore in safety.

Two days later there occurred another accident at the Tampico breakwater, when the Mexicano of the Pierce Navigation Company went ashore there. The Marconi operator sent out wireless distress calls, which were answered by the Mexican Government station at Tampico. The vessel was floated by tugs.

With aid summoned by wireless, the passengers and crew of the steamship Colon, which was stranded off the bar at Topolobampo on February 4, were safely taken off by the United States steamships Maryland and Annapolis. A wireless summons also was effective in salving a cargo of 40,000 sacks of sugar from the steamship Balmes, which, on March 30, stranded on a reef thirty miles west of Key West. The wireless request for aid was answered by the Key West Naval wireless station, which was instrumental in sending salvers to the wreck. The wireless message for aid also succeeded in saving the steamship Mexico of the Pacific Steam Navigation Company, which, on April 1, ran aground near Southwest Pass, La. Tugs summoned by wireless managed to float the vessel.

Charles F. Trevatt was the Marconi wireless operator on board the steamship Minnesota, when, on April 11, she ran on a reef at the entrance to the Inland Sea in Japan. The vessel struck with a terrific jolt. No sooner had the disaster occurred than Trevatt flashed the S O S. The call was taken up by the Blue Funnel liner Onfa, which, within an hour, was anchored within three miles of the wrecked vessel. Steps were at once taken to pull the Minnesota off the reef, and suddenly with an immense splash she slid safely into deep water, and was enabled to proceed on her voyage.

Wireless brought powerful tugs to the assistance of the steamship Asuncion on May 7, when she went ashore off Fraser River, and she was soon set free. Tugs were also summoned by aerial message to the assistance of the Alliance, when she was stranded at Richmond Beach, Washington, on June 3. The tugs that responded to the S O S call succeeded in taking off all on board, numbering forty persons.

L. F. Whitehead and H. D. Phillips were the Marconi operators on the steamship A. W. Perry of the Plant Line, plying between Boston, Halifax and Prince Edward Island. On June 8, during a fog, the vessel went on the rocks at Chebucto Head, N. S., with a crash and a bump, while she was two days out from Boston. The two wireless men flashed the S O S signals. Shore stations answered the calls for aid and summoned the relief vessels. A wrecking boat was soon on the scene through the promptness of the wireless operators, and it took off the forty-two passengers and crew. The Perry went down.

There followed in swift succession during the summer months six strandings, in each of which the wireless was of great service in saving passengers, crews, cargoes and vessels. The California of the Anchor Line on June 28 ran ashore at Tory Island, the wireless calls bringing a British destroyer to the assistance of the wrecked vessel, from which the passengers were removed. On July 2, the steamer Panuco grounded at the entrance to South Pass, La., with a crew of thirty-five men aboard. The wireless promptly brought aid in floating the vessel. On July 11, the aerial calls brought rescuers to the steamship Invermore, which was wrecked near Brig Harbor, Labrador, and the crew was taken off. On August 2 wireless brought help to the Georgian, which went ashore near San Francisco in a fog. The Harvard responded to the call and all on the stranded ship were saved. On August 18 the El Sud of the Morgan Line grounded on Galveston Bar during a Gulf hurricane. Wireless calls brought immediate assistance and the vessel was towed into Galveston harbor after the weather had moderated. Finally, on August 23 the steamer Metapan grounded at Cartagena Harbor, with forty-five passengers and a crew numbering ninety-two on board. Assistance summoned by wireless facilitated the discharging of the cargo into lighters, and the steamer was subsequently floated.

A later series of accidents wound up the events of the year. On October 8 the steamship Mariposa of the Alaskan Steamship Company grounded and sank on a rocky shore in Llama Passage, off Pointer Island, British Columbia. Wireless operators despatched the S O S, which was responded to by two vessels. The Despatch, being within thirty miles, was on the scene in time to save the lives of the 139 persons on board. On November 2 the steamship Santa Clara was wrecked near the entrance to Coos Bay, 170 miles south of Astoria. Wireless calls succeeded in bringing out a vessel to the rescue. Ninety-three persons were thus saved, but not before fifteen passengers and twenty-four members of the crew were drowned. Three days later the steamer Fort Bragg grounded in the Gulf of California. The U. S. S. San Diego responded to the distress call in time to save the lives of forty-seven persons.

It had been a year of serious and numerous disasters. Small wonder at the statement issued by the radio inspectors of the Bureau of Navigation, who reported twenty-six cases of vessels leaving our ports, which had met with accident or disaster requiring the use of wireless to summon assistance. Of these four summons were for fire; twelve for running ashore, stranding or getting into ice jams; three for breaking machinery; four for collisions; one for shifting of cargo; one for a vessel which had been storm-battered and one which had been torpedoed.

The Marconi wireless continues to prove its humanitarian offices in the reports of stranding accidents ushered in by the present year. On January 17, the Car Ferry Pere Marquette No. 19 went aground four miles north of Ludington. Wireless communication was established with Ludington and Pere Marquette Car Ferries No. 17 and No. 18, which were advised not to come in close on account of shoal water. Wireless continued to be used, however, throughout the salvage operations.

The big trans-Pacific passenger ship, Chiyo Maru, grounded in a fog on the morning of March 31, on one of the Lema Islands, south of Hong Kong A wireless call for assistance was sent out, and a British destroyer, which was in the vicinity came to the rescue at full speed. There was a heavy swell, and oil was poured on the water. There were 229 passengers on board who were rescued from the lifeboats, to which they had taken, by the destroyer.

(To be concluded)

Engineers Entertained in Seattle

Guests at the dinner given to the visiting members of the Institute of Radio Engineers. Sitting, reading from left to right, Roy A. Weagant, V. Ford Greaves, Philip Farnsworth, Lieutenant-Commander W. B. Wells, L. F. H. Betts, R. H. Marriott (toastmaster), Greenleaf W. Pickard, Frank N. Waterman, Frederick A. Kolster, Ellery W. Stone, A. A. Paysee and C. B. Cooper; standing, third from the left, Lieutenant E. J. Blankenship; **fourth, C. A.** *Kilbourne*

Members of the Institute of Radio Engineers and their guests visiting in Seattle were tendered a dinner by the Seattle Section of the Institute at the Butler Hotel in that city, on March 18. The dinner was given in honor of Frank N. Waterman and Greenleaf W. Pickard, wireless experts; Frederick A. Kolster, assistant physicist of the United States Bureau of Standards; V. Ford Greaves, radio engineer of the Department of Commerce; Lieutenants E. J. Blankenship; Dr. Frederick Osborne; Dr. Carl E. Magnusson; R. A. Weagant, chief engineer of the Marconi Wireless Telegraph Company of America and A. H. Ginman, general superintendent of the Marconi Company's Pacific Coast Division, together with their guests, L. F. H. Betts, D. N. Cosgrove and Judge Jere Neterer.

"These men," read the invitations sent out by R. H. Marriot, expert radio aide of the Navy and chairman of the Seattle Section of the Institute of Radio Engineers, "have accomplished important work in the radio field of engineering which as radio men, engineers and citizens of the Northwest, we should take opportunity to recognize."

ORDERS BY WIRELESS TELEPHONE TO BATTLESHIP

Standing on the bridge of the battleship New Hampshire in Hampton Roads, on the afternoon of May 6, Captain Lloyd H. Chandler, the commander of that warship, talked by wireless telephone with army and navy officers assembled around the desk of Secretary Daniels in Washington. The conversation between Captain Chandler and these officers was carried on as easily as if they had been standing in the same room, and continued nearly half an hour. Compliments were exchanged and orders were given by wireless telephone direct from the office of the Secretary of the Navy, to a ship at sea for the first time in history.

At the same time Secretary Daniels and other navy officials talked by long-distance telephone with the naval stations at Norfolk, New York, Chicago, San Diego, Pensacola, and other points, exchanging messages and giving official orders by word of mouth over thousands of miles of territory. Secretary Daniels was able to talk with the Commandant at the New York Navy Yard one minute, and the next minute he was talking with the Commandant of the Naval Station at San Diego. It took only twenty-eight seconds to make the telephone connection between Secretary Daniels's office and the Naval Station at San Diego and twenty-seven seconds to connect with the New York Navy Yard.

Standardization of Wireless Terms

Report of the Committee of the Institute of Radio Engineers

THE report of the Committee on Standardization of the Institute of Radio Engineers, which has just been presented for the year 1915, explains its mission as follows:

"The early history of new branches of engineering always shows the discouraging spectacle of a confused and ill-defined nomenclature, together with widely different meanings assigned to graphical and literal symbols by the various investigators and authors. As a result, there arise many unfortunate misunderstandings and a considerable amount of needless labor on the part of the practicing engineer and students of engineering. It therefore becomes desirable for the chief engineering institute in the new field to bend its best efforts in the direction of remedying such confusion through activities carefully carried on by a Committee on Standardization.

"The field of radio engineering is far from having escaped the objectionable conditions mentioned, as may be easily seen on reading either theoretical papers in this field or by a study of the reports of patent lawsuits."

As a result of sixteen regular meetings, and a number of less formal conferences, the committee presents the present report to the membership of the Institute and other workers in the radio field. It announces that it welcomes pertinent suggestions and criticisms of the present report as well as the views of those interested as to the proper future scope of standardization.

Definition of Terms

NOTE: Terms are generally arranged alphabetically according to the noun referred to.

1. **Absorption, Atmospheric**: That portion of the total loss of radiated energy due to atmospheric conductivity.
2. **Ammeter Hot Band:** } **Hot Wire**: An ammeter dependent for its indications upon the change in dimensions of an element which is heated by a current through it.
3. **Ammeter, Thermo**: An instrument for measuring current, depending for its indications on the voltage generated at the terminals of a thermo junction heated either directly or indirectly by the current to be measured.
4. **Amplifier** or **Amplifying Relay**: An instrument which modifies the effect of a local source of energy in accordance with the variations of received energy; and, in general, produces a larger indication than could be had from the incoming energy alone.
5. **Amplification, Coefficient of**: The ratio of the useful effect obtained by the employment of the amplifier to the useful effect obtained without that instrument.
6. **Antenna**: A system of conductors designed for radiating or absorbing the energy of electromagnetic waves.
7. **Antenna, Directive**: An antenna having the property of radiating a maximum of energy in one (or more) directions.
8. **Antenna, Flat Top**: An antenna having horizontal wires at the top covering a large area.
9. **Antenna, Harp**: An antenna having an approximately vertical section of large area and considerable width.
10. **Antenna, Inverted L**: A flat top antenna in which the leading down wires are taken from one end of the long, narrow horizontal section.

11. **Antenna, Loop**: An antenna in which the wires form a closed circuit, part of which may be the ground.
12. **Antenna, Plain**: An approximately vertical single wire.
13. **Antenna, T**: A flat top antenna in which the horizontal section is long and narrow, the leading down wires being taken from the center.
14. **Antenna, Umbrella**: One whose conductors form the elements of a cone from the elevated apex of which the leading down wires are brought.
15. **Antenna Resistance**: An effective resistance which is numerically equal to the ratio of the power in the entire antenna circuit to the square of the R. M. S. current at a potential node (generally the ground).

    Note: Antenna Resistance includes

    Radiation resistance

    Ground resistance

    Radio frequency ohmic resistance of antenna and loading coil and shortening condensers.

    Equivalent resistance due to corona, eddy currents, and insulator leakage.
16. **Arc**: The passage of an electric current of relatively high density through a gas or vapor the conductivity of which is mainly due to the electron emission from the self-heated cathode. Under present practical conditions, the phenomena take place near atmospheric pressure.
17. **Arc Oscillator**: An arc used with an oscillating circuit for the conversion of direct to alternating or pulsating current. The oscillations generated are classified as follows:

    Class (1). Those in which the amplitude of the oscillation circuit current produced is less than the direct current through the arc.

    Class (2). Those in which the amplitude of the oscillation circuit current is at least equal to the direct current, but in which the direction of the current through the arc is never reversed.

    Class (3). Those in which the amplitude of the initial portion of the oscillation circuit current is greater than the direct current passing through the arc, and in which the direction of the current through the arc is periodically reversed.
18. **Attenuation (Radio)**: This is the decrease, with distance from the radiating source, of the amplitude of the electric and magnetic forces accompanying (and constituting) an electro-magnetic wave.
19. **Attenuation, Coefficient of (Radio)**: The coefficient, which, when multiplied by the distance of transmission through a uniform medium, gives the natural logarithm of the ratio of the amplitude of the electric or magnetic forces at that distance to the initial value of the corresponding quantities.
20. **Audibility**: The ratio of the telephone current variation producing the received signal, to that producing an audible signal. (An audible signal is one which permits the mere differentiation of dots and dashes.)

    The measurement of audibility is an arbitrary method for determining the relative loudness of telephone response in radio receivers, in which it is stated that a signal has an audibility of given value. The determination of the above ratio may be made by the non-inductive shunt-to-telephone method, except that a series resistance should be inserted to keep the main current constant, and that the shunt resistance should therefore be connected as a potentiometer.
21. **Brush or Coronal Losses**: Those due to leakage convection elec-

tric currents through a gaseous medium.

22. **Cage Conductor:** A group of parallel wires arranged as the elements of a long cylinder.

Note: Any conducting element of an antenna may be a cage conductor.

23. **Capacity, Effective, of an Antenna:** The effective capacity and effective inductance of an antenna at any oscillation frequency are the equivalent capacity and inductance values determined from the following fundamental equations:

$$\omega = \sqrt{\frac{1}{LC}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where L = the total antenna inductance,

C = the total antenna capacity,

ω = the angular velocity of the free alternating currents in the antenna.

$$d = \pi R \sqrt{\frac{L}{C}} \quad . \quad . \quad . \quad (2)$$

or $$d' = \pi R' \sqrt{\frac{C}{L}} \quad . \quad . \quad . \quad ((2a)$$

where R' = series resistance inserted at the base of the antenna and

d' = increased decrement resulting therefrom.

Solving (1 and (2a) for L and C, we have

$$L = \frac{\pi R'}{\omega d'} = \frac{R'}{6 \times 10^8 \times d'} . \lambda$$

(λ in meters)

$$C = \frac{d'}{R'} = \frac{d'}{6 \pi^2 \times 10^8 \times R'} . \lambda$$

(λ in meters)

Having the antenna inductance and capacity, the resistance R of the antenna can be determined from equation (2). This value of R satisfies the fundamental equation:

RI^2 = power absorbed by the antenna,

where I = current measured at base of the antenna.

Note: The equation

and also $E = \frac{\pi R'}{d'} . I$

$I = \omega C E$

defines an effective voltage E, which is the voltage approximately given by the equation,

Energy per spark = $C E^2$.

24. **Center of Capacity of an Antenna:** See Form Factor, Note 2.

25. **Changer, Frequency:** A device delivering alternating currents at a frequency which is some multiple of frequency of the supply current.

26. **Changer, Wave:** A transmitting device for rapidly and positively changing the wave length.

27. **Characteristic, Dynamic, of a Conductor:** (For a given frequency and between given extremes of impressed E. M. F. and resultant current through the conductor): This is the relation given by the curve obtained when the impressed E. M. F.'s are plotted as ordinates against the resultant currents as abscissas, both E. M. F.'s and currents varying at the given frequency and between the given extremes.

28. **Characteristic, Static, of a Conductor:** This is the relation given by the curve plotted between the impressed electromotive force as ordinates and the resultant current through the conductor as abscissas, for substantially stationary conditions.

29. **Coefficient, Attenuation, Radio:** See Attenuatoin.

30. **Coefficient of Amplification:** See Amplification.

31. **Coefficient of Coupling, Inductive:** The ratio of the effective mutual inductance of two circuits to the square root of the product of the effective self inductances of each of these circuits.

32. **Coherer:** A device sensitive to radio frequency energy, and characterized by (1) a normally high resistance to currents at low voltages, (2) a reduction in resistance on the application of an

increasing electromotive force, this reduction persisting until eliminated by the application of a restoring or disturbing mechanical force, and (3) the substantial absence of thermo-electric or rectifying action.

33. **Communication, Radio**: The transmission of signals by means of electromagnetic waves originating in a constructed circuit.

34. **Compass, Radio**: A radio receiving device for determining the direction (or the direction and its opposite) in which maximum energy is received; or

A radio transmitting device for determining the direction (or the direction and its opposite) of maximum radiation.

35. **Condenser, Air**: A condenser having air as its dielectric.

36. **Condenser, Compressed Gas**: A condenser having compressed gas as its dielectric.

37. **Conductor, Cage**: See Cage Conductor.

38. **Corona**: See Brush or Corona Losses.

39. **Counterpoise**: A system of electrical conductors forming one portion of a radiating oscillator the other portion of which is the antenna. In land stations, a counterpoise forms a capacitive connection to ground.

40. **Coupler**: An apparatus which is used to transfer radio frequency energy from one circuit to another by associating portions of these circuits.

41. **Coupler, Capacitive**: An apparatus which, by electric fields, joins portions of two radio frequency circuits; and which is used to transfer electrical energy between these circuits through the action of electric forces.

42. **Coupler, Direct**: A coupler which magnetically joins two circuits having a common conductive portion.

43. **Coupler, Inductive**: An apparatus which by magnetic forces joins portions of two radio frequency circuits and is used to transfer electrical energy between these circuits through the action of these magnetic forces.

44. **Coupling**: See Coefficient of Coupling (Inductive).

45. **Current, Damped, Alternating**: An alternating current whose amplitude progressively diminishes. (Also called oscillating current.)

46. **Current, Forced Alternating**: A current, the frequency and damping of which are equal to the frequency and damping of the exciting electromotive force. See further Current, Free Alternating.

Note 1: During the initial stages of excitation, both free and forced currents co-exist.

47. **Current, Free Alternating**: The current following any transient electromagnetic disturbance in a circuit having capacity, inductance, and less than the critical resistance. See further, Resistance, Critical.

48. **Curve, Distribution, of a Radio Transmitting Station for a given distance**: This is a polar curve, the radii vectors of which are proportional to the field intensity of the radiation at that distance in corresponding directions. See also Compass, Radio.

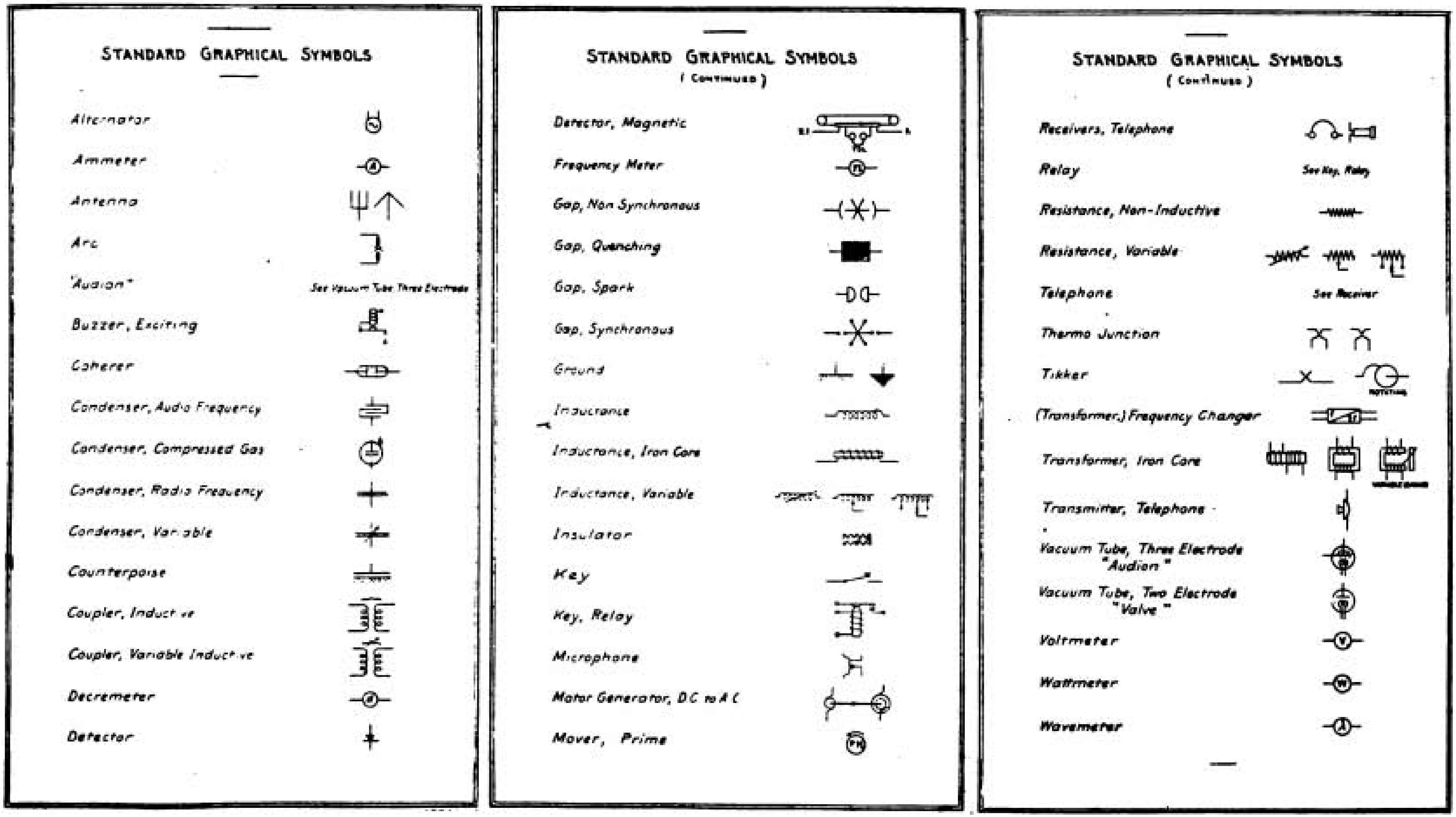
Note 1: The distribution curve depends, in general, not only on the form of the antenna, but also on the nature of the ground surrounding the station.

Note 2: The distribution curve generally varies with the distance from the station.

49. **Curve, Resonance, Standard**: A curve the ordinates of which are the ratios of the square of the current at any frequency to the square of the resonant current, and the abscissas are the ratios of the corresponding wave length to the resonant wave length; the abscissas and ordinates having the same scale.

50. **Cyclogram**: See Characteristic, Dynamic.

51. **Cyclograph**: An instrument for the production of cyclograms.



Standard graphical symbols recognized by the Institute of Radio Engineers

52. **Decrement:** See Decrement, Linear, and Logarithmic.

53. **Decrement, Linear, of a Linearly Damped Alternating Current:** This is the difference of successive current amplitudes in the same direction divided by the larger of these amplitudes.

Note: Let I_n and I_{n+1} be successive current amplitudes in the same direction of a linearly damped alternating current.

Then, the linear decrement

$$b = \frac{I_n - I_{n+1}}{I}$$

Also: $I_t = I_o (1 - bft)$,
where I_o = initial current amplitude,
I_t = current amplitude at time t,
f = frequency of alternating current.

54. **Decrement, Logarithmic, of an exponentially damped alternating current:** This is the logarithm of the ratio of successive current amplitudes in the same direction.

Note: **Logarithmic decrements are standard for a complete period or cycle.**
Let I_n and I_{n+1} be successive current amplitudes in the same direction,
d = logarithmic decrement,

Then, $d = \log_{\Sigma} \frac{I_n}{I_{n+1}}$,
where $\Sigma = 2.178+$.

55. **Decremeter:** An instrument for measuring the logarithmic decrement of a circuit or of a train of electromagnetic waves.

56. **Detector:** That portion of the receiving apparatus which, connected to a circuit carrying currents of radio frequency, and in conjunction with a self-contained or separate indicator, translates the radio frequency energy into a form suitable for operation of the indicator. This translation may be effected either by the conversion of the radio frequency energy, or by means of the control of local energy by the energy received.

57. **Device, Acoustic Resonance:** A device which utilizes in its operation resonance to the audio frequency of the received signals.

58. **Diplex Reception:** The simultaneous reception of two signals by a single operating station.

59. **Diplex Transmission:** The simultaneous transmission of two signals by a single operating station.

60. **Duplex Signaling:** The simultaneous reception and transmission of signals.

61. **Excitation, Impulse:** A method of producing free alternating currents in an excited circuit in which the duration of the exciting current is short compared with the duration of the excited current.

Note: The condition of short duration implies that there can be no appreciable reaction between the circuits.

62. **Factor, Damping:** The product of the logarithmic decrement and the frequency of an exponentially lamped alternating current.
Let I_o = initial amplitude,
I_t = amplitude at the time t,
Σ = base of Napierian logarithms (2.718=),
a = damping factor,
Then, $I_t = I_o \Sigma^{-at}$

63. **Factor, Form:** The form factor of a symmetrical antenna for a given wave length is the ratio of the algebraic average value of the R. M. S. currents measured at all heights to the greatest of these R. M. S. currents.

Note 1: For a given R. M. S. current at the base of the antenna, the field intensity at distant points is proportional to the form factor times the height of the antenna.

Note 2: The effective height (height of center of capacity) is equal to the form factor times the actual height of the antenna.

Note 3: The limiting values of

the form factor for various types of antennas are as follows:

Linear or Vertical Antenna	Flat Top Umbrella Antenna
Long Waves	
Lower Limit, 1/2	Upper Limit, 1
Fundamental	
Lower Limit, $2/\pi$	

Note 4: The form factor varies in a given antenna at various wave lengths due to variation of the current distribution.

64. **Frequencies, Audio (abbreviated a. f.)**: The frequencies corresponding to the normally audible vibrations. These are assumed to lie below 10,000 cycles per second.

65. **Frequencies, Radio (abbreviated r. f.)**: The frequencies higher than those corresponding to the normally audible vibrations, which are generally taken as 10,000 cycles per second. See also Frequencies, Audio.

Note: It is not implied that radiation cannot be secured at lower frequencies, and the distinction from audio frequencies is merely one of definition based on convenience.

66. **Frequency, Changer**: See Changer, Frequency.

67. **Frequency, Group**: The number per second of periodic changes of amplitude or frequency of an alternating current.

Note 1: Where there is more than one periodically recurrent change of amplitude, or frequency, there is more than one group frequency present.

Note 2: The term "group frequency" replaces the term "spark frequency."

68. **Frequency Transformer**: See Changer, Frequency.

69. **Fundamental of an Antenna**: This is the lowest frequency of free oscillations of the unloaded antenna. (No series inductance or capacity.)

70. **Fundamental Wave Length**: The wave length corresponding to the lowest free period of any oscillator.

71. **Gap, Micrometer**: A device for protecting any apparatus from excessive potentials, and consisting of a short gap designed for fine adjustment.

72. **Ground**: A conductive connection to the earth.

73. **Height, Effective, of an Antenna**: See Factor, Form; Note 2.

74. **Inductance, Effective of an Antenna**: See Capacity, Effective of an Antenna.

75. **Impulse Excitation**: See Excitation, Impulse.

76. **Interference, Wave (In Radio Communication)**: The reinforcement or neutralization of waves arriving at a receiving point along different paths from a given sending station; (to be distinguished from ordinary or station interference, which is the simultaneous reception of signals from two or more stations).

77. **Key**: A switch arranged for rapidity of manual operation and normally used to form the code signals of a radiogram.

78. **Key, Relay**: See Relay Key.

79. **Length, Wave**: See Wave Length.

80. **Losses, Brush or Corona**: See Brush or Corona Losses.

81. **Meter, Wave**: See Wave Meter.

82. **Oscillations (In radio work)**: See Current, Damped Alternating.

83. **Oscillator, Arc**: See Arc Oscillator.

84. **Potentiometer**: As commonly used for radio receiving apparatus, a device for securing a variable potential by utilizing the voltage drop across the variable portion of a current carrying resistance.

85. **Radiation, Sustained**: See Waves, Sustained.

86. **Radiogram**: A telegram sent by radio.

87. **To Radiograph (verb)**: To send a radiogram.

88. **Radio Telephone**: An apparatus for the transmission of speech by radio.

89 **Radiophone (noun)**: A telephone message sent by radio.

90. **To Radiophone (verb)**: To send a radiophone.

91. **Rectifier, Electron**: A device for

rectifying an alternating current by utilizing the approximately unilateral conductivity between a hot cathode and a relatively cold anode in so high a vacuum that a pure electron current flows between the electrodes.

92. **Rectifier, Gas**: An electron rectifier containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.

93. **Relay, Electron**: A device provided with means for modifying the pure electron current flowing between a hot catheode and a relatively cold anode placed in as nearly as possible a perfect vacuum.

These means may be, for example, an electric control of the pure electron current by variation of the potential of a grid interposed between the cathode and the anode.

94. **Relay, Gas**: An electron relay containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.

95. **Relay, Key**: An electrically operated key. See further, Key.

96. **Resistance, Antenna**: See Antenna Resistance.

97. **Resistance, Critical, of a Circuit**: That resistance which determines the limiting condition at which the oscillatory discharge of a circuit passes into an aperiodic discharge.

98. **Resistance, Effective, of a Spark**: The ratio of the power dissipated by the spark to the mean square current.

99. **Resistance, Radiation**: This is the ratio of the total energy radiated (per second) by the antenna to the square of the R. M. S. current at a potential node (generally the ground connection). See further, Antenna Resistance.

100. **Resistance, Radio Frequency**: This is the ratio of the heat produced per second in watts to the square of the R. M. S. current (r. f.) in amperes in a conductor.

101. **Resonance**: Resonance of a circuit to a given exciting alternating E. M. F. is that condition due to variation of the inductance or capacity in which the resulting effective current (or voltage) in that circuit is a maximum.

Note 1: Instead of varying the inductance and capacity of a circuit the frequency of the exciting field may be varied. The condition of resonance is determined by the frequency at which the current (or voltage) is a maximum.

Note 2: The resonance frequency corresponds the more accurately to the frequency of the free oscillations of a circuit, the lower the damping of the exciting alternating field and of the excited circuit.

102. **Resonance, Acoustic Device**: See Device, Acoustic Resonance.

103. **Resonance, Sharpness of**: See Tuning, Sharpness of.

104. **Signaling, Duplex**: See Duplex Signaling.

105. **Sharpness of Tuning**: The measure of the rate of diminution of current in transmitters and receivers with detuning of the circuit which is varied.

If d_2 is the decrement of the free alternating current in the circuit of d_1 the decrement of the exciting E. M. F., then the sharpness of tuning is arbitrarily defined as $\frac{\pi}{d_1 + d_2}$.

106. **Spark**: An arc of short duration.

107. **Static**: Disturbances caused by atmospheric charging of the antenna.

Note: When it is definitely known that disturbances are due to atmospheric charging of the antenna, the word "Static" shall be used. In general, disturbances shall be called "Strays."

108. **Strays**: Electromagnetic disturbances set up by distant discharges.

109. **Telegraphy, Radio:** The art of sending and receiving radiograms.
110. **Telephony, Radio:** The art of sending and receiving radiophones.
111. **Train, Wave:** The waves emitted which correspond to a group of oscillations in the transmitter. See also, Frequency, Group.
112. **Transformer:** In present radio practice the term should be restricted to audio frequency transformers. See Frequency, Audio.
113. **Transmission, Diplex:** See Diplex Transmission.
114. **Tuning:** The Process of securing the maximum indication by adjusting the time period of a driven element. See Resonance.
115. **Tuning; Sharpness of:** See Sharpness of Tuning.
116. **Vacuum Tube, Three Electrode:** As examples see Relays, Electron and Gas.
117. **Vacuum Tube, Two Electrode:** As examples see Rectifiers, Electron and Gas.
118. **Waves, Electromagnetic:** A periodic electromagnetic disturbance progressive through space.
119. **Wave Length (of an Electromagnetic Wave):** The distance in meters between two consecutive maxima, of the same sign, of the electric and magnetic forces.
120. **Wave Length, Fundamental:** See Fundamental Wave Length.
121. **Wave Length, Natural:** In a loaded antenna (that is, with series inductance or capacity) the natural wave length corresponds to the lowest free oscillation.
122. **Wave Changer:** See Changer, Wave.
123. **Wave Meter:** A radio frequency measuring instrument calibrated to read wave lengths.
124. **Waves, Sustained:** Waves radiated from a conductor in which an alternating current flows.
125. **Wave Train:** See Train, Wave.

The report also includes definitions of trade names and recommendations for tests and rating. The standard graphical symbols adopted are given on another page.

THE REGULATION OF INTERNATIONAL COMMUNICATION

The International Telegraphic Union, of Berne, which regulates the international wireless stations, land lines and submarine cables of the world, has issued a bulletin. At the head of the Union is Emil Frey, ex-president of Switzerland and a veteran of the Civil War. By international agreement, first made in 1865 and reaffirmed at numerous conventions, the Union was formed to codify cable regulations and standardize the treatment of messages to all parts of the world. With the advent of wireless, the Union took charge of this branch of communication as well. At present Mr. Frey's work is particularly difficult, due to the European war and the consequent interruptions of the service.

Just now it is the wireless which is making the most rapid strides, and Mr. Frey finds it difficult to keep up with the sweep of this medium of communication to the remotest islands of the seas. Each government gets up a list of its own stations, but the Union consolidates the lists of all governments. The American section, for instance, allowing all army, navy and private wireless stations and all boats with wireless, includes even the yachts of Vincent Astor and others with wireless equipments.

SERVICE BETWEEN KENTUCKY MINES

According to word from Louisville, Ky., the Harlan Coal Mining Company and Lick Branch Coal Company are preparing plans for wireless telegraph service between the several coal mines in Harlan County, Kentucky, and the main offices in Louisville. The sending apparatus will be located in the Black Mountains, Harlan County, where the Cumberland range reaches its highest elevation in Kentucky. The receiving end, it is stated, will be on the Starks building, Louisville. The distance on an air line is about 200 miles and by rail nearly 300 miles.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

A Closed Core Transformer That Has Several Advantages

The transformer that I am about to describe was designed in accordance with the article by R. H. Chadwick in the December, 1915, issue of THE WIRELESS AGE. If the directions given in this article are followed carefully the owner will be well satisfied with the results of his work.

First to be considered is the core. This is built of insulated laminations of silicon steel. The cross-section of the core is 2 inches by 2 inches, and the steel is 1/64 of an inch thick. One hundred and sixty pieces, 2 inches wide by 11 inches long, and 160 pieces, 2 inches wide by 6 inches long, shellaced on both sides, are required. These can probably be bought cut to the right size for about $1.50. If not, it is best to shellac the big pieces before cutting them as it is rather tedious to shellac a number of small pieces.

The core is built up as follows: Take one of the long pieces and place it on the table, then take another and place it on top of the first, so that one end will project 2 inches over the end of the first piece (Fig. 1). Take a third piece and put it in a position like the first, a fourth like the second, etc., until eighty pieces have been used. Repeat with the other eighty pieces and the core legs for the primary and secondary windings will be completed.

The next step is to find out the voltage of the A. C. mains. Do not take it for granted that it is 110, but find out by getting in communication with the electric lighting company. Having determined the voltage, the primary should next be considered.

For 110 volts four pounds of No. 14 D. C. C. wire will be needed; for 220, eight pounds. Take one of the legs of the core, wrap it with about six layers of empire cloth and fasten the empire cloth with tape. Begin winding one inch from the edge of the empire cloth and wind to within one inch of the other end. Then make a loop in the wire 4 inches long to take a tap from. Put one layer of empire cloth over the winding and start back again. Be sure that the wire in this second layer goes around the core in the same direction as that in the first. Continue winding in this way until 6 layers have been wound (12 layers for 220 volts), then fasten the wire. The whole primary should now be given a good coat of shellac to keep the end wires in place.

The secondary comes next in the order of construction. This is usually where the builder's troubles begin. The number of secondary turns is the same for 110 and 220. Eight pounds of No. 32 enameled wire are required, the cost being about $1.08 per pound. The secondary, should be wound on a lathe

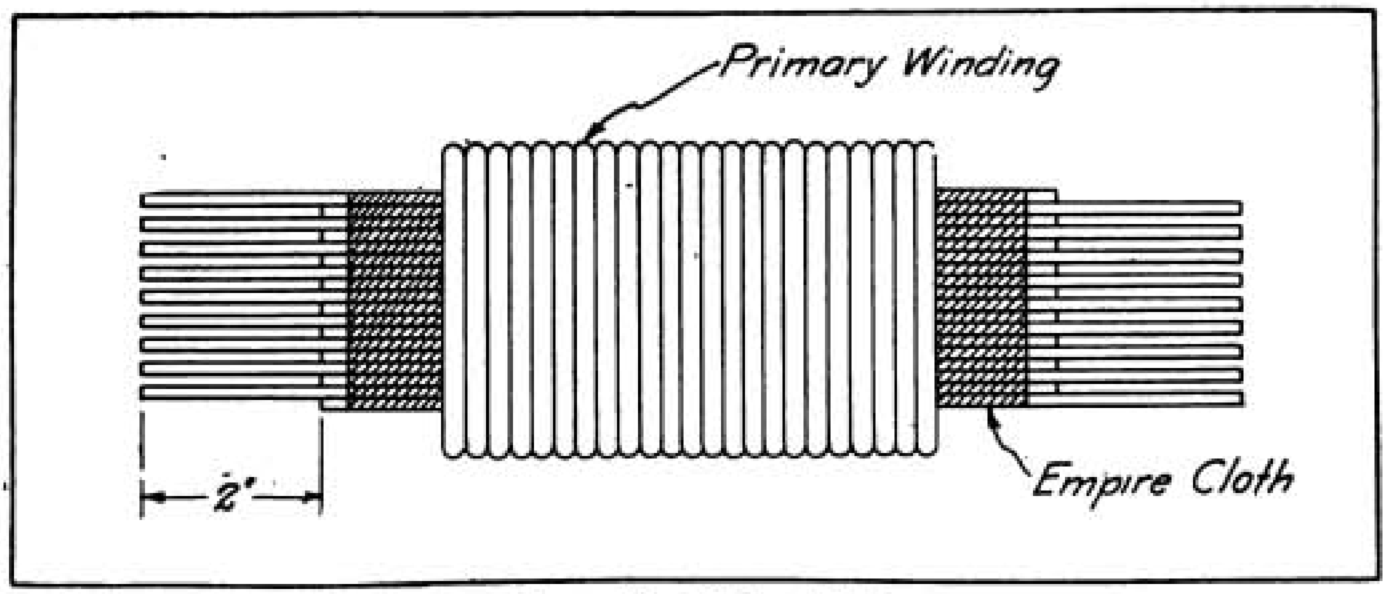


Fig. 1, First Prize Article

or a winding machine, and the wire must be run through hot paraffine while being wound.

The secondary is divided into twenty-four pies ¼ of an inch thick. Each pie is wound on a form (Fig. 2). If a winding machine is to be used, cut two

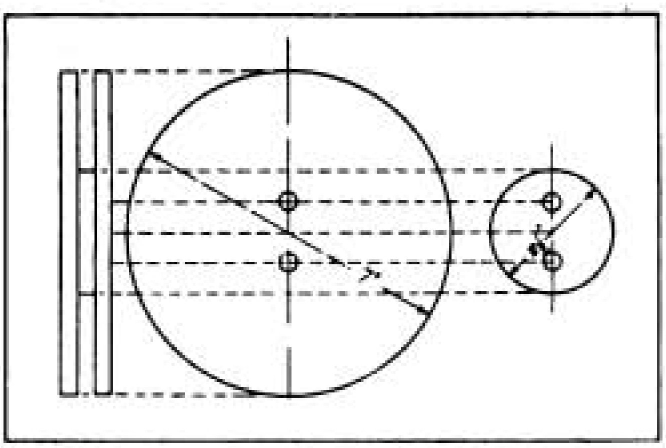


Fig. 2, First Prize Article

wood disks 7 inches in diameter for the sides of the form. If a lathe is to be used it is best to use the face plate for one side and screw the center disk and the other side of the form direct to the face plate.

A very good paraffine tank can be made as follows: Take a can (a baking powder can is about the right size, and cut out half of the cylindrical part, leaving both ends whole (Fig. 3). Solder the cover on the can and then drill hole A (Fig. 3), to take a small sized shaft. Use a small brass rod for the shaft, and put an empty spool on it. Then solder around the ends of the shaft. The spool should be wedged in place, as its purpose is to keep the wire well into the paraffine, not to act as a pulley. If it is allowed to turn it will throw the paraffine badly. The tank should be propped up about six inches and an alcohol lamp put under it to keep the paraffine hot.

To make the pies, wrap three or four thicknesses of paper around the center of the form so that the pie will come off easily; thread the wire through the paraffine, fasten it to the form, and then wind on 1,700 turns. If a lathe is used and it runs at constant speed, the best way to count the turns is by time. For instance, if the lathe is going at 170 R.P.M. wind for ten minutes on each pie. The lathe should not be run faster than 300 R.P.M. in any case.

After the twenty-four pies are wound, cut sixty-nine disks of empire cloth, 7 inches outside diameter and 2½ inches inside diameter. Then begin assembling the secondary on the core leg as follows: Take one pie and put four strips of tape around it (Fig. 4) so as to guard against possible loosening of the turns, and put it on the

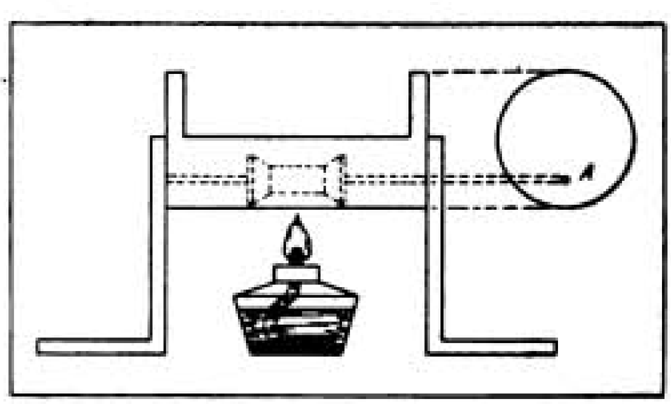


Fig. 3, First Prize Article

core one inch from the edge of the empire cloth. Then put on three disks of empire cloth and then the next pie,

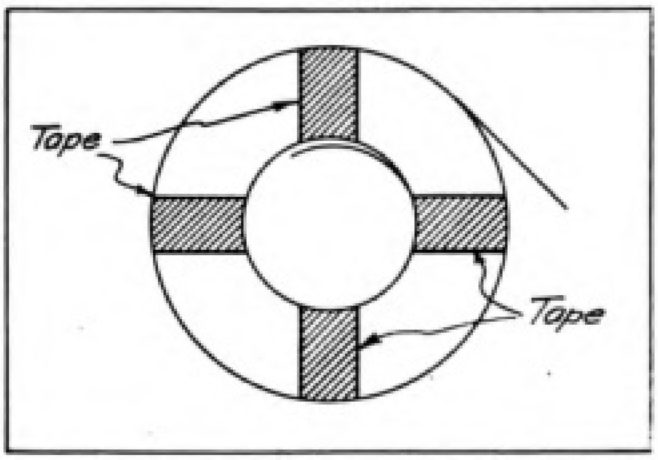


Fig. 4, First Prize Article

but put this pie on so that its wire runs the opposite way from that of the first. This is most easily understood by studying Fig. 5 carefully. Solder the two inside wires (those next to the core) together. Then put on three more disks of empire cloth and the third pie. The wire in this is to go in the same direction as that in the first one. Connect the outside wires of the second and third pies, the inside wires of the third and fourth, the outside wires of the fourth and fifth, etc., until all twenty-four have been put on.

The construction is now complete, except the assembling of the core. This is done by placing the primary and secondary legs in a parallel position 4 inches apart and building up the end, as shown in Fig. 6.

If properly constructed the transformer should give a heavy spark with a 50 watt lamp in series with the primary and a small condenser across the secondary. It will not heat at all, even on full power, and on low power will hardly "blink" the lights. The secondary voltage is 12,000, which makes the current easier to insulate than a higher voltage.

EDWARD M. SARGENT, *California.*

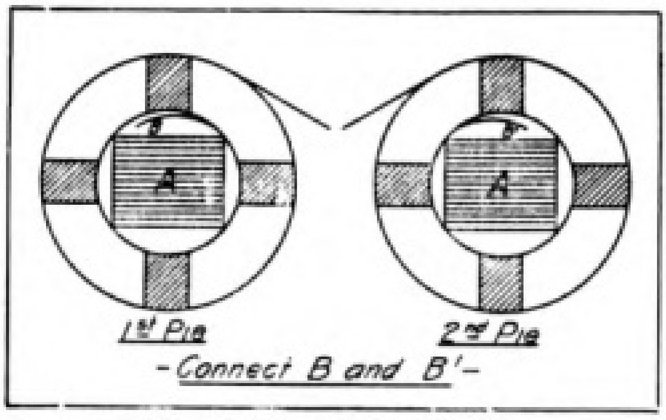


Fig. 5, First Prize Article

SECOND PRIZE, FIVE DOLLARS

A Device for Measuring Wire During a Coil Winding

An amateur's laboratory is not completely equipped unless it has a device for measuring the wire during the process of winding a coil. With the device I have designed the wire, in order to be measured needs only to pass over a series of spools; thus the measuring and winding operation may be performed in a single stroke.

The construction of the measuring device is clearly shown in Figs. 1, 2 and 3. First cut from a 1 inch by 6 inch piece of hard wood stock the piece A, as in Fig. 1. It should be 8 inches in length. At one end attach the piece B in Fig. 1, this being cut from the same stock in such a manner as to leave pro-

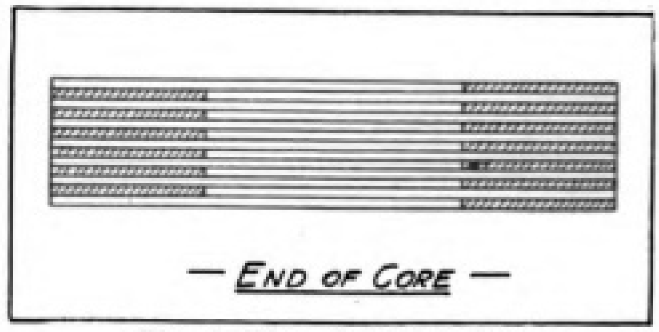


Fig. 6, First Prize Article

jections to carry friction wheels I and J (Figs. 1 or 2).

Next cut a measuring wheel as at C, Fig. 1 or 2. This should be 4½ inches in diameter, cut from the same stock. A groove finished flat, transversal to the radius, should now be cut until it has an exact length of 12 inches. The wheel is then placed on a shaft in D, Fig. 1, which projects through the end piece B and also through the bearing piece, E, and is attached to the revolution recorder, F, which is securely clamped to the block, G, in Fig. 1. A good recorder may be secured at any automobile or bicycle shop for a very nominal sum. A piece of iron rod, H, size optional, should be threaded at one end and placed in the board A at H (Fig. 1). This is intended for the spool of wire. The friction wheels, I, J, K, should next be made and attached as shown in Figs. 1 and 2. Also construct the wheel, F, counter to the wheel, L, the former being made to fit the flat groove of the latter. The ten-

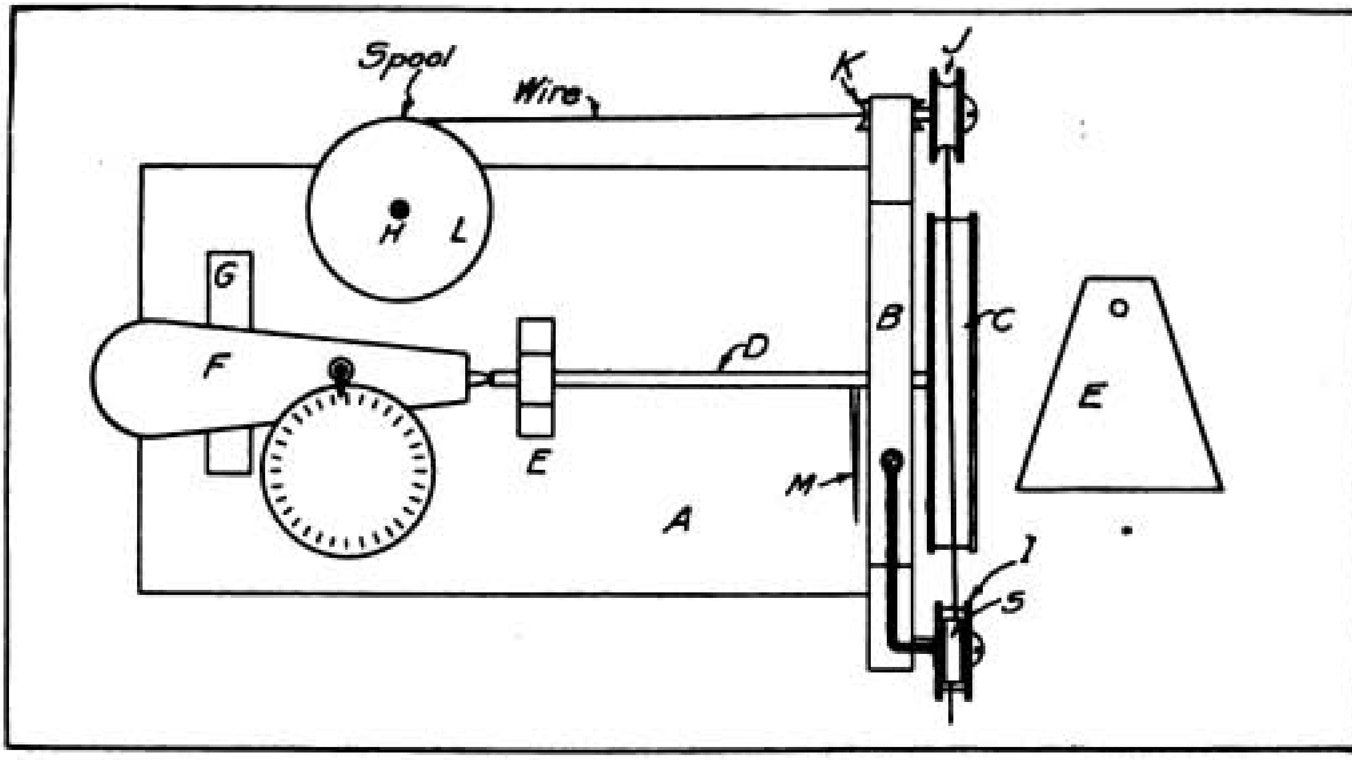


Fig. 1, Second Prize Article

sion wheel, S, should be mounted on a spring which is preferably adjustable so that in case of a break or stop the wire will not slip.

To operate the recorder proceed as follows: Run the wire from the spool L, in Fig. 1, under the friction guide, K, and over J, and continue it over and around the measuring wheel, C, and on through the tension holders, L and S. From this point the wire should be led directly to the tube being wound.

A pointer, M, in Fig. 1, should be made and placed in the shaft, D, close to the piece, B; cut a piece of white paper the size of the wheel, C, and calibrate it into twelve equal parts. Then glue it to the inside of the piece, B. The pointer will then indicate the number of inches and the revolution counter the number of feet which have passed the spot where the wires pass the top of the wheel, C. During the process of construction great care must be exercised to make all bearings and friction surfaces fit snugly yet loosely, thereby reducing all resistance and friction to a minimum, since too much tension might break or at least strain the insulation on very small wire.

MELVIN W. WALLACE, *Oregon.*

THIRD PRIZE, THREE DOLLARS
A Machine for Twisting Litzendraht Cable

Litzendraht consists of stranded wire cable with each strand insulated from the other. Amateurs frequently

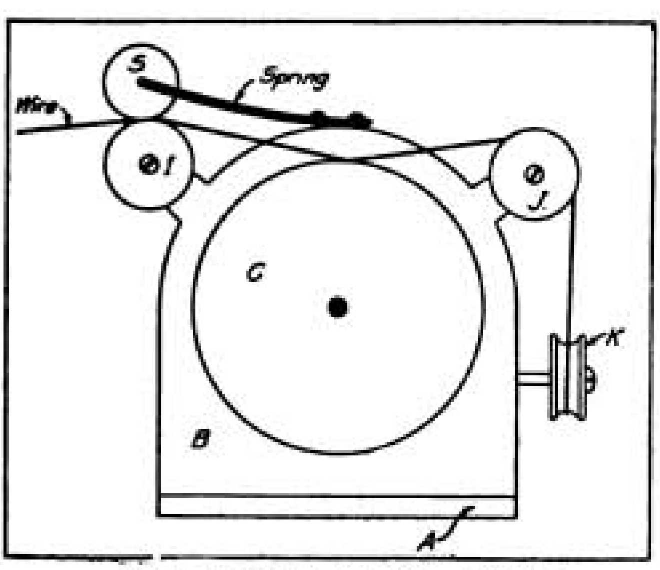


Fig. 2, Second Prize Article

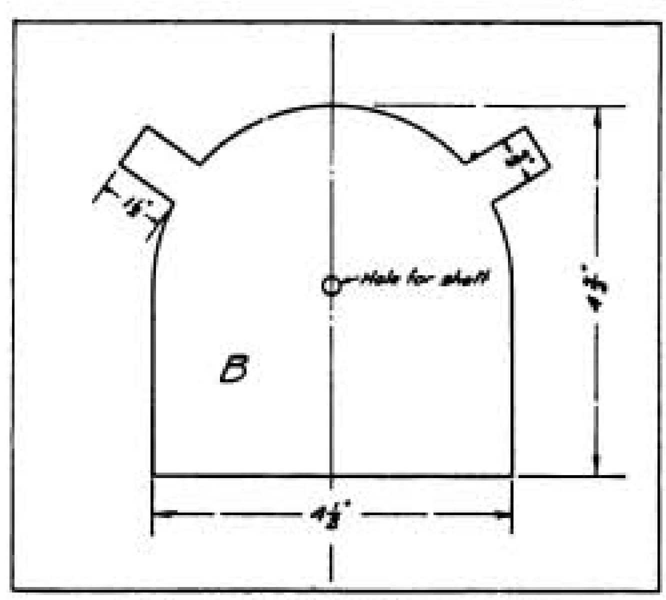
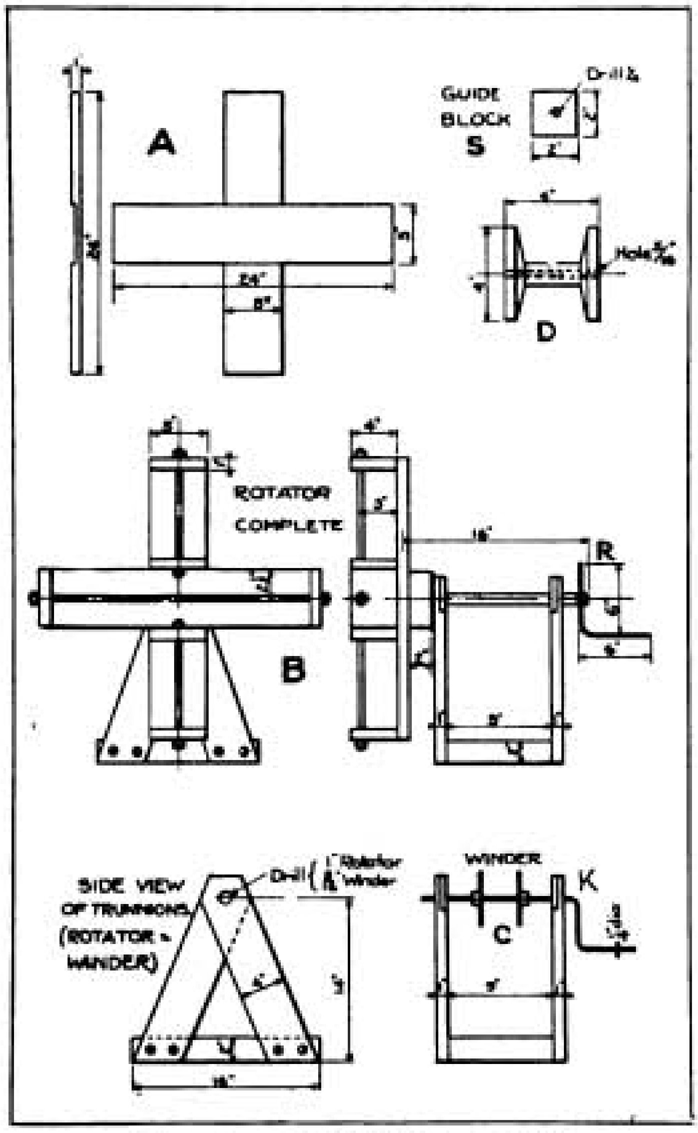


Fig. 3, Second Prize Article

desire to make use of this wire, but after finding the price is about 30c. a foot, undertake to construct the cable themselves. But the task is found to be hopeless unless the apparatus suitable for making the stranded cable is understood. Litzendraht wire gives numerous advantages, particularly in the windings of tuners and radio frequency circuits; in fact, the use of this



Drawing, Third Prize Article

wire is imperative for a decremeter, as its constants are not altered by changes in frequency. In addition, the high frequency resistance of Litzendraht is very low; in fact, almost at the same value as the ohmic resistance. To some extent it eliminates the condenser effect, which is so objectionable in coils of ordinary enamelled wire. Again, if several strands of the wire should become broken, the entire circuit is not immediately interrupted. Repairs can be delayed till an opportune time.

A description of a machine for making Litzendraht which has withstood long and hard, yet successful service, follows:

Halve together two pieces of oak 1 inch in thickness, with other dimensions 24 inches by 5 inches, A. Secure a 16-inch length of 1-inch pipe and drill a hole half through the joint, A, that is a driving fit for the pipe. To strengthen this structure make an extra block, 2 inches by 5 inches by 5 inches, and drill a hole in it to fit over the pipe. Fasten it to the back of the joint. A piece of ¼-inch rod, 12 inches in length, is bent at right angles in the middle and is used as a crank. It is to be slipped through a hole drilled crossways in the pipe, 1 inch in from one end, and is made adjustable by a set screw. Make the trunnions for this as in the drawing. These should be made very carefully and strong, as the crank shaft that they support must run at high speed. Cut six pieces of wood, 1 inch in thickness, into rectangles 4 inches by 5 inches. One inch in from the 5-inch edge on each and also in the middle, drill a ¼-inch hole. Fasten these to the cross piece as per the drawing. Mount axles of ¼-inch steel fitted with nuts to hold them in place in these holes. After putting the crank in position, slide the pipe through the bearings and drive it into the hole in the cross piece. This part, the rotator, is now complete (B).

A proper winding mechanism must now be constructed and the actual design will vary with the materials at hand. A handy type is indicated in the accompanying drawing. It is self-explanatory (C). A guiding block must be used to bunch the wires. A piece of steel ⅜ of an inch in thickness and 2 inches by 2 inches must be secured; a ¼-inch hole should be drilled through its center. The hole is carefully countersunk on both sides and then filed and smoothed with emery to a glass-like finish. If there is the slightest roughness on this piece, it will break the wire or scrape off the insulation.

The simplest way to make up a Litzendraht cable is to purchase five pounds of No. 32 B. & S. enamelled

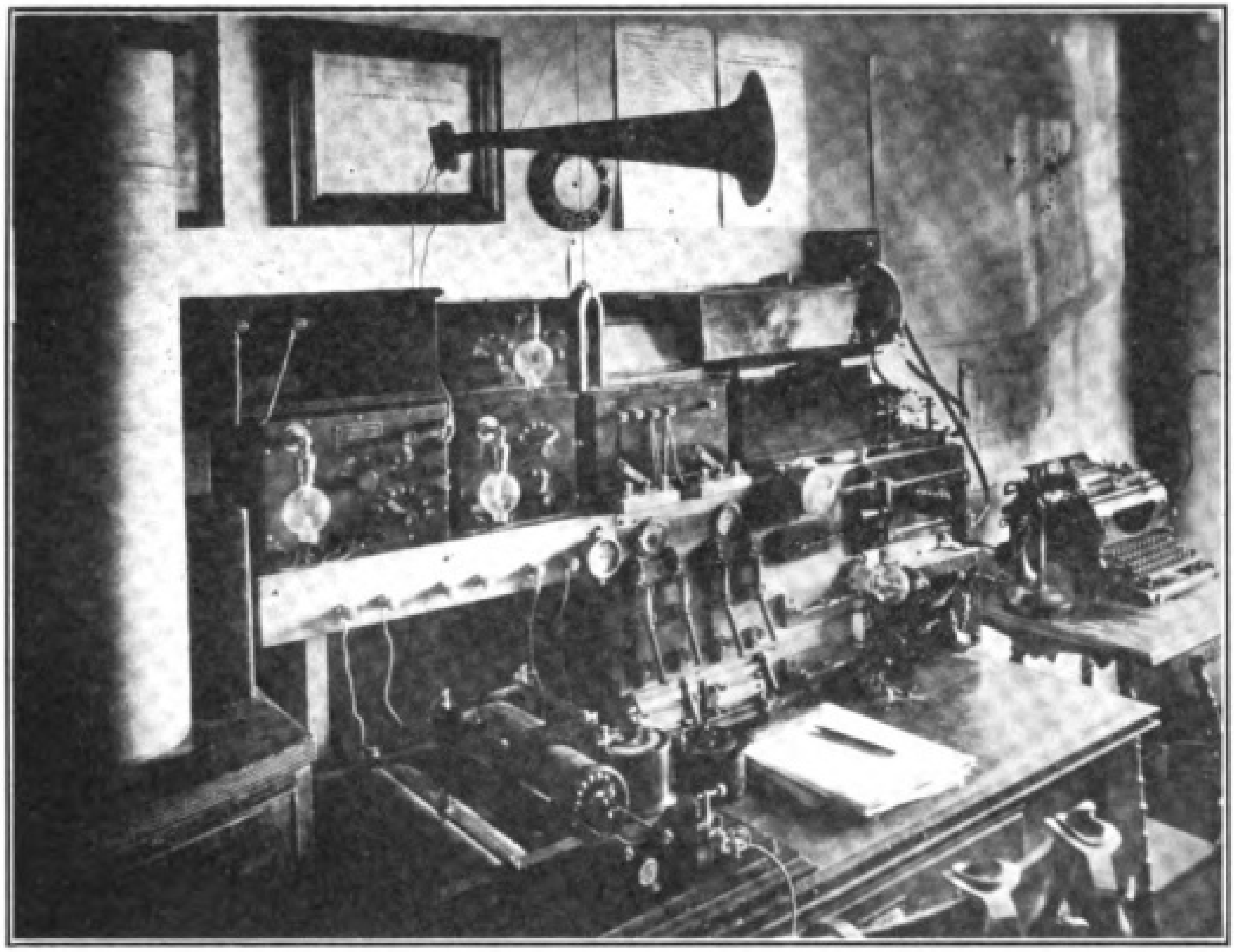


Illustration accompanying Fourth Prize Article. Station of Chris. M. Bowman

copper wire and one 1-pound spool and mount these on the rotator. However, any quantity desired may be used. Spools (D) can be purchased at any wire supply house for 10c. each, and the lot evenly divided among them. The spools on the rotator must all weigh the same.

A rather large spool must be used on the take-up reel. The rotator and the take-up reel should be mounted ten feet apart. The five strands of wire are then slid through the guiding block (F) and hooked on to the spool (K). Crank (R) should be rotated ten times to one of crank (K). The guide block (F) is held about 2 feet from the take-up reel.

There are 5,112 feet of No. 32 B. & S. enamelled copper wire to the pound, and a pound costs about $1.25. Thus Litzendraht cable made by this method costs about $0.00125 per foot. The resultant cable is about the size of No. 20 B. & S.

RAYMOND F. ADAMS,
District of Columbia.

FOURTH PRIZE, SUBSCRIPTION TO WIRELESS AGE

A Station With an Excellent Record for Long Distance Receiving

The wireless enthusiast is generally interested in wireless stations which have performed unusual long distance receiving work. Therefore a description and a photograph of my receiving station should be of interest to the readers of THE WIRELESS AGE. The transmitting and receiving apparatus are compactly mounted so that they are within reach of the operator who may remain in his chair. The transmitting set is of ½ k.w. to 1 k.w. capacity and derives its power from the city mains at 110-volt direct current. This passes through a rotary converter of 1 k.w., delivering 80 volts alternating current. The switchboard is therefore equipped with measuring instruments and switches for both direct and alternating current. The usual open circuit, hot wire ammeter is also mounted on the switchboard. The antenna switch and the circuit breaking switch for the rotary converter starting box are so placed that they can be operated simultaneously by a single movement of one hand. Similarly, the rotary gap switch lever has an extension handle placed directly over the key so that the same movement which starts the motor brings the hand to the transmitting key. A shunt switch throws the necessary choke coils in or out of the circuit. Oil immersed transmitting condensers are employed and in addition, protective resistance rods are placed across both the alternating current and direct current line.

Three aerials are employed, either separately or in any combination, through selective switches. It may interest some amateurs to know that the transmitting range of this apparatus extends into thirty-two counties of four states.

A conspicuous portion of the receiving set is the triple vacuum valve amplifier with loud speaker horn, as shown in the photograph, also the large coils employed in the use of the "Armstrong circuit" as well as the complete switchboard. With the triple vacuum valve amplifier, spark stations have been heard in daylight from the Atlantic to the Mississippi River, and from Canada to Cuba. With a single wire aerial 500 feet in length and a single valve hooked up according to the Armstrong circuit, continuous wave stations have been heard from Canada to the Canal Zone and from Germany to California. The signals from Arlington when employing the spark set have been copied 300 feet from the loud speaking horn, and signals from practically all stations along the Atlantic Coast in the United States have been received loud enough to copy on the typewriter, or to send many miles on the long distance telephone. Occasionally, radio telephone conversations have been heard, although their origin has not always been definitely known.

The entire equipment is mounted on a table 28 inches by 48 inches. The wall space required is only 58 inches in height from the floor by 48 inches in length. The set is not fastened to the wall in any manner, as all parts are attached directly to the table and are self-supporting, so that it could be moved without putting the set out of commission.

I shall be glad to give additional information concerning my equipment through correspondence to those who desire it.

Chris. M. Bowman, *Pennsylvania.*

HONORARY MENTION

Distances Covered with a 200 Meter ½ k. w. Set

We thought it would be a matter of interest to the amateur field to know the distances that can be covered with a 200 meter transmitting set of ½ k. w. power connected to an 80-foot aerial raised to a height of 50 feet above the earth.

We recently established communication with an amateur at Centerville, Cal., which is 310 miles north and near San Francisco. The owner of the receiving station employed a vacuum valve detector, but our station was not similarly supplied, as we had a galena detector only.

We also exchanged calls with an amateur at Richmond, Cal., 350 miles distant and about 10 miles north of San Francisco. He used a galena detector for receiving purposes. We have received a letter from an amateur located in Pocatello, Idaho, 700 miles distant, saying that our signals had frequently been heard there. Now and then we communicate with an amateur at San Diego, Cal., 115 miles south. These results would seem to disprove the statement often made that the amateur experimenter is limited in his work to local communication. The range northward into Idaho is especially noteworthy, when it is remembered that high mountains are believed to interfere with wireless waves.

Howard C. Seefred and Lyndon Seefred, *California.*

HONORARY MENTION

A Detector of Simple Construction That Remains in Adjustment

My experiments have led me to believe that the cat whisker receiving detector is more of an annoyance than anything else. I therefore constructed an efficient substitute.

The accompanying drawing shows the construction is very simple and should be understood at a glance. A piece of fibre tubing from an old fuse, about ½ inch in diameter, has placed in it two brass discs, A and B, of any thickness to fit flush in the tube. The disc, A, is inserted about ¼ of an inch from the end, after which a number of zincite particles are placed in the tube, sufficient quantity being used to take up a space of about ¼ of an inch. Place the tube in an upright position and tape it lightly so that the filings will pack closely. Then pour about an equal quantity of copper, silver and brass filings on top of the zincite and treat in the same manner, tapping the sides to pack them closely.

Next insert the disc, B. Press disc A and disc B together as tightly as possible and by means of hot sealing wax, permanently hold A and B in position. The final leads for connection to the binding posts are taken from wires soldered to A and B. As will be seen from the drawing, the entire detector takes up a very small amount of space, being no more than 1½ inches in length.

A detector of this type has been in use at my station for more than a month. I have found it exceedingly satisfactory, and it does not require continual readjustment.

PAUL A. BURVANT, JR., *Louisiana.*

HONORARY MENTION

Low Temperature Alloys for Crystal Mounting

The following formulae present a combination of metals which will melt at very low temperatures. A little consideration will show which of the combinations is the cheapest. Some combinations will melt at a higher temperature than it is advisable to use, but if caution is exercised in allowing the alloy to cool before mounting, no injury to the crystals will result. The following temperatures have been verified, and may be relied upon if the metals are chemically pure:

TABLE NO. 1

Bismuth ...	8	
Lead	4	Liquid at 212° F.
Tin	4	

TABLE NO. 2

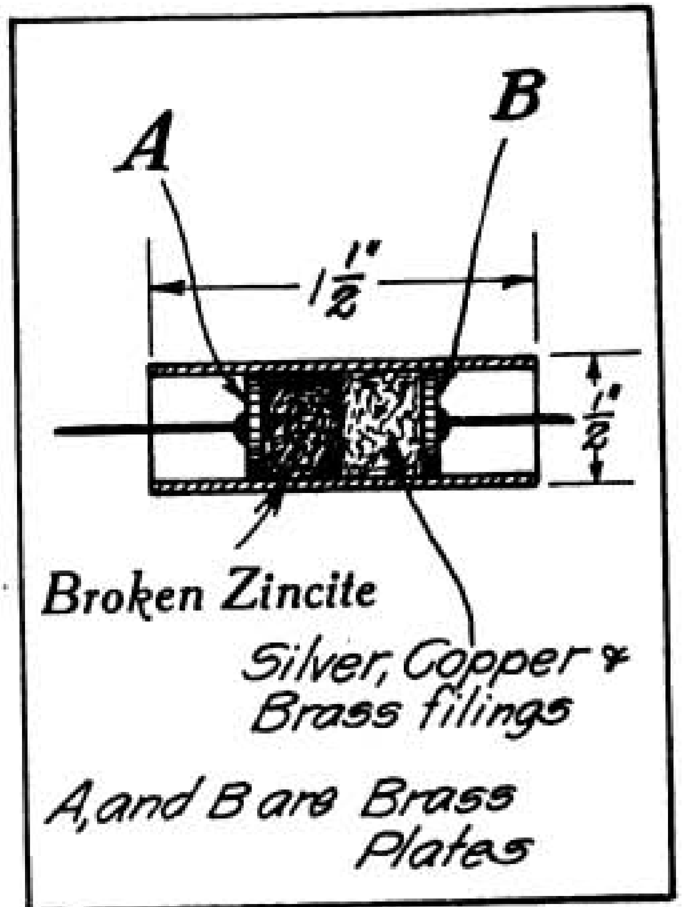
Bismuth ...	8	
Lead	5	Liquid at 202° F.
Tin	3	

TABLE NO. 3

Bismuth ...	5	
Lead	3	Liquid at 197° F.
Tin	2	

TABLE NO. 4

Mercury ..	250	
Bismuth ..	50	Liquid at 113° F.
Tin	25	
Lead	25	



Drawing, Honorary Mention Article, Paul A. Burvant, Jr.

TABLE NO. 5

Lead	26.90	
Bismuth ..	50	
Tin	12.78	Liquid at 149° F.
Cadmium .	10.40	

TABLE NO. 6

Bismuth ...	8	
Lead	6	Liquid at 208° F.
Tin	3	

TABLE NO. 7

Bismuth ...	8	
Lead	8	Liquid at 226° F.
Tin	3	

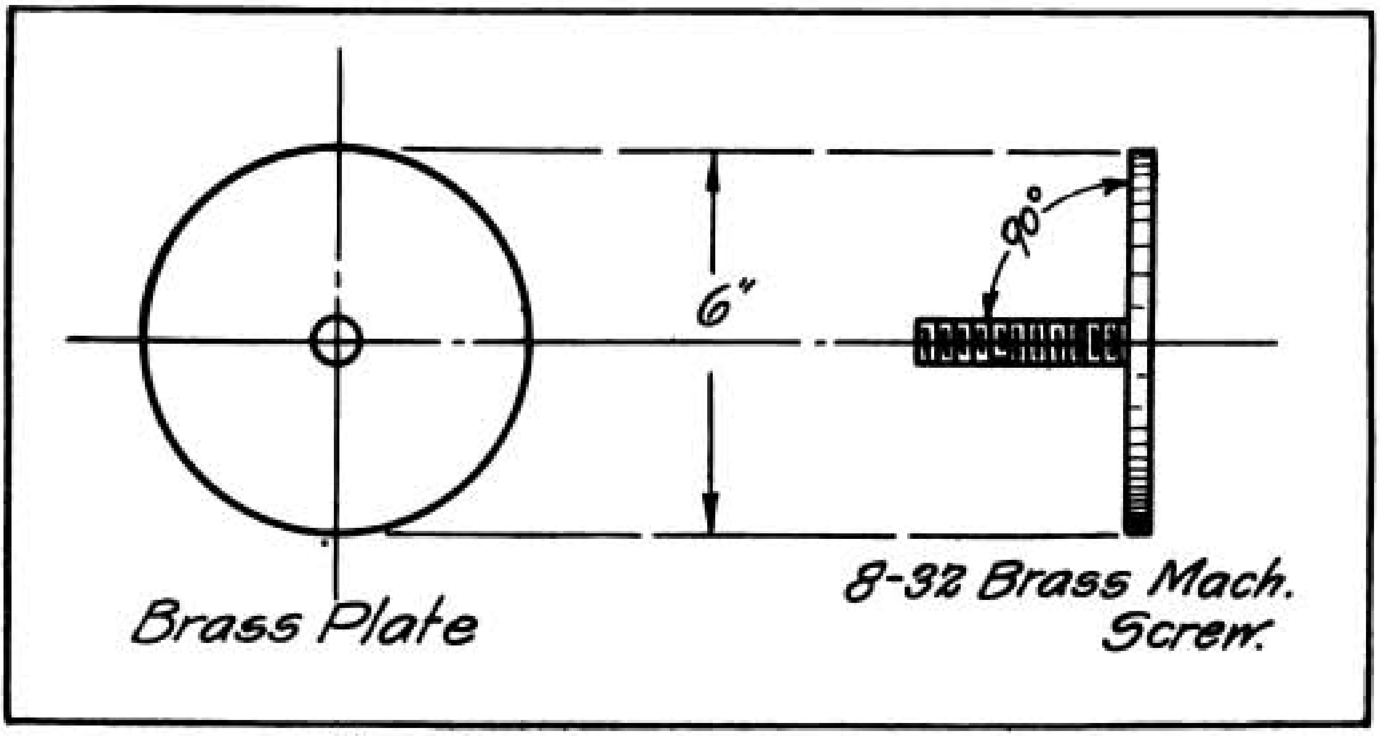


Fig. 1, Honorary Mention Article, Gaile Stowell

TABLE NO. 8

Bismuth	2	
Lead	5	Melts in boiling water.
Tin	3	

O. G. FURMAN, *California.*

HONORARY MENTION

A Variable Condenser Which Can Be Made At Slight Cost

In the following article I shall endeavor to set forth the construction of an efficient variable condenser, which can be made at a slight cost from material found in any amateur's workshop. This type of variable condenser has a relatively small capacity, yet it is sufficient for the secondary of the average loose-coupler.

Procure a sheet of either zinc, brass, copper or aluminum, 6 by 12 inches. On this draw two circles, with a diameter of 6 inches, forming two plates. Cut these plates out and smooth the edges with a fine file. Next, solder an 8-32 brass machine-screw to one of these plates in the exact center, taking care that the axis of the screw is perpendicular to the plate. Then solder a 3-inch length of 8-32 threaded brass rod or else a 3-inch brass machine screw to the other plate, taking care that the axis of the rod is perpendicular to the plate. The plates should then appear as in Fig. 1. Next construct a case for the condenser as follows:

Prepare a base for the instrument 5 inches by 3 inches. The end pieces are 3 by 4 inches, of ¼-inch wood. Holes to pass an 8-32 screw are drilled in each end-piece, as shown in Fig. 3. Then these end-pieces are fastened to the base, as shown in Fig. 2. Next, solder an 8-32 nut to a brass strip; this strip has two holes ⅛ of an inch in diameter, drilled as shown in Fig. 3, the nut being soldered over one hole.

Now, the condenser is ready to assemble. Place the plate with the short machine-screw in one of the ends, and fasten with a nut. The plate with the longer screw is placed in the other end, and the brass strip screwed on the out-

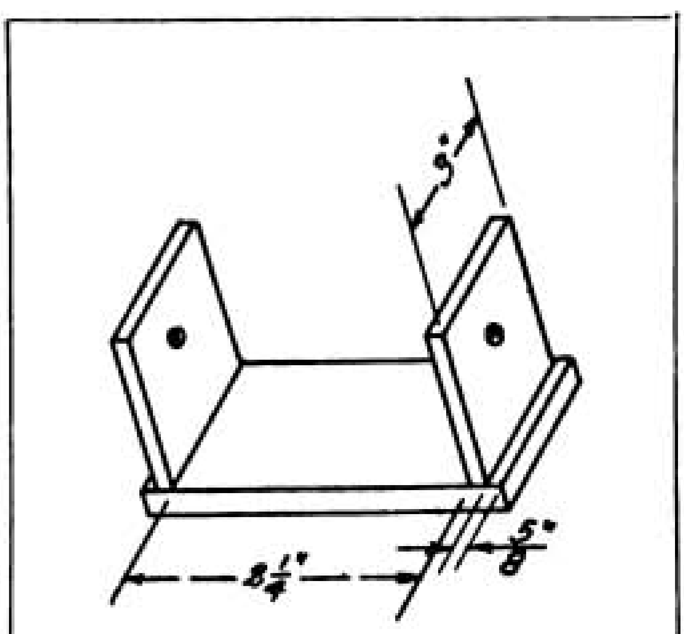


Fig. 2, Honorary Mention Article, Gaile Stowell side of the end-piece. The strip should hang downwards, and a ⅛-inch hole drilled where the other hole in the strip falls. Then an 8-32 machine-screw is placed in this hole and secured by a nut on the outside. Fasten a hard-rubber knob on the longer machine-screw, and the condenser is completed. It should then appear as in Fig. 4. Leads are taken off at the binding-posts A and B, in Fig. 4. The condenser operates as follows:

The movable plate approaches the stationary plate, thereby increasing the capacity. A narrow circular band of paper should be glued on the surface of the stationary plate to prevent the short-circuiting of the condenser. When the plates are at the maximum distance apart, the capacity is very nearly zero.

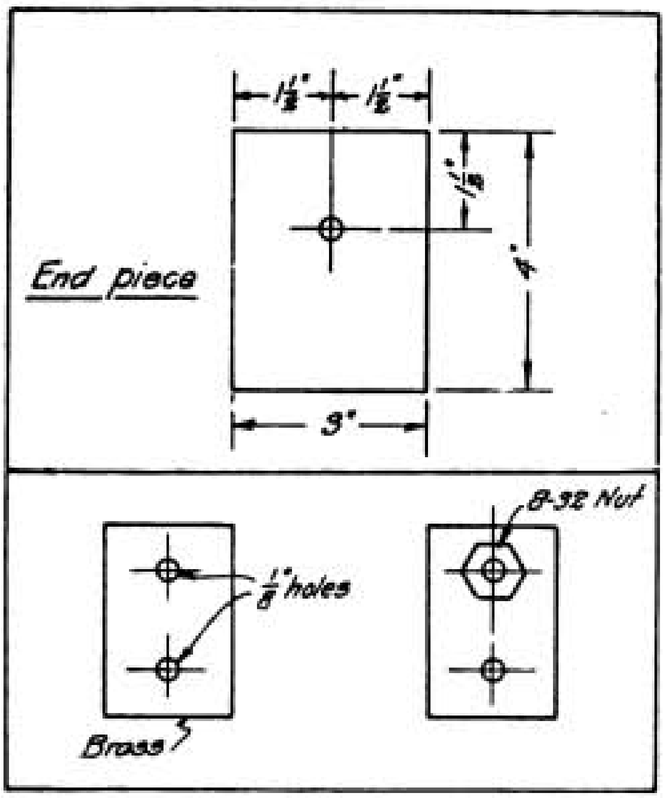


Fig. 3, Honorary Mention Article, Gaile Stowell

If desired, the instrument may be mounted in a case which completely encloses it, leaving only the hard-rubber handle projecting. The cost of the finished instrument should not exceed twenty-five cents, providing the work is done by the experimenter himself. The finished instrument will make a handsome and efficient addition to the set of any ameteur.

GAILE STOWELL, *Iowa.*

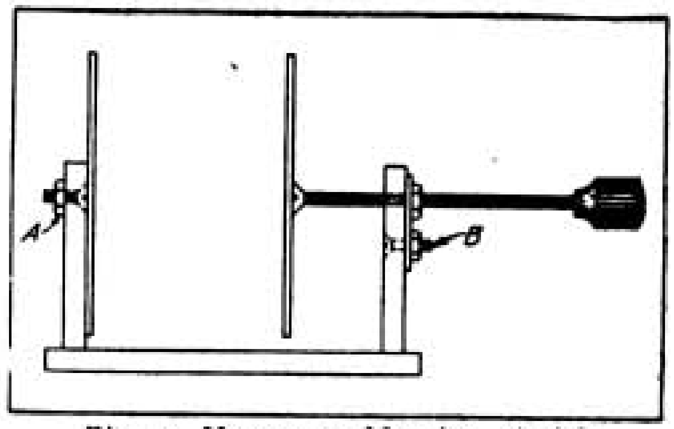


Fig. 4, Honorary Mention Article, Gaile Stowell

LONG DISTANCE COMMUNICATION

I noted in the April issue of THE WIRELESS AGE an article by R. H. E. Mathews, regarding long distance transmission. While I have nothing positive to advance, I have experienced about the same results as Mr. Mathews. According to the radio list the call letters of his station are 9-IK. I have frequently heard 9-IK, 9-GJ, 9-JB, 9-KV and 9-EV. I have established direct communication with 9-PC and 8-ZW; also 8-NH. I recently received a letter from 9-JB (Winnetka, Ill.), saying that he received my signals very well. On April 9, I heard 9-PC and 1-ZL communicating with each other directly, and seemingly without any trouble whatsoever. Station 9-PC is in Fort Wayne, Ill.; 1-ZL in Northampton, Mass., and 1-CM, Laconia, N. H. These results apparently should not be considered as "freaks," as they can be obtained almost every evening.

Although I have worked 1-ZL and 1-CM, I seem to have considerable difficulty in reaching them. I have no difficulty, however, in transmitting to stations located in the western part of the United States, although I experience the greatest difficulty in transmitting northeast. I have an aerial of the inverted L type directional westward which may account for the latter difficulty. I should like to hear from the owners of other stations in regard to this last matter.

JACOB WEISS, *New York.*

The 135-foot spire of Trinity Church, Watertown, N. Y., is used as an aerial tower by the local Boy Scout troop.

Vessels Recently Equipped with Marconi Apparatus.

Names	Owners	Call Letters
Oliver J. Olson	Standard Oil Co. of New Jersey.	WNB
Harry Luckenbach	Luckenbach Steamship Co.	KGX
Navahoe	R. Lawrence Smith, Inc.	KOR
Freshfield	R. Lawrence Smith, Inc.	VEZ
Starlite	Standard Oil Co. of New Jersey.	KPK
Moonlite	Standard Oil Co. of New Jersey.	KPL
Twilite	Standard Oil Co. of New Jersey.	KPO
Dawnlite	Standard Oil Co. of New Jersey.	KPP
Sunlite	Standard Oil Co. of New Jersey.	KPQ
Daylite	Standard Oil Co. of New Jersey.	KPR
Barge The Limit	Whitney Bros. Co.	WCV
Munplace	Munson Steamship Line.	KUG
Munsomo	Munson Steamship Line.	KUK
Republic	John A. Hooper.	(Not assigned)
Campana	Standard Oil Co. of New Jersey.	KOM
Nebraskan	Garland Steamship Corporation.	WKY
Tug Vigilant	Moore & McCormick Co., Inc.	(Not assigned)

THE SHARE MARKET

NEW YORK, May 10.

Except for the securities of the Canadian company which have received strong support from buyers in the Dominion, Marconi shares have for the past month remained quiet and steady in a dull market. Owing to the provision of the English act against trading with the enemy, no stocks not held in Great Britain prior to September 1, 1914, can be sold on a British exchange. On account of this limitation of the market, American prices on English shares have ruled lower than the quotations in London. On the New York Curb, the activity in shipping, sugar and metal shares have drawn speculative interest away from other classes of stocks. Within the past week, both interest and prices have shown improvement.

Bid and asked quotations today: American, 3¼-3½; Canadian, 2-2½; English, common, 10-10½; English, preferred, 8½-11.

MAKING PROGRESS AT MARE ISLAND

The construction of the 300-foot towers for the new long distance wireless station at Mare Island, near San Francisco, Cal., is under way. When the 30 k.w. apparatus is installed Mare Island will be in constant communication with ships of the American navy along the coast as far as the southern boundary of Mexico. In addition, navy officers will be able to communicate directly with any station on the Pacific and the Government station at Arlington.

EASIER TO SEND BY DAY THAN AT NIGHT

The wireless service men with the American punitive expedition into Mexico, it is related, were surprised to discover that conditions in that country were exactly the reverse of those in the United States. In the United States the wireless operators find that the night time is much better for the transmission of dispatches. South of the border the day time is best.

There is so much atmospheric disturbance at night in Mexico that wireless men prefer the day as a time for operating. This is not due to the altitude, which is 7,000 feet, but to the minerals in the mountains, especially iron ore.

Guglielmo Marconi was forty-two years old on April 25.

National Amateur Wireless Association

OFFICERS OF THE ASSOCIATION.

PRESIDENT, Guglielmo Marconi.

NATIONAL ADVISORY BOARD OF VICE PRESIDENTS

Professor A. E. Kennelly,
Harvard University.
President, Institute of Radio Engineers.

Professor Samuel Sheldon,
Polytechnic Institute of Brooklyn.

Professor Alfred N. Goldsmith
College of the City of New York.

Professor Charles R. Cross,
Massachusetts Institute of Technology.

Hiram Percy Maxim,
President, American Radio Relay League.

Major William H. Elliott,
Adjutant General, Junior American Guard.

Capt. W. H. G. Bullard, U. S. N. Superintendent, U. S. Naval Radio Service.

Lieut.-Col. Samuel Reber, Signal Officer, U. S. Army.

E. E. Bucher, Instructing Engineer, Marconi Wireless Telegraph Company.

ADMINISTRATIVE OFFICERS:

ACTING PRESIDENT,
J. Andrew White,
Editor, THE WIRELESS AGE.

MANAGING SECRETARY,
Clayton E. Clayton,
450 4th Avenue, New York.

A national organization of wireless amateurs was announced in the October, 1915, number of THE WIRELESS AGE. Further details of the organization are given in an address made by J. Andrew White, which was published in the November WIRELESS AGE. Reprint copies sent upon request.

MEMBERS' EQUIPMENT.

1st. CERTIFICATE OF MEMBERSHIP.

The handsomely steel-engraved Certificate, with shadow background half-tone, is sealed and signed by Officers, with the endorsement of Senatore Marconi, as President. Every member will want to frame and place it alongside of his Government License certificate, two documents establishing status as wireless amateurs.

2nd. AERIAL PENNANT.

The 36 inch aerial pennant, painted in four colors on scarlet felt, will stand long service at your aerial mast head. Every member will be proud of the National Insignia flying from his aerial.

3rd. MEMBERSHIP PIN.

The National Amateur Wireless Association Pin in gold and enamel is the National emblem of the Association. The design shown on the preceding page can but faintly describe its handsome appearance in three colors and gold. The pin has a special patented hub and shank which permits it being securely fastened on the coat lapel or on the vest without turning upside down.

4th. LIST OF RADIO STATIONS OF THE WORLD.

Revised Edition just published. See advertisement. Regular 50c edition.

5th. HOW TO PASS U. S. GOVERNMENT WIRELESS LICENSE EXAMINATIONS.

Regular 50c edition of this popular book. Members who already have a copy, see concessions below.

6th. HOW TO CONDUCT A RADIO CLUB.

This splendid book, which has been months in preparation and incorporates portions of articles running under the same title in THE WIRELESS AGE, is re-written to cover every new development, and with a large proportion of new matter. It is the foundation stone of the National Amateur Wireless Association activities. Price of this book 50c.

7th. MONTHLY BULLETIN SERVICE.

It is intended to make the monthly bulletin service for members of the National Amateur Wireless Association one of the most important features of the Association. This bulletin is to be used in connection with "List of Radio Stations of the World" described above. It will carry all additions (both amateur and commercial) to "List of Radio Stations of the U. S.", issued by the Bureau of Navigation, U. S. Department of Commerce, and secured for members at 18c a copy. The Government list is issued only once a year. The Association Bulletin will keep both lists up to date for you month by month, and in addition, will carry other special and invaluable Association features not obtainable elsewhere

8th. ONE YEAR'S SUBSCRIPTION TO THE WIRELESS AGE.

THE WIRELESS AGE is the Official Organ of the National Amateur Wireless Association and will contain full reports of wireless amateur activities, both national and local. It is planned to give published recognition to individual amateur achievement.

CONCESSIONS:

Those who, *during the past six months,* have become subscribers to THE WIRELESS AGE, or have renewed their subscription, or have purchased any portion of the Membership Equipment, may consider such payment as partial payment of Membership Application as given below. If you have paid for a subscription to THE WIRELESS AGE which includes books which are not a part of the Membership Equipment, then you may credit $1.25 of the remittance as partial payment on the Membership. For example, you may have remitted $2.25 for the combination offer of the 1915 Year Book with one year's subscription to THE WIRELESS AGE. In this combination, the price of both the book and the subscription was reduced, to make the special offer; therefore, you may be credited only with that part of the payment which went to the magazine—that is, $1.25. *Coupon subscribers receive no credit for trial orders.* Subscribers to THE WIRELESS AGE who *began or renewed more than six months ago,* will secure through Membership dues a renewal for another year; and their subscriptions will be extended for one year from the time the present subscription expires.

INITIATION FEE

An initiation fee of $1.00 is required of all new members to pay for the initial membership equipment, consisting of Nos. 1, 2, 3, 4, and 5.

ANNUAL DUES

The annual dues are to be not more than $2.00. For this, all members are to receive:

1st. The Monthly Bulletin Service.

2nd. THE WIRELESS AGE for one year.

3rd. How to Conduct a Radio Club or equivalent.

4th. 10% discount on any book on wireless published, and other features to be announced later.

SPECIAL NOTICE REGARDING CORRESPONDENCE.

As the National Amateur Wireless Association is in no sense a money making enterprise, and as the nominal dues will cover a very small amount of handling expense, it is desired that the correspondence be limited to only the most essential necessities. A cordial invitation is extended to all club officials to write on matters pertaining to organization. This invitation also includes those who are interested in starting new clubs.

Charters Out of the amount paid by each member for annual dues, it is purposed to allow organizations that have become part of the National Amateur Wireless Association a rebate of 50 cents out of each $3.00 for their own treasury—a fund to take care of local expenses. Please note that this is a rebate, not a deduction. In order to qualify for recognition as a unit in the National Amateur Wireless Association, a club must have at least five active members and at least one-quarter of its total membership become members of the National Amateur Wireless Association. Clubs securing a charter will have representation in the National Council; this means that they elect their own delegate and thus secure a voice in the management of the Association and in the planning of its future development and activities.

Clayton E. Clayton, Managing Secretary,
450 4th Ave., New York.

Checks and money orders should be made payable to: Natl. Amateur Wireless Assn.

APPLICATION FOR MEMBERSHIP.

CLAYTON E. CLAYTON, Managing Secretary,

NATIONAL AMATEUR WIRELESS ASSOCIATION, Date...............

450 4th Avenue, New York City.

As I desire to receive full recognition as an amateur wireless worker of the United States, I ask the privilege of enrollment as a Member in the National Amateur Wireless Association and request that you send me the complete Members' Equipment for which I enclose herewith remittance of $1.00 Initiation Fee, covering Initial Equipment, and $2.00 for First Annual Dues—or $3.00 in all. Option.*

I trust that you will act upon my application promptly and forward the equipment to me at the earliest possible date.

My qualifications for membership are given in blank spaces below.

Signature .... Age..............

Street Address ....

Town and State..

Please credit me with $........ paid for......................

* Option.

In the event that an applicant is unable to send the entire amount of the membership dues with this application, the figure $3.00 may be crossed out and $1.00 written in its place. This will be considered an agreement on the part of the applicant accepted for Membership that the balance of dues ($2.00) will be paid at the rate of 50c per month for the next four months, at which time pin, pennant and Certificate of Membership will be issued. The other equipment will be sent at once.

FILL IN ANSWERS TO THESE QUESTIONS.

1—Have you a Government License (give number.........) or do you purpose applying for one?..

2—If you are under 21 years of age, give names of two adults for references as to character.

Reference..

Reference..

3—If you are a member of any Local, State or Interstate wireless club or association, give its name, and name of Secretary with address.

....

4—Are you now a subscriber to THE WIRELESS AGE?........................

5—If you already have any books included in the equipment, state which ones.........

....

National Amateur Wireless Association

A DIRECTING ORGANIZATION DEDICATED TO THE PROMOTION OF RADIO COMMUNICATION

CALL LETTERS 9PY
S. W. PIERSON
CARROLLTON, ILLINOIS

GUGLIELMO MARCONI, PRESIDENT

Reduced fac-simile of letter head.

For Clubs and Members of National Amateur Wireless Association

The following list of items of optional equipment is listed at cost price in order to give members and clubs of the Association every material advantage in the way of a complete equipment that may be desired. Prices include transportation charges to 5th Parcels Post Zone. Postage extra to 6th, 7th and 8th Zones.

LETTER HEADS AND ENVELOPES:

100 National Association Letter heads with imprint of member at left hand side, as illustrated above 75c

Without member's imprint........ 35c

100 Envelopes with imprint...... 65c

Special prices on 1000 Letter Heads to Clubs.

MESSAGE BLANKS:

Pads of 50.................... 10c

STATION LOG BOOK:

A record book in which to keep track of all your operations and communications, in paper........ 15c

in cloth 30c

RADIO STATIONS OF THE U. S.:

Call list issued by the U. S. Department of Commerce, postpaid.. 18c

PHOTOGRAPHS AND PICTURES:

Photographs of important stations, such as Belmar, Arlington, Sayville, Honolulu, etc., 9" x 12", each $1.00

Duotone picture of G. Marconi, with facsimile signature, suitable for framing 25c

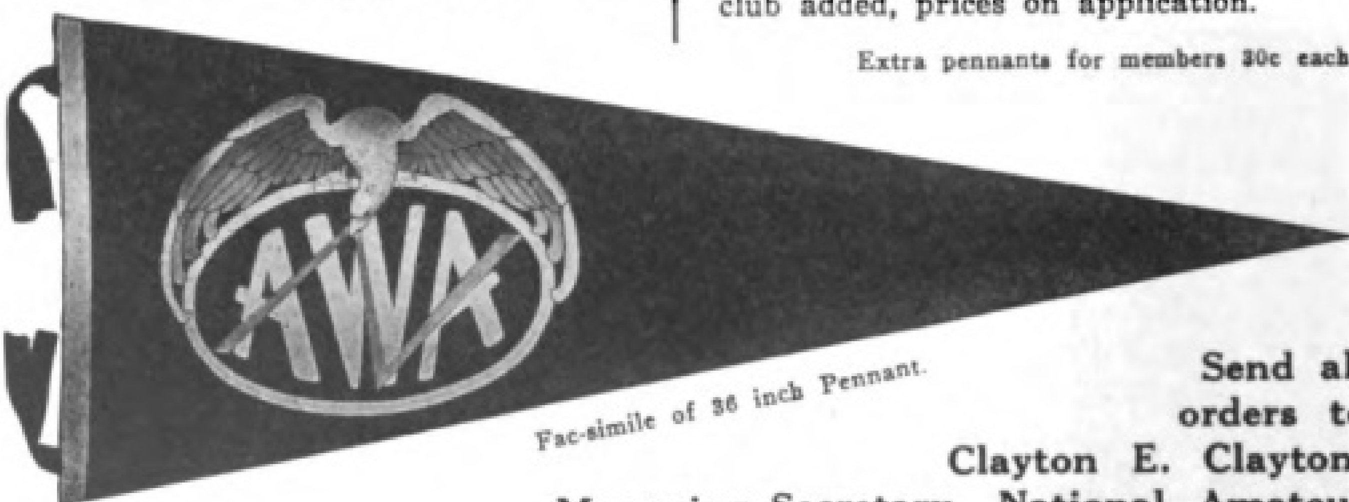
SOLID GOLD BUTTONS, 14 Karat N. A. W. A. emblem............ $1.75

WIRELESS MAP OF THE WORLD in colors 50c

YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, published at $1.50, special to members and clubs $1.10

CLUB PENNANTS: Made of first quality wool bunting, letters and emblem sewed on with cut outs in color and name of club added, prices on application.

Extra pennants for members 30c each



Fac-simile of 36 inch Pennant.

Send all orders to Clayton E. Clayton, Managing Secretary, National Amateur Wireless Association, 450 Fourth Ave., N. Y. City.

Queries Answered

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

Positively no Questions Answered by Mail.

G. K., Vincennes, Ind.:

You should purchase a text book covering the fundamentals of amateur wireless telegraph apparatus and familiarize yourself with the underlying principles. The book "How to Conduct a Radio Club" is recommended for the solution of your problems. The aerial, 30 feet in length by 20 feet in height, has a natural wave-length of approximately 80 meters; with it you can expect a small sending or receiving range. With the ½-inch spark coil as the source of power, you should be able to transmit a distance of one or two miles. The receiving equipment you describe should allow communication with local amateurs, but it is rather doubtful whether you will be able to hear signals at a great distance.

For continuous and uninterrupted service, an alternating current transformer is superior to a spark coil. To communicate one or two miles, a 1-inch or 2-inch spark coil fulfills the requirements. Many amateur stations are able, with a 2-inch spark coil, to communicate thirty miles.

* * *

J. C. M., Larchmount, Norfolk, Va., inquires:

Ques.—(1) Please give me data concerning the natural wave-length of an aerial consisting of four wires, with the usual spacing, 51 feet in length and 40 feet in height.

Ans.—(1) The fundamental wave-length of this aerial is approximately 165 meters. The inductance value is approximately 40,000 centimeters and the capacitance about .0002 microfarad.

Ques.—(2) Please give the possible wave-length adjustment with a receiving transformer connected to this aerial, the transformer having the following dimensions: The primary winding is 4 inches in length, 3½ inches in diameter, wound with No. 30 single cotton-covered wire; the secondary winding is 3½ inches in length, 3 inches in diameter, wound with No. 36 single silk-covered wire.

The additional equipment comprises a perikon detector, a Mesco variable condenser with a capacity of .001 microfarad and a pair of Brandes superior 2,000-ohm telephones.

Ans.—(2) The primary winding will raise the wave-length of the antenna described in the first query to about 1,500 meters.

The secondary winding shunted condenser of .0001 microfarad will respond to a wave-length of 2,000 meters, but with the capacitance of .001 microfarad in shunt will afford a wave-length adjustment of about 5,000 meters. You will observe that, in order to keep the antenna circuit in resonance with the secondary winding at the longer range of wave-lengths, a loading coil of considerable proportions is required.

Ques.—(3) Basing your answer upon the diagram of connections accompanying my query for the Marconi Type D tuner, approximately to what range of wave-lengths would my receiving apparatus tune?

Ans.—(3) Your diagram of connections is incorrect. The fixed stopping condenser should be connected in series with the lead from one of the sliders to a terminal of the detector. The potentiometer and head telephones may either be shunted about the fixed stopping condenser or placed around the crystal detector. With the circuit thus corrected the Type D tuner should permit response to wave-lengths (with the aerial referred to in the first query) up to 3,000 meters.

* * *

R. F., Jr., Rosebank Post Office, Grasmere, N. Y., inquires:

Ques.—(1) Please state the natural period of an aerial, 65 feet in length, 35 feet in height, with a lead-in 40 feet in length. It comprises four wires, spaced 2 feet 5 inches apart.

Ans.—(1) The fundamental wave-length is approximately 168 meters.

Ques.—(2) What would be the natural wave-length of the same aerial with the lead-ins attached to the center, the latter being 20 feet in length.

Ans.—(2) In this case the fundamental wave-length would be between 90 and 100 meters.

Ques.—(3) Which of the two aerials described will be the less directive?

Ans.—(3) The antenna of the T type.

Ques.—(4) Regarding wave-length, which aerial is the better for operation at the wave-length of 200 meters?

Ans.—(4) The first described aerial will give the best results, as the dimensions are well within the limits for operation at the wave-length of 200 meters.

* * *

H. F. W., Montpelier, Vt., inquires:

Ques.—(1) Will you kindly explain why the buzzer circuit of the receiving set, described in the October, 1915, issue of THE WIRELESS AGE, is connected to the potentiometer battery circuit?

Ans.—(1) In the later sets of this type the buzzer testing circuit has been completely disconnected from the potentiometer battery circuit and connected to independent binding posts. Crystals of carborundum often give better response from a buzzer testing circuit when one terminal of the buzzer tester is attached directly to some portion of the circuit.

Ques.—(2) What are the requirements of any potentiometer battery in the matter of voltage and amperage?

Ans.—(2) For crystalline detectors, the maximum value of potential need not exceed four volts. The current output of the battery in any receiving set is unimportant, because these detectors generally require only a very small fraction of an ampere.

Ques.—(3) How is provision made in receiving sets for a variation of the ratio of the capacity to the inductance of the circuit in order to maintain the same wave-length?

Ans.—(3) For the antenna circuit this is accomplished by connecting a variable condenser in series with the earth lead. By proper selection of capacity at the condenser and corresponding inductance value at the aerial tuning inductance, or at the primary winding of the receiving oscillation transformer, the wave-length of the circuit can, with a change of decrement, be maintained. There are limits, with a given antenna system, over which this variation may be carried. To have a particularly noticeable effect upon the wave-length of the antenna system, the maximum capacity of the variable condenser must be somewhat near that of the antenna itself, because when two condensers are connected in series the resultant capacity is nearer to that of the smaller one; consequently a condenser of large capacity has but little effect upon an antenna of small capacity. At the secondary winding of the receiving tuner, the desired ratio of inductance to capacity is obtained at the multiple point switch connected to the secondary winding and at the variable condenser connected in shunt to this winding. For the best strength of signals the capacity of the condenser in the secondary winding must be kept at a low value; at the most it should not exceed .001 microfarad and it is more usual to employ a capacitance of about .0005 microfarad.

Ques.—(4) On what wave-lengths do Arlington and Sayville transmit when employing the undamped oscillation transmitter?

Ans.—(4) The wave-length of Arlington is between 6,000 and 7,000 meters; the wave-length of Sayville is about 9,000 meters.

Ques.—(5) Please give the approximate dimensions for the construction of a condenser to have a capacity of .04 microfarad. The dielectric is to be extra thin paraffin tissue paper.

Ans.—(5) One surface of the condenser should have ap-roximately 1,200 square inches of foil. Knowing the dimensions, you can rearrange the construction of the condenser to suit the design of your receiving set. For example: it may be made up of a number of small sheets of tinfoil, say, 3 inches by 6 inches, with a sufficient number of sheets connected in parallel on one side of the condenser to represent a total area of 1,200 square inches.

* * *

W. O. S., Ithaca, N. Y., inquires:

Ques.—(1) Please tell me the wave-lengths and the capacity in microfarads, of the following aerials:

Aerial No. 1 is 100 feet in length, 30 feet in height, with a 50-foot lead-in, and is of No. 14 wire throughout. Aerial No. 2 has two wires, 360 feet in length, 30 feet in height, with two 50-foot lead-ins. This aerial has seven strands of No. 22 wire, with a lead-in of No. 12 wire.

Ans.—(1) The fundamental wave-length of the first described aerial is approximately 237 meters and the total capacitance about .00035 microfarad. The fundamental wave-length of the second aerial is approximately 560 meters and the capacitance about .00128 microfarad.

Ques.—(2) Please give a formula for the capacity of two parallel wires.

Ans.—(2) The following formula is applicable:

$$C = \frac{L}{4 \times 9 \times 10^5 \times 2.3026 \log_{10} \frac{2D}{d}}$$

where C = the capacity in microfarads;
L = the length of the wire in centimeters;
d = the diameter of the wire in centimeters;
D = the distance apart of the axes in centimeters.

* * *

M. H. P., Lansing, Mich., inquires:

Ques.—(1) In the beat receiver diagram, described on page 82 of the book "How to Conduct a Radio Club," what is the function of coils L-5 and L-6? What part do coils L-6, L-7, L-11 and L-12, shown in the February Monthly Service Bulletin of the National Amateur Wireless Association, play in the operation of the apparatus?

Ans.—(1) The coupling transformer L-5 and L-6, is used for impressing oscillations of the wing circuit upon the grid circuit of the vacuum valve; this is said to result in an increase of the amplitude. Similar functions are performed by the coils L-6 and L-7, L-11 and L-12, in the diagram published in the Bulletin. The complete circuits are known as regenerative circuits. The undamped oscillations which flow in the wing circuit are passed to the grid circuit, causing a periodic variation of the current in the wing circuit, which results in increased amplitude of oscillation.

Ques.—(2) Would the diagram shown in "How to Conduct a Radio Club" be as effective as that shown in the February Bulletin, if the second valve indicated in the Bulletin article were used as an amplifier for the apparatus described in the book?

Ans.—(2) An amplification of the signals will be obtained by adding the second valve to the circuit indicated on page 82 of the book, but it is quite probable that better signals will be received by the method indicated in the Bulletin. As therein stated, the great advantage of that circuit lies in the fact that the amplitude of the oscillations supplied from the local generator to the antenna circuit can be very carefully regulated by means of the coupling coil L-4, L-3. Both circuits are applicable to the reception of damped and undamped oscillations.

Ques.—(3) In both of these articles No. 28 single silk covered wire is recommended for the coils of inductance. What latitude on either side might be used and still maintain the same efficiency, the inductance value being kept about the same?

Ans.—(3) Certain experimenters report good results with loading coils for the wing and grid circuit made up of No. 36 single silk covered wire. It is not advisable, in our opinion, to go below No. 26. With No. 36 wire the dimensions of coils, of course, can be considerably less.

Ques.—(4) By placing a vacuum valve in a state of oscillation, is the internal action in any way injurious to the bulb, so that its working as an ordinary detector is impaired? And do all types of vacuum valves work satisfactorily in such circuits?

Ans.—(4) If the vacuum valve is one of the type in which considerable gas is present and the valve is worked beyond the point of ionization (blue glow) the filament is apt to disintegrate rather rapidly. If, however, the circuits described on page 82 of the book "How to Conduct a Radio Club" are used and the coils designed after the dimensions given, it is possible to set the valve in a state of oscillation below the characteristic blue glow point. Hence it will work as well in an ordinary circuit as when set into oscillation. Identical results are not obtained from all valves; it is found difficult to keep some of them in a stable state of oscillation: in fact, equal results cannot be obtained from two separate filaments in the same bulb.

Ans.—(5) A complete disquisition on the working of the vacuum valve under all conditions of oscillation is published in the proceedings of the Institute of Radio Engineers for September, 1915. Copies of the proceedings can be obtained from the Secretary, No. 111 Broadway, New York City. The price in the United States is $1 a copy.

J. S. G., Scranton, Pa.:

Ques.—(1) Please give the dimensions for a buzzer that will send about two miles.

Ans.—(1) The dimensions for a buzzer of this type are not necessary. Any of the small buzzers procurable in the amateur market will serve the purpose. Distances of several miles are only possible when an extremely sensitive receiving set is employed at the receiving station.

Ques.—(2) I should like to construct a condenser of .01 microfarad capacity, to be used with this buzzer. What are the correct dimensions for the foil?

Ans.—(2) The condenser should have approximately 300 square inches of foil. You may arrange the design to suit conditions. It may be made up of a number of small sheets, connected in parallel.

Ans.—(3) A complete circuit for amplifying the signals of a crystalline detector by means of a vacuum valve is published in the book "How to Conduct a Radio Club."

* * *

C. J. P., New York City:

The natural wave-length of a given aerial system is the same for either transmitting or receiving purposes. If the receiving tuner you describe actually has a possible wave-length adjustment of 3,000 meters, you certainly should be able to hear the signals from Arlington on an aerial 175 feet in length by 80 feet in height. Lacking the dimensions of the tuner, it is difficult to give proper advice, but if you will duplicate the coils and the diagram of connections appearing in the Monthly Service Bulletin of the National Amateur Wireless Association, for January, 1916, you will have a receiving equipment that will give very loud signals from Arlington in New York City. The tuning coils described are applicable to crystalline detectors as well as to the vacuum valve, with the exception that the capacity of the grid condenser C-2 must be considerably increased. It may have a value varying from .003 to .04 microfarad. The diagram of connections accompanying your query is quite correct, with the exception that it shows no variable contacts on the primary and secondary windings. For crystalline detectors, we prefer a secondary winding of No. 32 single silk covered wire.

* * *

A. T. R., Columbus, Ohio:

Ques.—(1) Regarding the rotary quenched spark gap, described in the February issue of THE WIRELESS AGE by Mr. Heninger: What should be the separation between the electrodes of the gap?

Ans.—(1) The electrodes should be separated by no more than 1/100th of an inch.

Ques.—(2) What is the capacity in watts of this set?

Ans.—(2) Between ¼ and ½ k.w. Please observe that the condenser capacity of this set is .02 microfarad, which is an excessive value for operation at the wave-length of 200 meters. The maximum value of capacity that can be employed for a wave-length of 200 meters is

.01 microfarad. The value is preferably .008 microfarad to allow for longer connecting leads to the various parts of the equipment.

* * *

L. L. H., Albany, Ore., inquires:

Ques.—(1) Please state the natural wave-length of this aerial: The flat top portion consists of two wires spaced 9 feet apart and the lead-in is taken off the high end. The flat top is 475 feet in length, 75 feet in height at one end and 35 feet at the other. The length of the lead-in is 100 feet.

Ans.—(1) The fundamental wave-length of this aerial is about 750 meters.

Ques.—(2) Please give the capacity in microfarads of the aerial referred to.

Ans.—(2) Approximately .00149 microfarad.

Ques.—(3) Where can I obtain a book giving the dimensions of standard bare copper wire, single and double cotton wire, also single and double silk covered wire?

Ans.—(3) Secure a copy of Foster's "Electrical Engineers' Pocketbook." The price is $5 a copy. Communicate with the Marconi Publishing Corporation, No. 450 Fourth Avenue, New York, for further particulars.

Your fourth query cannot be answered because the fundamental wave-length of your aerial is already in excess of 600 meters; therefore we could not give you the correct number of turns for the primary winding of the transformer, or the exact location of a dead end switch because you now require a short wave condenser. It is difficult to state the exact number of turns for a given secondary winding unless we are fully informed as to the maximum and minimum values of capacity for the condenser in shunt to that winding. You are advised to construct a wave-meter like that described in the Radio Club article in the March, 1916, issue of The Wireless Age. By placing this meter in inductive relation to the antenna system and exciting it with a buzzer you can preadjust your tuning coil to a distinct wave-length by experiment.

Regarding your query in reference to the calculation of inductance, in the article appearing in the August, 1915, issue of The Wireless Age: You are quite correct in your assumption. In the case of bare wire for the correction factor, D is taken as the spacing between turns and the ratio of $\frac{d}{D}$ is the ratio of the diameter of the bare wire to the space taken up between turns.

* * *

J. E. R., Albany, N. Y., inquires:

Ques.—(1) Please give me the necessary data for a closed core transformer of ¾ k.w. capacity to be operated at 110 volts 40-cycle alternating current. The secondary voltage is to be in the neighborhood of 12,000 volts.

Ans.—(1) We assume that you are already familiar with the laying out and assembly of the laminations for the core. If not, you should familiarize yourself with articles in the amateur department of The Wireless Age, where, in previous issues, the subject has been covered. These data are applicable. The outside measurements of the core are as follows: Length, 9½ inches; width, 7½ inches; thickness of the core, 1¾ inches. The primary winding is made upon one leg of the core and the secondary on the opposite leg. The primary winding consists of fourteen layers of No. 14 double cotton covered wire for which about six or six and one-half pounds are required. The secondary winding contains ten pounds of No. 34 enamelled wire made up in sections ¼ of an inch in thickness with an outside diameter of about 5½ inches. The inside diameter is approximately 2¾ inches. The secondary sections should be separated by insulating discs having a thickness of ⅛ of an inch. The primary and secondary windings may be insulated from the core by means of empire cloth at least ¼ of an inch in thickness.

Ques.—(2) Please tell me the receiving range and possible wave-length adjustment of the following equipment: The antenna has six wires 75 feet in length with an average height of 40 feet. The receiving tuner has a primary winding 4½ inches in diameter, 6 inches in length, wound with 210 turns of No. 26 enamelled wire. The secondary winding is 6 inches in length by 3¾ inches in diameter, wound with No. 30 enamelled wire. The apparatus also includes a galena detector, a variable condenser across the primary winding and a pair of 3,000-ohm head telephones.

Ans.—(2) The fundamental wave-length of the antenna system is approximately 220 meters and with the primary winding described will permit adjustment in that circuit to a wave-length of about 1,550 meters. A similar value of wave-length is readily obtained in the secondary winding. During the night time you should hear commercial stations located on the Atlantic coast. You require a loading coil in series with the primary winding to hear the time signals from Arlington, however.

* * *

R. B., Toledo, Ohio, inquires:

Ques—(1) What is the address and the cost a year of the Philosophical Magazine?

Ans.—(1) The annual subscription price is $9.90. Send your remittance to Taylor & Francis, 7½ Red Lion Court, Fleet Street, E. C., London, England.

Ques.—(2) Can the Proceedings of the Radio Institute be purchased by non-members? If so, what is the cost?

Ans.—(2) Copies of the Proceedings are sold to non-members for $1 each. Send your remittance to the Secretary, 111 Broadway, New York City.

Ques.—(3) What is the subscription price a year of Science Abstracts? Where can copies be purchased?

Ans.—(3) The New York agents for this publication are Spon & Chamberlain, No. 123 Liberty Street, New York City. This journal is divided into two sections; section A is devoted to physics; section B to engineering. The annual subscription price of a single section is $4.50 and for both sections $7.50. The price of a single copy is 40c.

J. C. McG., Wollaston, Mass., inquires:

Ques.—(1) Please give the approximate values of the capacity and inductance of wave-length of the following three single wire aerials: Aerial No. 1 is 135 feet in height: aerial No. 2, 155 feet in height, and aerial No. 3, 175 feet in height. The lead-in to each aerial is approximately 50 feet in length. The ground lead is 70 feet.

Ans.—(1) Aerial No. 1 has an approximate wave-length of 275 meters, a capacitance of .00033 microfarad and an inductance of 64,630 centimeters. Aerial No. 2 has a fundamental wave-length of 300 meters, a capacitance of approximately .000369 microfarad and an inductance value of 68,700 centimeters. Aerial No. 3 has a fundamental wave-length of 332 meters, a capacitance of .0004 microfarad and an inductance of about 77,580 centimeters.

To give the dimensions for a receiving tuner for a definite range of wave-length, as in your second query, we should have to know the inductance and capacity value of the particular aerial with which this is to be employed. For adjustment to a wave-length of 1,500 meters, the secondary winding of the receiving tuner may be 3½ inches in length by 3 inches in diameter, wound full with No. 30 single silk covered wire. A small variable condenser is, of course, connected in shunt with the secondary winding. The dimensions of the primary winding will vary with the size of the aerial. With the ordinary run of amateur aerials the primary winding may be 4 inches in length by 3½ inches in diameter, wound with No. 26 single silk covered wire. For crystalline detectors No. 32 wire is often preferred; hence the dimensions of the secondary winding in respect to length may be slightly decreased.

For 200-meter work an aerial of the inverted L type cannot exceed 50 feet in length for the flat top portion. One of the T type may be from 110 to 120 feet in length. The height from the earth should not exceed 50 feet with these dimensions.

* * *

J. J. C., Brooklyn, N. Y., inquires:

Ques.—(1) What is the fundamental wave-length of a three-wire aerial 85 feet in length, 35 feet in height? It is of the inverted L type.

Ans.—(1) The fundamental wave-length is approximately 210 meters.

Ques.—(2) Please give the dimensions for a loose coupler to be used in connection with a tikker detector for the reception of undamped oscillations from Sayville and other stations.

Ans.—(2) The secondary winding should be made up on a card board or hard rubber tube 6 inches in diameter, 14 inches in length, wound full with No. 24 single silk covered wire. This winding should be shunted by a condenser of .001 microfarad capacity. The condenser in shunt with the head telephone should be one of rather large capacity, approximately .05 microfarad. Condensers of even larger capacity have been effectively employed across the telephone circuit. We do not know the dimensions of the aerial with which this apparatus is to be employed, but the primary winding of the oscillation transformer may be 14 inches in length, 7 inches in diameter, wound closely with No. 22 single silk covered wire. If for use with your present small aerial the loading coil should be 36 inches in length, 7 inches in diameter, wound closely with No. 22 single silk covered wire. A loading coil of decreased dimensions can be employed if a variable condenser is shunted from the antenna to the earth. If your receiving station is already supplied with a variable condenser it will be cheaper to connect the apparatus in this manner, than to construct a loading coil.

* * *

L. B., Wildwood, N. J.:

A 4-wire aerial, 50 feet in length by 50 feet in height, of the inverted L type, has a fundamental wave-length of approximately 177 meters, which is quite the proper value for the transmission and reception on the 200-meter restricted wave.

Your receiving apparatus is probably adjustable to wave-lengths of 2,500 meters, particularly if the capacity of the condenser in shunt to the secondary winding is about .001 microfarad.

The station at Sayville operates at a wave-length of about 9,000 meters. An undamped oscillation generator is employed. The Marconi station at Cape Cod operates on press schedule, each evening, at fifteen minutes after ten o'clock, with a wave-length of 2,100 meters. The station is also fitted with a small transmitting set which operates at wave-lengths of 300 and 600 meters. The small set at Key West, Fla., for commercial correspondence, operates at a wave-length of 600 meters. This station is also fitted with a 25 k.w. spark set and 30 k.w. arc set, the latter using a wave-length of approximately 6,000 meters. The station at Darien, Isthmus of Panama, operates at a wave-length of approximately 7,000 meters and the signals are audible in New York City during the daytime with a supersensitive receiving set.

The Packard 500-watt 13,000 volt transformer, which we assume is to be operated on the 200-meter wave, should give you a daylight range of from thirty to forty miles and a considerably greater night range, depending on the type of apparatus used at the receiving station.

* * *

J. C., Rankin, Pa.:

The editor of this department has expressed his opinion in previous issues, concerning the range of wave-lengths to be obtained from the coils of a tuner. It is first necessary for us to know the maximum and minimum values of capacity of the condenser connected in shunt to the secondary winding. In addition we cannot estimate the range of the primary winding, unless information concerning the inductance and capacity of the aerial system with which it is to be employed is supplied. Roughly speaking, a secondary winding, 4½ inches in diameter by 6 inches in length, wound with No. 32 double cotton covered wire, should be responsive with a small condenser in shunt to wave-lengths of approximately 3,000 meters. No. 38 single silk covered wire is too small for receiving tuners. The resistance is detrimental to the flow of energy.

A loading coil, 2 feet in length, 6¼ inches in diameter, wound closely with No. 20 enamelled wire, will raise the average amateur aerial to a wave-length of about 6,000 or 7,000 meters.

The design of a 1 k.w. open core transformer is given in the book "How to Conduct a Radio Club." It is preferable to vary the power input to this transformer by an external reactance, which is easy to construct. Wind this coil with the same size wire used on the primary winding of the transformer proper. The aerial shown in your diagram is similar to that employed at the average station, and the indicated disposition of the lead-ins will not interfere with the reception of signals. We have stated many times in the columns of this department that a super-sensitive receiving set is required for reception of signals from Nova Scotia. It will be found extremely difficult to pick up these signals with receiving apparatus fitted with an ordinary crystalline detector.

* * *

L. H. M., Skagway, Alaska:

Mechanical interrupters have not proven to be as efficient as the ordinary hammer break fitted to the usual induction coil. The interrupter shown in your drawing should be shunted by a condenser having at least 8,000 square inches of tinfoil, separated by a thin sheet of paraffin paper. We have no additional advice to offer, but believe you will soon discover that the life of the contacts on your interrupter is limited.

* * *

R. M., San Francisco, Cal.:

The appearance of an ether wave, as set up by a transmitting aerial, is depicted on pages 106 and 107 of the "Text Book on Wireless Telegraphy," by Rupert Stanley. The subject is described in the book "Wireless Telegraphy and Telephony," by A. E. Kennelly. For each cycle of current in a wireless telegraph aerial, there is set up two distinct sets of electric loops or strains, with their forces acting in opposite directions. The greatest distance between two points in a succession of waves at which the strain is at a maximum and in the same direction is the wave-length of the emitted energy.

* * *

E. B. D., Baltimore, Md.:

The results you have obtained with Poulsen tikkers are of interest. A reconstructed receiving tuner is advised in connection with the Armstrong circuit, as described in the "Proceedings of the Institute of Radio Engineers." A secondary winding of No. 32 wire is better for the vacuum valve detector, while the primary winding may be of No. 24 or No. 26 wire.

If you desire to receive strong signals from undamped transmitters, construct a receiving tuner after the design given in the book "How to Conduct a Radio Club."

Concerning potentiometers: The better method for constructing a non-inductive potentiometer is to take two spools of the resistance wire and wind two layers side by side simultaneously. The beginning terminals should be connected together and the extreme ends connected to the source of energy. Constructed in this manner, inductive effects will be practically absent.

Regarding your last query: A multi-layered loading coil, regardless of the radio frequency circuit in which it is to be used, is not practical. A high frequency current will not traverse the turns of a multi-layered winding.

* * *

R. A. M., Ione, Cal., writes:

Ques.—(1) I have a 200 cycle, alternating current generator with a spark gap mounted on the end of the shaft. The oscillation transformer is placed about two feet from the generator. Are the windings of the generator liable to be short circuited or burned out by induction from the high voltage current flowing through the oscillation transformer?

Ans.—(1) If the frame of the generator is connected to earth, you need not fear that the windings of the generator will be affected by direct induction from the oscillation transformer. It is desirable, however, to keep the low voltage mains in a radio station at a considerable distance, or at least at right angles to the circuits of radio frequency.

Ques.—(2) I have an inductively coupled receiving tuner of the usual construction, but I cannot hear certain stations unless I set the secondary switch in contact with two taps. In other words, one section of the secondary winding is short circuited. What is the cause of this phenomenon?

Ans.—(2) This merely indicates that the multiple point switch fitted to your secondary winding does not afford sufficient closeness of adjustment to place the secondary circuit in resonance with the primary circuit. This can be overcome by fitting the secondary winding with a small variable condenser. Then the lack of closeness of adjustment in the secondary switch can be compensated for by small values of capacity at the condenser.

Ques.—(3) My 200-cycle generator has six poles. How many plugs should I use on the spark gap to get the very best results?

Ans.—(3) For a synchronous discharge there should be six electrodes on the disc. This will give a spark for each alternation and will produce a musical pitch.

* * *

A. C. M., Seattle, Wash.:

We advise you to secure a copy of the "List of Radio Stations of the World," on sale by the Marconi Publishing Corporation. The call letters of the Canadian Northwest stations are contained in this list.

Ques.—On what wave-length does NPW (Eureka, Cal.) work?

Ans.—For commercial correspondence this station operates with the standard wave-lengths of 300 and 600 meters.

* * *

L. M. C., Rochester, Pa., writes as follows:

The belief is generally held by amateurs that the quenched spark gap is applicable only to 500-cycle sets. After an extensive series of experiments, I have fully satisfied myself that by proper adjustment and construction, it will give thirty per cent. better radiation than the average rotary gap. The tone is not high, but it is also far from a low pitch. In fact, it resembles a medium toned rotary gap, but is quite different in several respects.

* * *

P. E. M., Mount Pleasant, Ia.:

The apparatus shown in the photograph accompanying your query will undoubtedly permit the reception of Arlington time signals with the flat top aerial 150 feet in length. An aerial of this length raised sixty feet above the earth has a fundamental wave-length of approximately 400 meters and during the night hours should permit the reception of signals from the high power stations on the Atlantic and Gulf coasts.

* * *

R. P. B., Lockport, N. Y.:

There is no advantage in producing an excessively high spark note with the non-synchronous rotary gap. Apparently you are not familiar with the safe range for mechanical speeds. We have never heard of a rotary disc being driven at a speed of 12,000 R. P. M. and do not know any insulating material that will withstand the peripheral strain. The average rotary gap revolves at 3,000 R. P. M.

A transmitting set will have better carrying qualities with a non-synchronous rotary gap constructed to give from 200 to 400 sparks per second of time. The aerial, 90 feet in length by 65 feet in height, has a fundamental wave-length of approximately 280 meters.

* * *

H. A. D., Johnstown, N. Y.:

We have no record of a patent having been issued for the multi-audi-fone.

The fundamental wave-length of your two-wire aerial, 600 feet in length with a 300-foot lead-in, is approximately 1,450 meters. It is too long for the reception of either 300 or 600-meter waves. For the best signals at these two wave-lengths, the flat top portion should not exceed 200 feet in length.

* * *

M. R., New Haven, Conn.:

The wave-length of your aerial, 75 feet in length by 60 feet in height, is approximately 240 meters. The description of your receiving tuner indicates a possible adjustment to wave-lengths of 5,000 meters, if used with a crystalline detector. Since there are no spark stations operating at this wave-length, you should use some form of an oscillating vacuum valve circuit which will permit the reception of either damped or undamped oscillations. The coupler you describe is feasible, but it should be loaded in the primary and secondary circuits with loading coils of the type described in the book, "How to Conduct a Radio Club," under the heading "Beat Receivers." For the super-sensitive receiving set described in that issue, small variable condensers, procurable at amateur supply houses, are recommended. These generally have a capacity of .001 microfarad or thereabouts.

* * *

M. J. M., Albany, N. Y.:

It makes no difference if the primary and secondary windings of an inductively-coupled receiving tuner are wound in opposite directions. Complete data for the construction of a 1 k.w. open core transformer, to be operated on 60-cycle current, are given in the book, "How to Conduct a Radio Club." For operation on 40-cycle current, the impedance of the primary winding should be increased by additional turns.

* * *

C. H., South Norwalk, Conn.:

The book entitled "How to Conduct a Radio Club" has a number of diagrams applicable to all types of receiving detectors. You are advised to study carefully the chapter on the "Theoretical Explanation of a Receiving Tuner" and also, if possible, to duplicate the various diagrams of connections shown for the crystalline type of detector.

Your aerial has a fundamental wave-length of about 400 meters, which should give good response from commercial stations operating at wave-lengths of 600 meters. If you are a good operator and are able to interpret call letters, you should, by this time, have determined the full range of your set.

The vacuum valve detector is considered more sensitive than that of the crystalline type.

* * *

L. A. K., Mattoon, Ill.:

A loading coil 28 inches in length, 5 to 6 inches in diameter, covered with No. 22 S. C. C. wire, will boost the fundamental wave-length of your aerial system to approximately 10,000 meters. It is, as you say, quite necessary that another loading coil be inserted in series with the secondary winding to obtain resonance in the two circuits. However, it may be found that your present coupler will not afford sufficient closeness of coupling for strong signals. We assume you intend to construct a long distance receiving set, responsive to high-power stations. You, together with other inquirers regarding this subject, are referred to the book, "How to Conduct a Radio Club," which covers the subject fully.

* * *

F. M., Gravesend Bay, Brooklyn, N. Y.:

Like many other amateurs you have designed and constructed a receiving tuner that is responsive approximately to wave-lengths of 5,000 meters, but because there are no spark stations within your range using this wave-length, the tuner is useless. The longest wave-length employed by spark stations within your range is that of the Arlington station when sending the time signals, namely, 2,500 meters. The Sayville station formerly operated at wave-lengths of 4,800 meters, but the spark set has been put out of commission. You have shown that you are not entirely familiar with the variometer. Study Chapter IX of the book, "How to Conduct a Radio Club," which describes the subject in detail. Your apparatus certainly is responsive to Arlington time signals, but the tuner may have decreased dimensions and still respond to this station. The correct dimensions are fully described in the National Amateur Wireless Association Monthly Service Bulletin for January, 1916.

* * *

O. M. H., Whiting, Ind.:

The three-slide tuner, 17 inches in length by 3¼ inches in diameter, wound with No. 22 enamelled wire, connected to the aerial, 80 feet in length, should be responsive to wave-lengths of 3,500 meters. The inductively-coupled receiving tuner with the dimensions you have supplied will also be responsive to wave-lengths up to approximately 3,500 meters.

* * *

E. M., Ely, Minn.:

The fundamental wave-length of your antenna is approximately 220 meters, and if adjusted to resonance with the transmitting set described, will emit a wave-length in excess of this value. It is very difficult to estimate the range of an amateur transmitting outfit, but if the primary and secondary circuits are in exact resonance, your ¼ k.w. transformer should cover fifty miles. Of course the range will depend upon the type of apparatus employed at the receiving station. Some amateur stations fitted with sensitive receiving apparatus may be able to hear you during the night hours at a distance of several hundred miles. We do not know what effect the iron ore deposits in your vicinity will have, but if near to the surface of the earth they should, it seems, assist the passage of the electromagnetic waves.

* * *

W. C. S., Freeport, La.:

A condenser for the restricted 200-meter wave, as we have stated many times in this department, must have a capacity of between .008 and .01 microfarad. Four plates of glass, 14 by 14 inches, covered with foil, 12 by 12 inches and connected in parallel, will give the desired value of capacity. If these plates will not withstand the potential of the transformer, you should connect eight plates in parallel in each bank and the two banks in series.

If the one to one transformer is to be used with the vacuum valve amplifier, you may purchase one of this type from the Manhattan Electrical Supply Company, New York City. The secondary winding of an induction coil or your 1 k.w. Thordarson transformer may be used as alternatives.

* * *

K. T. R., Newington, Conn.:

On page 860 of the August, 1915, issue of THE WIRELESS AGE is published a list of the high-power stations, employing damped and undamped oscillations, their call letters and the approximate wave-lengths at which they operate. Any type of oscillating vacuum valve circuit of the correct proportion will permit the reception of both damped and undamped waves. If the apparatus is adjusted to operate on the "beat" phenomenon, the note of spark stations is distorted and the resultant note is of a lower frequency. Apparatus of this type is described in detail in the book, "How to Conduct a Radio Club."

Damped oscillations are produced by the discharge of the condenser through a spark gap, while undamped oscillations may be supplied by a Goldschmidt high frequency alternator, an Alexanderson high frequency alternator, a Poulsen arc, or a battery of vacuum valves. A high frequency spark set is generally considered as one where the primary source of current has a frequency of 500 cycles a second. A high frequency generator is one supplying more than 20,000 cycles per second of time. The Goldschmidt alternator is operated at a frequency usually of about 50,000 cycles per second, corresponding to a wave-length of approximately 6,000 meters.

Apparatus for the reception of undamped oscillations, requires very careful design throughout and is difficult to manipulate at the first trial. A series of experiments are generally required to familiarize the manipulator with the method for best adjustment. Do not be surprised if your initial tests are not what you expected them to be. You will find circuits of this type extremely interesting, and with very small aerials they will permit the reception of signals at night time from high-power stations two or three thousand miles away. It is sometimes found difficult to make a vacuum valve oscillate at wave-lengths below 2,500 meters. They are more stable at frequencies corresponding to wave-lengths in excess of four or five thousand meters.

* * *

J. W. P., Newport, R. I.:

With so many wireless stations in commercial operation, it is difficult to ascertain the origin of the strange signals you hear. In view of the swinging tones, it is quite likely that you received signals from a station employing undamped oscillations. Take, for example, the station at Tuckerton, N. J.; owing to the unequal speed of the alternator, the pitch of the tone in a "beat" type of receiving apparatus varies.

* * *

T. P., Rocky Mountain, N. C.:

The diagram of connections sent to us indicates that you are not familiar with receiving apparatus. The secondary circuits in your drawing are improperly connected for either the crystalline detector or the Poulsen type of tikker. The tikker ought to be connected in series with the crystalline detector and the head-telephones connected in shunt to the fixed condenser. The fixed condenser is, of course, placed in series with the tikker and the crystalline detector. The latter may be omitted, although it has the effect of clearing up the pitch of the note.

What use have you for receiving apparatus adjustable to a wave-length of 16,000 meters? We are not aware that any stations operate at this wave-length. The greater part of commercial traffic at high-power stations is dispatched at a wave-length of 6,500 meters.

A ½ k.w. transmitting set will transmit during the daylight from thirty to fifty miles.

Your transmitting condenser has a capacity of .007 microfarad, which is quite correct for operation at wave-length of 200 meters and will permit from two to three turns to be connected in series with the primary winding of the oscillation transformer.

* * *

W. I., Springfield, Mo.:

Examine the diagram of connections for the crystalline vacuum valve combination described in the book, "How to Conduct a Radio Club." The condenser connected in series with the crystalline detector need not be variable in capacity. One of .005 microfarad capacity will do.

* * *

J. A. R., New York City:

An aerial with a flat top, 50 feet in length, is quite correct for the restricted amateur wave. Dimensions for receiving tuners to cover a definite range of wave-lengths, are given in the book, "How to Conduct a Radio Club." Connect one of your variable condensers in shunt to the secondary winding of the receiving tuner, and the other either in series with the antenna or in shunt to the primary winding, accordingly as a shorter or longer wave-length adjustment is required. For general receiving work, an amateur receiving tuner to be responsive to spark stations should have a maximum wave-length adjustment of 3,000 meters.

* * *

J. E. B., New York City:

The call letters BZR are those of the British naval station in Bermuda.

* * *

C. S. R., New Brunswick, N. J., says that he is about to erect an antenna 1,000 feet in length and has the necessary supports, insulators, etc., but that he is only able to make use of galvanized iron wire. He desires to know whether this antenna will be efficient.

Ans.—Undoubtedly signals will be received, but, of course, the high frequency resistance of this wire is greater than that of copper wire and consequently there will be some losses. The editor of this department has often used galvanized iron wire aerials, obtaining excellent results. Copper wire is preferable, however.

* * *

P. A. W., West Stockholm, N. Y., has an aerial 155 feet in length, 50 feet in height at one end and 65 feet in height at the other. It is composed of six No. 14 B. & S. aluminum wires, spaced 3 feet apart. He says that the lead-in wire is 125 feet long and wishes to know the natural wave-length.

Ans.—The natural wave-length of this antenna is about 410 meters.

Ques.—I am constructing a spark coil to be used on a 110-volt current in connection with an electrolytic interrupter. Does it require a primary condenser?

Ans.—No.

* * *

B. M., East Orange, N. J.:

The primary and secondary windings of the oscillation transformer for a quenched gap should be arranged so that the coupling between them can be very closely adjusted. Proper radiation from a quenched set is dependent upon a certain degree of coupling and very close adjustment of the inductance values in use at the primary and secondary windings of the oscillation transformer. We do not know the voltage of the secondary of your transformer, the number of plates in use at the gap, nor the general design of the condenser, but if the various portions of the equipment are fairly well proportioned, the quenched gap should consist of no more than two or three plates in series. When a quenched gap is used in place of the ordinary gap, a closer degree of coupling at the oscillation transformer may be employed than with the gaps of ordinary construction.

* * *

H. G. S., Irvington, N. J.:

The aerial described in your communication is "freakish" in the extreme and we cannot understand why you insist on such design. It has been proven that the best results are obtained with a long, narrow aerial rather than with one which is spread in many directions.

After looking at your diagram, we suggest that you stretch a single flat top aerial, if possible, in the 300-foot direction. A single wire, 300 feet in length, will certainly receive at a greater distance than a flat top aerial 80 feet in length.

* * *

R. D., Milwaukee, Wis., inquires:

Ques.—(1) Are the twelve-jar condensers and the type B oscillation transformer on sale by the Marconi Company suitable for use with a 1 k.w. 20,000 volt transformer and a rotary spark gap having six plugs revolving at a speed of 5,000 R. P. M.? This apparatus is to be operated on the 200-meter wave.

Ans.—(1) This condenser has a capacity of .009 microfarad which is quite correct for the 200-meter wave. We consider the speed of the disc discharger excessive.

Ques.—(2) I have two aerials placed at an angle of 150 degrees to each other. One aerial consists of two wires 175 feet in length, spaced 5 feet apart. The second aerial comprises four wires, 70 feet in length, and spaced 18 inches. Each aerial is 60 feet in height and fastened to the same mast. Which should I employ for transmission purposes?

Ans.—(2) For the restricted wave of 200 meters the small aerial should be employed. The natural wave-length of the 70-foot aerial is approximately 239 meters, which requires a short wave condenser to be connected in series for operation on wave-lengths of 200 meters.

Ques.—(3) If the small aerial is used for transmission purposes and the larger one for receiving will there be any loss of transmitting power in the larger aerial?

Ans.—(3) There will be some absorption of energy by this antenna, but it will not be excessive provided the longer aerial is disconnected from earth during the period of transmission. We offer the further advice that for receiving from amateur stations the small aerial be employed for both transmitting and receiving purposes, while the large aerial is preferred for the reception of signals from stations using wave-lengths of 600 meters and more. The wave-length of the larger aerial is approximately 460 meters.

* * *

O. N., Washington, D. C., inquires:

Ques.—(1) Please give the dimensions for a loading coil to raise the wave-length of the primary and secondary circuits of the receiving tuner described to a wave-length of 16,000 meters. Please give the diameters of the tubes and the size of the wire.

The primary winding is 10 inches in length by 4¼ inches outside diameter, wound with No. 24 double silk wire. The secondary winding is 10 inches in length by 3½ inches in diameter, wound with No. 34 S. S. C. wire. The aerial with which this tuner is to be employed is 175 feet in length and consists of two wires with an average height of 55 feet. The lead-in is 50 feet in length. The aerial is of the inverted L type.

Ans.—(1) The fundamental wave-length of the antenna system is approximately 330 meters, and, assuming it to have a capacity of approximately .001 microfarad, the primary winding alone connected in series will allow the antenna circuit to be adjusted to about 5,000 meters. To be raised to a wave-length of 16,000 meters you require a loading coil approximately 4½ feet in length by 6 inches in diameter, wound closely with No. 22 single silk covered wire.

You can raise the wave-length of the secondary winding to a similar value by inserting a coil 6 inches in diameter, 28 inches in length, in series with the present secondary winding. This coil should be wound with No. 30 single silk covered wire. The loading coil and the secondary winding should be shunted by a variable condenser of small capacity.

Ques.—(2) With the loading coils cut out of the circuit can I receive stations above 1,000 meters, using dead end switches on the oscillation transformer?

Ans.—(2) Yes; sectionalize the windings, breaking both the primary and secondary winding into small units. With the secondary winding alone shunted by a variable condenser of .001 microfarad, it will respond to a wave-length of approximately 10,500 meters.

It may interest you to know that there are no wireless stations operating at a wave-length of 16,000 meters.

Ques.—(3) With the loading coil, oscillation transformer and vacuum valve detector referred to, and the same aerial with additional apparatus comprising three variable condensers, 2,000-ohm telephones, all apparatus being hooked up in accordance with one of the Armstrong circuits, how far can I receive undamped wave stations?

Ans.—(3) During the night hours you should hear the high-power stations at Nauen and Hanover, Germany. In daylight you may hear the government station located at Darien, Isthmus of Panama.

Ques.—(4) What is the range of wave-lengths of the oscillation transformer described in my first query?

Ans.—(4) This question is answered in the foregoing query. Both circuits are readily adjustable to a wave-length of 5,000 meters, provided the secondary winding is shunted by a condenser of small capacity.

* * *

F. D., New York City:

We are not familiar with the commutator scheme which your amateur friends employ for producing a high spark note with an induction coil. We have never obtained satisfactory results with a mechanical converter or interrupter with coils having a spark of more than five or six inches.

A spark coil is not designed for use as an open core transformer and we do not advise its use under any conditions. If you are forcing ten amperes on 110 volts through the primary winding of your 1½-inch spark coil, there is danger of burning this winding out; in fact, we do not believe it will stand continuous service.

* * *

C. B., Philadelphia, Pa.:

An aerial for long distance receiving purposes suitable for the reception of signals from high-power stations here and abroad should have a natural wave-length of, say, 2,000 meters. Two wires 1,000 feet in length with a distance of from 30 to 60 feet above the ground, will give fair results provided a supersensitive receiving set such as described in the July, 1915, issue of THE WIRELESS AGE is used.

The natural wave-length of the antenna described in your communication is about 430 meters.

The following dimensions are correct for a two-inch spark coil: The primary coil should be 7 inches in length by ⅝ of an inch in diameter, covered with two layers of empire cloth. It should be covered with 184 turns of the No. 16 D. C. C. wire. The secondary winding requires one pound of No. 36 enamelled wire in two sections, each section having a diameter of about 2¼ inches, the total width of the secondary winding being about 5¼ inches. There should be eight or ten layers of empire cloth between the primary and secondary winding. The primary condenser for this coil requires 1,400 square inches of coil.

* * *

C. D., Peekskill, N. Y., says:

Ques.—(1) I have the facilities for the erection of an aerial either 400 feet in length, consisting of four wires, or one 1,000 feet in length, comprising a single wire. I have the necessary apparatus modelled after that described in a previous issue of THE WIRELESS AGE under the heading "Supersensitive Receiving Set." Do you think it possible to hear Nauen, Germany (POZ), or Colon, Panama (NAX), during the winter months at nighttime?

Ans.—(1) The wave-lengths of the Nauen and the Colon stations are widely different. The Colon station operates for commercial service at a wave-length of 600 meters and makes use of damped oscillations, while the Nauen station operates on a wave-length of approximately 9,400 meters and makes use of undamped oscillations. Your four-wire aerial, 400 feet in length, will be satisfactory for the reception of Colon signals, but the 1,000-foot aerial is preferred for the reception of signals from Nauen.

Ques.—(2) Will a single wire aerial composed of three No. 20 bare copper wires stranded withstand a span or stretch of 1,000 feet?

Ans.—(2) Not under all conditions of weather. We should prefer a heavier wire, particularly during the winter months when sleet storms may be expected.

The Colon, Panama, station (NAX) maintains a continuous watch.

With an aerial 1,000 feet in length and the supersensitive receiving set referred to, provided you properly understand the vacuum valve detector, you should experience little difficulty in hearing the signals from the Nauen, Germany, station during the nighttime. In fact, by extremely careful adjustment, you should be able to hear this station during daylight.

* * *

O. M. B., Lawrence, Mass.:

The receiving apparatus modelled after the Marconi multiple tuner described in another publication was intended for use with a crystalline detector and is not equally applicable to the reception of damped or undamped oscillations as is the apparatus described in the book "How to Conduct a Radio Club."

It is a fact, as we stated previously, that when shellac is applied to the coils of a receiving tuner the effective distributed capacity of the coil is increased. There is no compound on the market which would eliminate this effect; in fact, it would be more or less present with all insulating compounds. To be avoided the wire must be applied to the coil without the shellac. The losses due to this effect may be considered harmful only when the last degree of efficiency is desired.

For information concerning the computation of the wave-length of an aerial from its dimensions you are referred to the article by Cohen, published under the direction of the Bureau of Standards.

Ques.—(3) When did the series of articles published in THE WIRELESS AGE, entitled "Operators' Instructions," begin?

Ans.—(3) Chapter I appeared in the July, 1913, issue of The Marconigraph.

Ques.—(4) Should I desire to prepare for the examination for a first-grade or second-grade commercial license what book would you advise me to obtain that would be of aid in securing the necessary information?

Ans.—(4) We recommend the following books: "How to Pass the U. S. Government Wireless License Examination," the "Naval Manual of Wireless Telegraphy" for 1915 by Commander Robison, and the "Text Book on Wireless Telegraphy," by Rupert Stanley. All are on sale by the Marconi Publishing Corporation, 450 Fourth Avenue, New York City.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of THE WIRELESS AGE, published monthly at New York, N. Y., for April 1, 1916.

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

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

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, John Curtiss, 450 Fourth Avenue, New York; Editor, J. Andrew White, 233 Broadway, New York; Managing Editor, J. Andrew White, 233 Broadway, New York; Business Manager, John Curtiss, 450 Fourth Avenue, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)
John Bottomley, 233 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)
None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a *bona fide* owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

JOHN CURTISS,
(Signature of Business Manager.)

Sworn to and subscribed before me this 8th day of April, 1916.

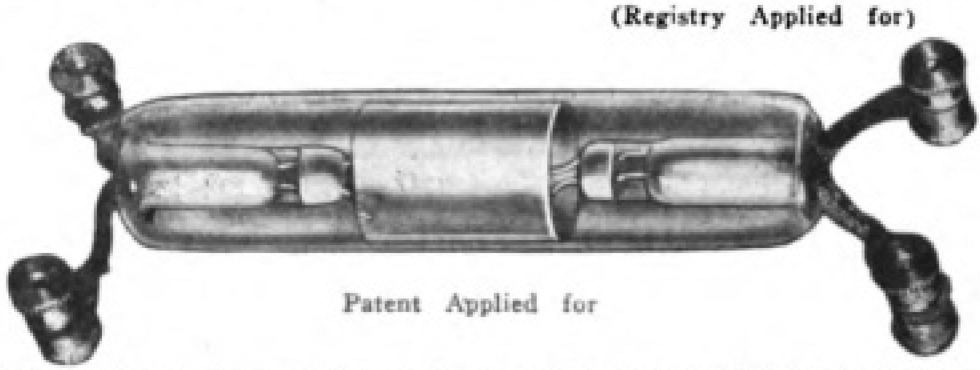
[Seal.] C. J. OLIPHANT.
Certificate filed in New York County No. 55.
(My commission expires March 30, 1917.)

NO INJUNCTION ISSUED

AGAINST

The Genuine AUDIOTRON

(Registry Applied for)



Patent Applied for

The AudioTron has smashed all records—Seattle copies OUI in daytime with one tube. Your receiving range will be more than doubled if you equip your set with the genuine AudioTron—not imitations.

The internal action or mode of operation, not the mechanical structure, determines the quality and sensitiveness. The AudioTron differs from all other bulb or tubular detectors since it utilizes the variations, produced by the impressed grid potentials, in a pure electron flow from negative incandescent tungsten to a cold positive plate. *Its operation, in no way, utilizes a sensitive gaseous medium.*

The genuine electron operated AudioTron is not a "so-called AudioTron" Radiotron, or other form of tubular audion. The genuine AudioTron is so marked and bears our test tag. Don't be misled. We offer $100 cash for proof that this company has been enjoined.

NEW PRICES

Double Filament AudioTron Tube, $6.50
Single Filament AudioTron Tube, 5.50

including full instructions for using and operating

Terms: Cash—Transportation Prepaid—Satisfaction Guaranteed

Write Your Own Guaranty

Any genuine AudioTron not received in good condition—not proving sensitive—not giving satisfaction—not being as represented—will be replaced.

When ordering state whether AudioTron is to be used as a detector of damped waves, as an amplifier, or as an oscillator for undamped wave reception.

Special Offer—Expires July 10, 1916

With every double filament AudioTron ordered before July 10, 1916, at $6.50, transportation prepaid, we will include, free of charge, one regular AudioTron Fixed Condenser especially designed for use in the grid circuit of our tube. Don't delay.

Dealers: Write for "New Trade Proposition," "Profit Sharing Plan" and "The Patent Situation." We have a winner for you. Are you with us?

AudioTron Sales Company

315 Lick Building, SAN FRANCISCO, CALIF.