THE WIRELESS AGE

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Stockholders holding 1 *per cent. or more of total amount of stock, Marconi Wireless Telegraph Company of America,* 233 *Broadway, New York City. Known bondholders, mortgagees, and other security holders, holding* 1 *per cent. or more of total amount of bonds, mortgages, or other securities: none.*

JOHN CURTISS,
Business Manager.

Sworn to and published before me this 2d day of October, 1913.

B. N. Swift,
Commissioner of Deeds,
New York City, No. 163,
New York Register, No. 15,104,
Commission expires April, 1915.

MARCH, 1914

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THE RADIO REVIEW

OUR always greatly revered and recently rejuvenated contemporary, the New York Tribune, throws some light on one of the most distressing details surrounding the heroic self-sacrifice of Operator Kuehn, of the Monroe.

A Touching Incident in Connection with the Monroe Disaster

Following the publication of a letter from one of its readers, the subject of which was "The Heroism of Kuehn," a letter containing a check for five dollars was received from Mrs. H. G. Hollenberg, secretary of the Harmony Club. The sender requested The Tribune to turn over the money to the family of Ferdinand Kuehn, the young wireless operator, who gave his life-belt to a woman passenger and perished when the Dominion liner Monroe went down.

In her letter Mrs. Hollenberg told of the circumstances under which the young man had been reared and how his mother, a highly educated Frenchwoman, and his father, a well-bred German, had struggled to educate him and train him to be honorable above all things. The writer sent the check to the newspaper, she said, for the reason that she had lost track of the family for the last few years, and did not know the address.

When a reporter called at the home of Ferdinand Kuehn to deliver the contribution he was met at the door by the mother of the young man.

Mrs. Kuehn, a sweet-faced woman of middle age, greeted the caller in a soft voice, in which there was slight French accent.

"You gave me a start," she said. "Every time I hear a footstep I feel it must be my boy coming home. Even yet I cannot believe that it is all true—that he is gone. Oh, I know I am foolish to go on so, but he always was so gay and happy and so glad to get home, it doesn't seem possible that he can be taken away."

Then a proud light came into her eyes and a tender half smile seemed to dispel some of the sadness in her face.

"He was a real man, wasn't he? What he did, and the wonderful self-sacrifice of it help me to bear this grief. But he always was a good boy. He never failed to make a friend of any one with whom he was associated. Before he went to the Monroe he was on the Jefferson, and the captain of the ship often would come up here to see Ferd.

"What we are to do I don't know. My boy was our mainstay, and I have had to beg him to keep even a small amount of his wages for himself. See, here are some pictures, taken on the boat. Hasn't he got a generous look in his face?

"It was kind of your reader to send this money, and I shall write and

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thank her. One has to think of money, no matter what happens; isn't it true?

"Mr. Kuehn is in such poor health that he can do very little work, and, while I am doing all I can, it is hard for me to find employment which will allow me time to look after my husband and my little ten-year-old girl. I don't like to ask for charity and haven't done so. But it is not easy."

How Wireless Solves Surveying Problems

IN surveying the wilderness wireless telegraphy is proving invaluable; according to official reports, the French have used it with much success in Africa, and now it is to solve the vexed question of the frontier between Brazil and Peru. Much of the world, it should be understood, has been surveyed with some accuracy in pieces, but not as a whole, much as though one had a plan of a house without knowing exactly where it stood. The great problem is to bring these parts into relation, and here wireless is invaluable by furnishing the exact Greenwich time, which a chronometer can carry only approximately. In Brazil the ingenious plan has been adopted of using great trees as masts for receiving stations, and thus a great number of points can be accurately fixed as a basis for triangulation. To get great precision in flashing the time the chronometer at one end uses standard time and the other astronomical time, which is a trifle quicker because the star year is shorter than the solar year. In flashing seconds the best of the two corresponds every three minutes, and the rest of the time is in syncopation, and by this temporal application of the vernier principle comparison has been made to a 50th of a second, which in that latitude would mean only about 10 yards of error in the longitude; when all the sources of error are allowed for it is believed by Colonel Woodroffe, chief of the boundary commission, that the error is less than 100 yards. In its work the commission uses a new instrument, the "astrolabe," invented by the French savants Claude and Driencourt, which weighs no more than a theodolite and gives latitude observations correct to a quarter of a second of arc, instead of six seconds, a gain of 24 fold in accuracy.

Guarding Against Another Titanic Disaster

MOTOR-BOAT ice scouts form the latest scheme adopted by trans-Atlantic shipping companies in London as a means of circumventing ice perils during their voyages in the North Atlantic. The new Allan liners Alsatian and Calgarian are the first ships to be equipped in this way. Each of them is to carry on her next voyage two motor boats each of the size of a lifeboat, fitted with 30 horse-power motors and with wireless and submarine signaling apparatus.

The plan is to send these ice scouts ahead during foggy weather to report to the liners by wireless telegraphy the where-

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abouts of ice and other dangers. The motor boats will also be available for towing life-boats in the event of the abandonment of a liner. The Aquitania, of the Cunard Line, is to carry four of these craft, and other trans-Atlantic steamers are to be similarly equipped.

The Increase in Message Traffic

WIRELESS messages numbering 285,091 were sent in the United States in 1912, according to a census report recently given out. This is an increase of 84.4 per cent. in five years. The total income of the four companies for 1912 was $669,158, compared with $106,791 for five companies in 1907. There were 958 employees, who received $393,606 in wages.

The totals include only the plants operated for commercial purposes. All plants in the insular possessions are excluded. The amount expended for construction and equipment increased $888,156, or 280 per cent. over 1907, and the number of employees 782, or 444 per cent.; the increase in salaries and wages being $311,835, or 381 per cent.

Wireless Possibilities May Halt Telegraph-Telephone Acquisition

REPRESENTATIVE STEENERSON of Minnesota has made a suggestion that has caused the Democratic leaders to halt in their plans to have the Government acquire the telegraph and telephone lines of the country. In a speech in the House Mr. Steenerson made the statement that the present method of communicating by wire would become obsolete in a few years. He declared that the wireless system is reaching a stage of development which would obviate in the comparatively near future the necessity for the use of the equipment now utilized by telephone and telegraph lines. As it would take a billion dollars to acquire control of the existing wire lines, it is altogether probable that Mr. Steenerson's suggestion will lead to an inquiry to determine the exact scientific status of radio communication. Mr. Steenerson has presented a resolution apropriating $100,000 to enable the Postmaster-General to experiment with wireless telegraphy on a commercial basis. Mr. Steenerson firmly believes that if the experiment is made the Administration will abandon its plan to acquire the telegraph and telephone lines by condemnation, and that in time the Government will develop the wireless system to a point where it will be able to handle all the business of the kind required by the needs of the country.

The Editor.

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The Monroe Disaster

In which the Marconi Tradition was again upheld when Operator Kuehn laid down his life for another

DEEDS of heroism and bravery in time of peril alleviate in a measure the horror of a marine disaster in which almost half a hundred persons perished. Again, the wireless operators—faithful guardians through the day and the night —proved that they could be tried in calamitous extremities and meet the test unflinchingly. One, in particular, distinguished himself by his valor, and the account of how he gave his own life to save that of a woman stands out prominently in the annals of self-sacrifice.

And the ever-indispensable wireless, too, operated on a sinking vessel, faithfully performed its great service to humanity. With only ten minutes to spare before the waters swallowed up the ill-starred craft, a far-reaching appeal was sent out over the ocean. There was just time to flash the S O S and give the location of the disaster, but that brief message was sufficient to convey the information that lives were in danger and help was needed.

Forty-nine human lives—twenty-five passengers on the Old Dominion line steamer Monroe and twenty-four of her crew—were claimed by the sea early on the morning of January 30 last, when the Nantucket, a smaller ship of the Merchants and Miners Transportation Company, reaching for Norfolk, Va., from Boston, came into collision with the Monroe in the heavy fog. The vessels were off Hog Island, sixty miles from Cape Charles; the Monroe, bound for New York, barely five hours out of Norfolk.

The Nantucket did not escape undamaged. Her bow was crumpled up and she began to leak in an alarming manner. A temporary patch was placed over the rent and she stood steadfastly by while her searchlight swept the sea in search of the victims of the accident. Not until all hope of effecting rescues was gone did she leave the scene of the disaster.

"Women and children first!" was the order of Captain E. E. Johnson, of the Monroe, as he stood by the sinking vessel in command of one of the three lifeboats which it was possible to launch. The

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women, for the most part protected by life preservers which the faithful blacks had helped them to adjust, were floating about in the still, icy waters, and Captain Johnson and First Officer Horsley, who commanded another boat, moved slowly around in the mists of the fog, picking them up, guided only by the dim gleam of the searchlight from the Nantucket, which had backed away from the sinking Monroe. Twelve minutes after the vessels had struck the Monroe had turned over and sunk, bottom uppermost.

It was the first death-dealing accident to befall a vessel of the Old Dominion line in almost fifty years of its existence, and old sailors declared it the worst disaster in coastwise traffic in a half century.

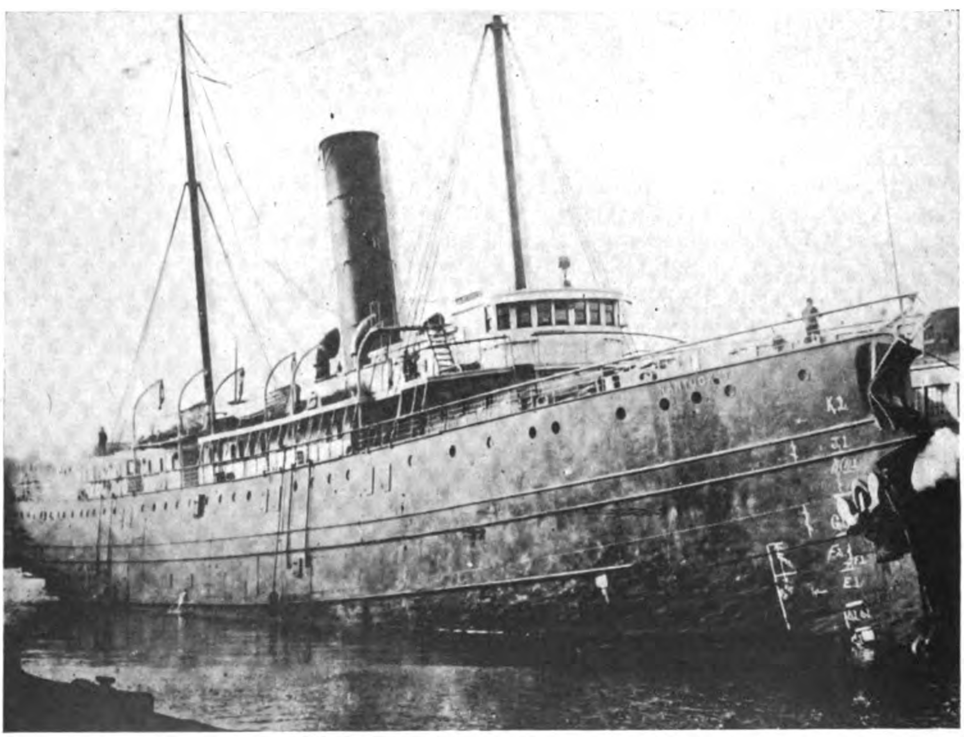
The nose of the Nantucket had torn clear through till it reached the midriff of the Monroe before her captain was able to back away. A moment later the lights of the Nantucket, which was heavily laden with freight and carried but two passengers, could be discerned.

But Captain Johnson was not looking for them. He had been on the bridge, and when the crash came he hastened below and hustled the stewards to get the passengers out of their cabins and up on the boat deck.

Then Captain Johnson hurried to his lifeboats. Already the Monroe was filling on the starboard side and listing heavily. Second Officer Gately ran below to ascertain the extent of the damage. He did not come up till the ship went down, and then he floated around for hours on a ladder.

The captain found that all four boats on the starboard side were useless. Of those on the port side, one had been crushed. He and First Officer Horsley bestirred themselves to get the others off.

Vainly the stewards, by Captain Johnson's orders, and vainly the other officers tried to persuade the passengers to go up to the boat deck. Most of them, huddled



The Nantucket, of the Merchants and Mariners Transportation Company, did not escape undamaged when she came into collision with the Monroe. Her bow was crumpled up and she began to leak in an alarming manner. A temporary patch, however, allowed her to reach port in safety.

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together in their nightclothes, a few having seized blankets, would not leave the promenade deck. Yet the boats were up above, and that is why Horsley and Johnson could only get eighteen people in their boats when they launched them.

There was no confusion, no screaming. Everything went along in peaceful, almost orderly fashion, the negroes helping the whites into the life preservers and urging them to get above to where the boats were.

Five minutes had passed when the boats were launched—then came the first big lurch of the Monroe and half the passengers and crew were thrown bodily against the bulwarks, some of them suffering injuries that led to death later.

Steadily the ship careened, till her deck was almost vertical and her port side was facing the fog-obscured sky. The men helped women climb to the top, where they settled themselves on the upturned side.

The darkness was now complete, save for the glimmer of the Nantucket's lights. The dynamos of the Monroe had both given out, and not a light was burning on her.

Slowly the ship began to settle, and presently those who still clung to her side —many having been washed off or having slid into the sea from sheer inability to hang on—decided that unless they were going down with the ship they had better get out to where the lifeboats were trying vainly to reach the vessel—afraid to come too near, yet desperately anxious to reach those who were in the whirl of the waters about the ship.

Then came the searchlight of the Nantucket playing directly on the dying Monroe. That light, almost blinding in its intensity when reflected from the wet sides of the ship, decided those who were still clinging. They slid off and the sea became alive with drowning men and women.

Chief Engineer Oscar Perkins had tried in vain to keep the lights of the Monroe going for another minute or two. He did succeed, in fact, in getting the second dynamo started, but the lights merely flickered and went out. Perkins jumped into the sea.

The Monroe turned till her keel was almost uppermost, and it seemed to some of those who were rescued that they heard at that last moment shrieks from some that never got out of their staterooms.

Ferdinand J. Kuehn, who gave his life preserver to a woman passenger, and went to his death in the icy water, is here seen at the key in the wireless cabin of the Monroe. His heroic self-sacrifice was in keeping with the altruism that characterized his entire life.

Then the Monroe sank, but in the oily, fog-laden waters she went down with just a sough. The water where she found her grave is sixteen fathoms.

The light of the Nantucket was playing around the waters now, guiding Captain Johnson and Officer Horsley and also two boats which had been put off from the Nantucket to where the Monroe's people were feebly striking out for life.

The boats in charge of Captain Johnson and First Officer Horsley and those from the Nantucket scoured the waters, picking up as many as possible of the men and women struggling to keep afloat. Two life rafts that had floated from the

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Monroe also served to aid the work of rescue. Those who were taken from the sea were placed aboard the Nantucket. Several died from exposure after they reached the ship.

Ferdinand J. Kuehn, chief wireless operator on the Monroe, was in the operating room when the collision occurred. He told R. S. Etheridge, his assistant, who was off duty, of the accident and sent out the S O S Call. Etheridge came to the wireless room with life preservers, one of which was put on by Kuehn. Etheridge sent out an S O S, giving the position of the Monroe, and while he was at the key the dynamos died. Etheridge then dashed for a lifeboat and was picked up by the Nantucket.

Another snapshot of the heroic wireless operator, taken aboard the Monroe shortly before the disaster occurred.

Kuehn was standing on the deck when a woman ran toward him. He stopped her as she was passing.

"Where is your life preserver?" he asked.

"I have none. Oh, I am lost!" she replied.

Kuehn quietly took off his preserver and fastened it upon her. Then he led her to the rail and helped her over.

Captain Johnson made the following statement concerning the death of Kuehn:

"Kuehn was standing by lifeboat No. 3 with a life preserver on and was about to leave the vessel. At that moment a woman passenger came along and Kuehn took off the life preserver and fastened it around her. After seeing her safely off the vessel he missed his footing and fell into the water. He managed to keep afloat for a while, but the water was too cold and he finally sank, having given up his life to save another."

Etheridge, Kuehn's assistant, was in his berth when the accident occurred. In speaking of the disaster Etheridge said:

"I immediately got up and placed what clothing possible on myself, Mr. Kuehn having called me. He went back to the radio room and sent out distress signals. In the meantime I made my way to him with lifebelts and relieved Kuehn, so he could place one on himself. After doing this I advised him to make for the lifeboats.

The Monroe, the most luxuriously appointed vessel of the Old Dominion Line, sank ten minutes after she was rammed by the Nantucket in a heavy fog off the Virginia coast.

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"The S O S calls, giving the position of our boat, were continued by me. Then the ship's current gave out. After all available means were used, and knowing the immediate danger, I went back on deck.

"I assisted in getting three boats ready and made a jump for the last one lowered. We cleared the Monroe and at once went to the assistance of those who were still afloat, rescuing about twenty-five. The same boat made another trip and picked up several more people.

"The operating staff of the Nantucket should be complimented on its good work. They were badly handicapped on account of the continuous blasts of the whistle. When the Nantucket struck the Monroe the impact caused the aerial to fall. It was put in working order after great difficulty.

"The Nantucket sounded distress calls from about 2:30 to 3 A. M."

Details of the accident revealed that the Monroe sank ten minutes after the collision and consequently there was only time to give the call letters, S O S, and the position of the vessel. The calls were picked up by Operator Rosenfield at the Virginia Beach station.

The force of the collision bent the foremast on the Nantucket and the forward stay fell over the side, causing the wire ropes holding the antenna to part. Aboard the Nantucket were A. Doehler, senior wireless operator, and F. L. Smith, his assistant. When the antenna fell they rigged up a rope halyard and hauled it back to the top of the foremast. It was also necessary to clear the smokestack of the wires, and in order to do this Smith climbed on to the funnel. Wireless communication was established at fifteen minutes after two o'clock in the morning, and from that time till the Nantucket docked at Norfolk at half past one o'clock in the afternoon her wireless apparatus was almost constantly in operation, her distress calls being picked up by both ship and shore stations.

Kuehn, who was twenty years old and a son of Mr. and Mrs. Abraham Kuehn, of New York City, was highly esteemed in the Marconi service. He became interested in electro-mechanics when a student in a high school in the Bronx. In his early years he learned the principles of wireless telegraphy sufficiently to install a set in his own home. His schoolmates, as well as the children of the neighborhood in which he lived, still remember how industriously he worked at the construction of the first wireless apparatus he ever used.

Ambitious to become proficient as a wireless telegraph operator, Kuehn entered the telegraph department of the Paine Uptown Business School, in New

A. Doehler, senior wireless operator, and F. L. Smith, his assistant on the Nantucket, rigged up a rope halyard and replaced the fallen antenna when the force of the collision brought it down.

York, on August 15, 1910. He pursued his studies from that time until he was graduated on January 11, 1911. Upon his graduation he obtained employment as a commercial operator. He was detailed to duty on the steamship Denver, of the Mallory line, and was afterwards assigned to the Jefferson, of the Old Dominion line. When the latter vessel was placed in dry dock for repairs about a month before the Monroe sank, Kuehn was transferred to the ill-starred craft. At the time of the collision he was making his second trip on her. His father has been in ill health for a considerable time and the young man was planning to send the elder Kuehn on a vacation and meet the expenses himself.

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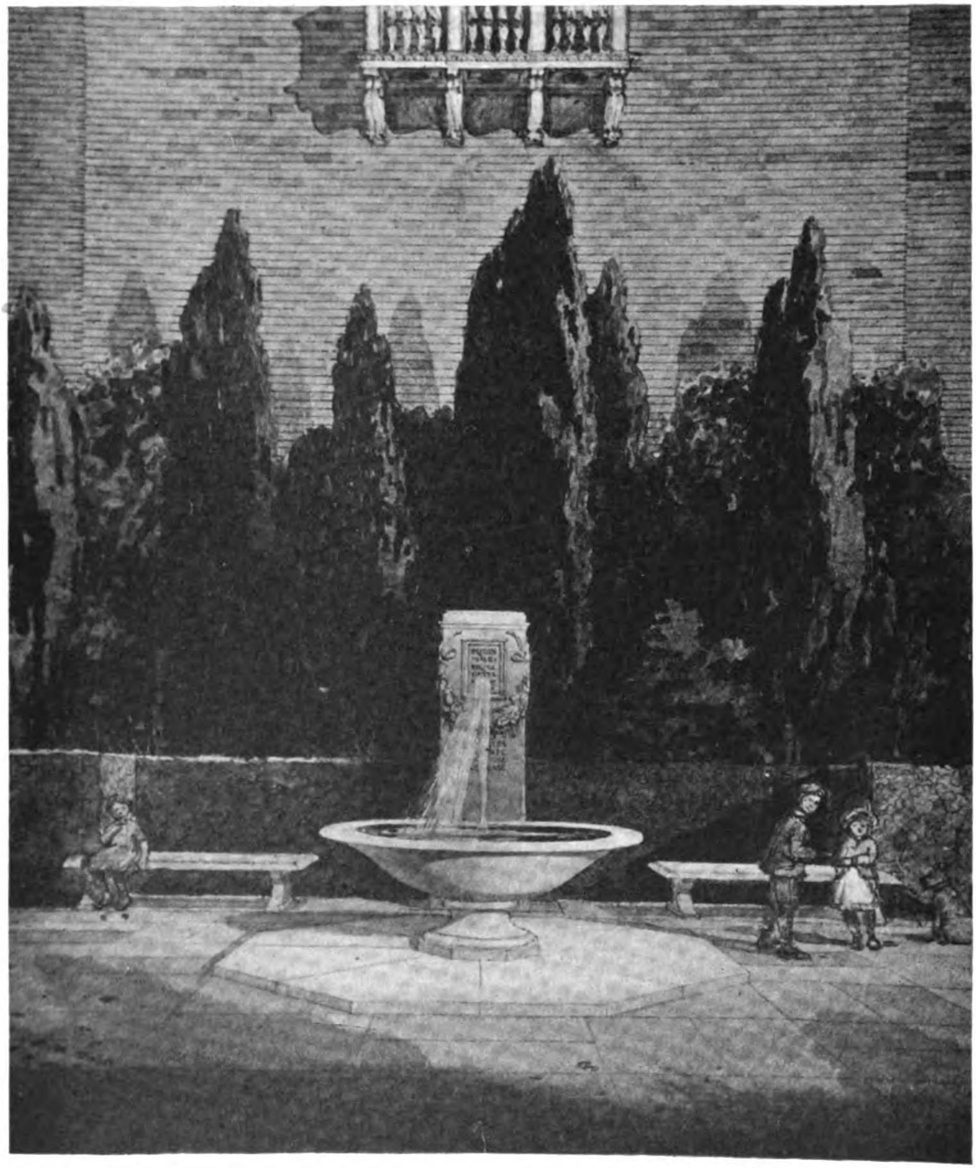

MEMORIAL·FOUNTAIN·TO WIRELESS·OPERATORS·LOST·AT·SEA

This fountain, with the granite seats and cenotaph and the surrounding evergreens, will be soon erected at the base of the Tower of the Barge Office, in Battery Park, New York. It was designed by the firm of Hewitt & Bottomley, architects. The drawing for it, reproduced above, was chosen by a specially appointed committee from twelve drawings submitted in competition. Many monuments have been put up to the memory of the victims of the Titanic disaster, but among them all this one is especially interesting because the majority of the contributions for it have been subscribed in small amounts by Marconi operators. The design is classic. The fountain itself is a large white basin with a central jet of water. It has been most suitably and beautifully placed in Battery Park overlooking the harbor and in sight of numberless ships that daily pass the point of Manhattan Island. The cenotaph contains the following inscriptions:

IN MEMORY OF WIRELESS OPERATORS LOST AT SEA AT THE POST OF DUTY

Jack Phillips, S. S. Titanic, April 15, 1912, Atlantic Coast
George C. Eccles, S. S. Ohio, Foundered 1 A. M., August 26, 1909, Pacific Coast
Stephen F. Sczepanek, S. S. Pere Marquette, Car Ferry No. 18, Lake Michigan, September 9, 1910
Laurence Prudhunt, S. S. Rosecrans, January 7, 1913, Pacific Coast
Donald Campbell Perkins, S. S. State of California, August 18, 1913, Pacific Coast
Ferdinand J. Kuehn, S. S. Monroe, January 30, 1914, Atlantic Coast

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The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
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ARTICLE VI

The calculation and construction of inductances are described, formulas for circuits containing inductance are given, and a method of measuring large inductances is treated.

III. MEASUREMENTS OF INDUCTANCE

General Considerations

SECTION 17. Standards of Inductance; Their Calculation. Standards of inductance for low or audio frequencies are usually constructed by winding "litzendraht," that is, multiply stranded wire, on marble or serpentin cores (preferably the former, because of its freedom from traces of iron). The advantage resulting from the use of litzendraht is that the current distribution throughout the current-carrying conductors remains uniform, even when the frequency increases considerably. This is not the case for solid wire, particularly that made of copper or of any other good conductor; for in solid wire the current at high frequencies deserts the central portion of the cross-section of the wire and crowds to the surface. Not only is the effective resistance of the wire thus changed, but the inductance of the coil of wire is also altered (diminished). The core of a standard inductance should always be a rigid non-conductor, and the wire should be immersed in melted wax in a vacuum after winding on the core and solidly inbedded so that there will be no alteration in the dimensions of the coil as time elapses.

For audio frequencies, the standards of inductance may be multi-layer coils without any noticeable error resulting from changes of frequencies of the current passed through them, but for radio frequency standards (20,000 cycles per second and up) the coils should be single-layer helices. The inductance of such helical coils and their change of inductance with frequency can be readily calulated.

There are a great number of formulas for calculating the inductance of various types of coils, and lack of space forbids our recapitulating them here. A complete set of such formulas in very convenient form is given in a publication of the Bureau of Standards, namely, the reprint of Volume 8, Number 1, of the Bulletin of the Bureau of Standards, entitled "Formulas and Tables for the Calculation of Mutual and Self-Induction (Revised)." The experimenter is particularly referred to Nagaoka's formula for the inductance of a solenoid or helix on page 119 of that publication, and the accompanying tables on pages 223-225. These tables, in conjunction with the formula, are very well adapted to logarithmic or slide-rule calculation. In the same publication the increase of resistance and the decrease in inductance of straight wires are given on pages 172 et seq. The influence of frequency upon the self-inductance of coils is given in Reprint Number 37 of the above Bulletin by Prof. J. G. Coffin. It is there shown (page 290) that the

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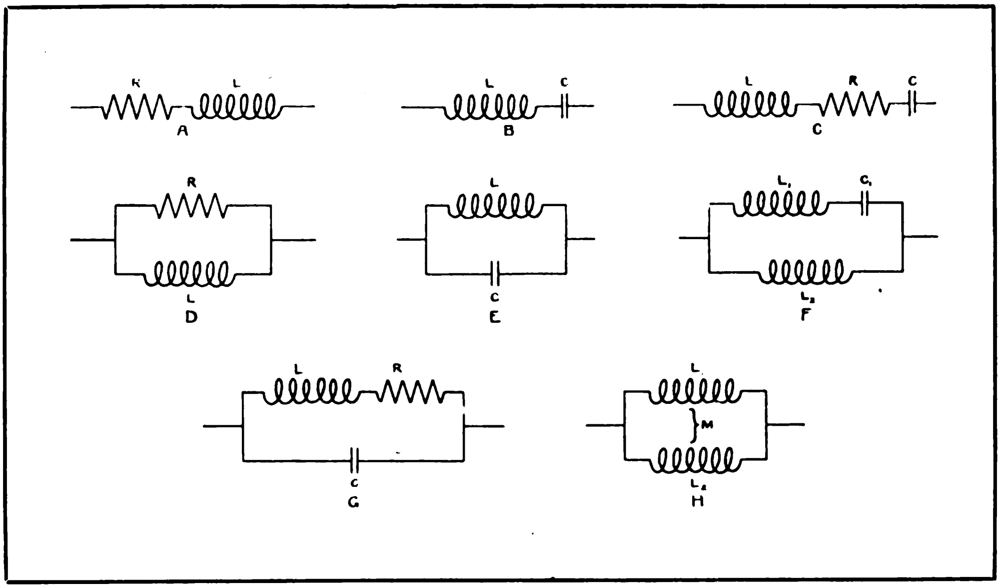

Fig. 33

greatest possible change in inductance (that is, the difference between L_0, the inductance for zero frequency, and L_∞, the inductance at infinite frequency), is given by

$$L_0 - L_\infty = \frac{8}{3} \pi^2 N^2 r_1 d$$
$$= 26.2 N^2 r_1 d \qquad (37)$$

where N is the number of turns per cm., r_1 the radius of the core on which the coil is wound, and d the diameter of the wire of the coil. The change in inductance will be given in centimeters of inductance, there being 10^9 (= 1,000,000,000) cm. to one henry. This change of inductance is the *greatest* which can occur (due to change in frequency), and therefore marks the maximum effect of that sort to be expected at the very highest frequencies.

An inductance always has an electrostatic capacity relative to its surroundings, and this capacity will vary unless the inductance is enclosed in a metal case (of carefully arranged metal sheet, which shall not permit eddy currents). However, the change due to this error is, in general, so small that at low frequencies it may be neglected for air core inductances up to 0.1 henry. At higher frequencies (say 20,000 and above), the influence of this dielectric shunt path may be very serious. Such capacities to ground between inductances or other parts of radio apparatus may give rise to peculiar effects. Thus, J. H. Dellinger found that two nearly identical hot-wire ammeters in series in a circuit might read alike on audio frequency current, but indicate widely differently on radio frequencies, simply because their capacities to ground were different. In effect, each of them was shunted by a condenser of a different value; and as the higher frequencies were reached, their readings became greatly divergent.

Inductances are sometimes so placed that their magnetic fields cut conductors, thus inducing eddy currents and causing losses by heating. For example, on a battleship the influence of the metal walls of the room may be to cause considerable loss. Investigators have advised in such cases placing copper shields over the steel walls where the induction takes place. It seems that in this case most of the eddy current energy is returned to the field without producing any serious loss, whereas if the iron or steel walls are left exposed, the hysteresis losses become serious.

The conclusion to be drawn from the last two paragraphs is that inductances

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should be kept clear of, (a) conducting masses, and (b) of substances of high dielectric constant, if high precision and low losses are desired.

In making careful inductance measurements, the influence of the leads must not be neglected, particularly at short wave lengths. Frequently the change in inductance of loose non-rigid leads will seriously interfere with repeating observations. The leads on low voltage radio frequency inductances should be kept at a definite separation. Their length should not be altered without applying a correction. The simplest way of meeting these requirements is to nail all leads in place, or, where flexibility is required, to sew the leads into the folded-over edges of a stout strip of leather. To assist the experimenter, we give a table for the inductance per meter length of various wires placed, respectively, 1 cm. and 1 inch apart. The direct current resistance (including the return wire) is also given per meter length.

Number of Wire	Inductance Per Meter (in henrys) 1 cm. Apart	1″ Apart	D. C. Resistance (in ohms)
14	83. $(10)^{-8}$	120. $(10)^{-8}$	0.0164
18	100. $(10)^{-8}$	139. $(10)^{-8}$	0.0417
24	130. $(10)^{-8}$	166. $(10)^{-8}$	0.168
32	166. $(10)^{-8}$	....	1.06

We further give the capacity between such leads per meter of length (which capacity may be regarded as added across the terminals of the condenser to which the inductance is connected).

Number of Wire	Capacity Per Meter (in farads) 1 cm. Apart	1″ Apart
14	153. $(10)^{-13}$	101. $(10)^{-13}$
18	124. $(10)^{-13}$	87. $(10)^{-13}$
24	94. $(10)^{-13}$	71. $(10)^{-13}$
32	71. $(10)^{-13}$	....

The inductances may be wound in a variety of ways, of which some are the following: (a) For very small inductance (and easily calculable systems), in the form of large rectangles of heavy wires. (b) In spiral coils. (c) In helices (solenoids) on the surfaces of cylinders. (d) In spiral helices on the surfaces of cones. (e) In spherical variometers (Ayrton and Perry) where inductance variation is secured by means of variation of the mutual inductance of two concentric rotating coils wound on segments of the surfaces of spheres. (f) In "double-D" variometers (of the Rendahl type), inductance variation as in e). (g) In various patterns of cylindrical variometers (e. g., those of the Lorenz Company).

Section 18. Equivalent Impedance, Reactance and Inductance of Combinations of Inductance, Capacity and Resistance in Series.

We shall consider first an inductance L in series with a resistance R (shown in Fig. 1, Circuit A). The impedance, Z, is given by

$$Z = \sqrt{R^2 + \omega^2 L^2} \qquad (38)$$

For an inductance L in series with a capacity C (Case B), we have for the impedance Z and the reactance X.

$$Z = X = \omega L - \frac{1}{\omega C} \qquad (39)$$

And for an inductance L, a capacity C and a resistance R, all in series (Case C),

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \qquad (40)$$

If inductances L_1, L_2, L_3, etc., are placed in series, their total inductances is

$$L = L_1 + L_2 + L_3 + \ldots\ldots \qquad (41)$$

assuming they have *no mutual inductance.*

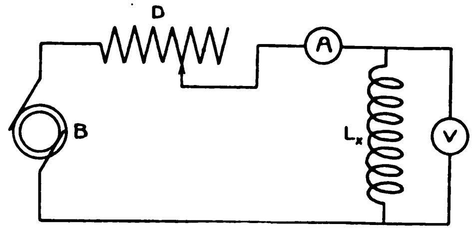

Fig. 34

If inductances L_1 and L_2 are placed in series, and if their mutual inductance is M, the total inductance will be

$$L = L_1 + L_2 + 2\,M \qquad (42)$$

if their magnetic fields are assisting each other, and

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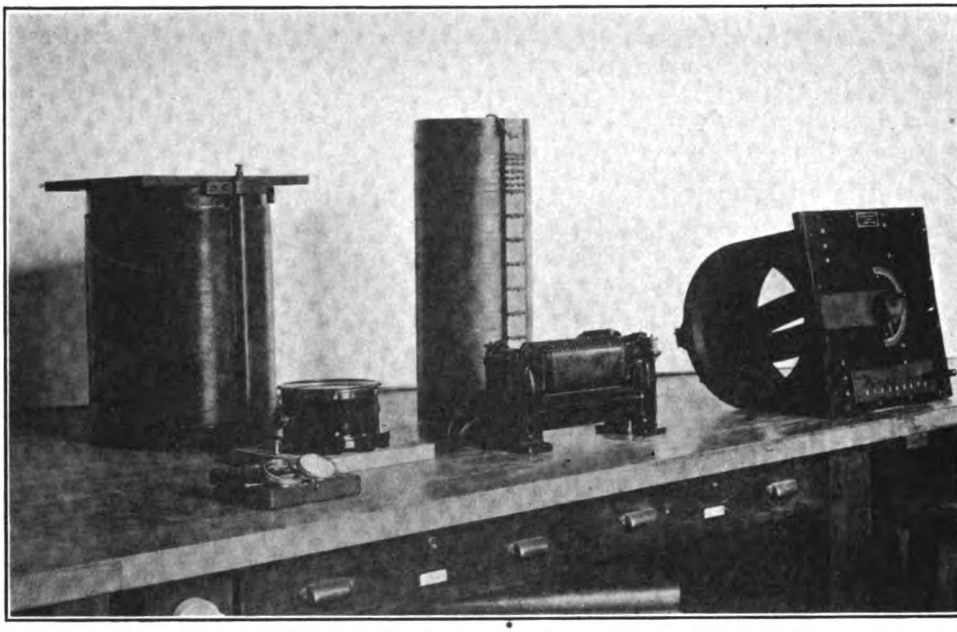

Fig. 35

$$L = L_1 + L_2 - 2M \tag{43}$$

if their magnetic fields oppose each other. In the last three cases, the reactances are ωL, where L is the total inductance.

In all cases, if we divide the impressed electromotive force (voltage) by the impedance (or reactance, where no impedance is given), we obtain the resulting current for steady conditions.

Section 19. Equivalent Impedance, Reactance and Inductance of Combinations of Inductance, Capacity and Resistance in Parallel.

The first case considered (D, in Fig. 1) is that of an inductance L and a resistance R in parallel. The *equivalent resistance,* R_e, is

$$R_e = \frac{R\,\omega^2 L^2}{R^2 + \omega^2 L^2} \tag{44}$$

The *equivalent inductance* is L_e, and is given by the equation

$$L_e = \frac{R^2 L}{R^2 + \omega^2 L^2} \tag{45}$$

The impedance of the combination is

$$Z = \frac{R\,\omega L}{\sqrt{R^2 + \omega^2 L^2}} \tag{46}$$

In case E, an inductance is placed in parallel with a capacity C.

$$L_e = \frac{L}{1 - \omega^2 L C} \tag{47}$$

and

$$X = \frac{\omega L}{1 - \omega^2 L C} \tag{48}$$

If an inductance L_1 and a capacity C_1 are placed in series, and the combination shunted by the inductance L_2, we have for the reactance (Case F),

$$X = \frac{\omega L_2 (1 - \omega^2 L_1 C_1)}{1 - \omega^2 C_1 (L_1 + L_2)} \tag{49}$$

Case G shows an inductance L in series with a resistance R, both shunted by a capacity C. This approximates to the case of a telephone receiver in parallel with a condenser.

$$L_e = \frac{L(1 - \omega^2 L C) - C R^2}{(1 - \omega^2 L C)^2 + \omega^2 C^2 R^2} \tag{50}$$

$$Z = \frac{\sqrt{R^2 + \omega^2 [L(1 - \omega^2 L C) - C R^2]^2}}{(1 - \omega^2 L C)^2 + \omega^2 C^2 R^2} \tag{51}$$

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If inductances L_1, L_2, L_3, etc. (between which there is no mutual inductance), are placed in parallel, the total inductance is given by the equation

$$\frac{1}{L} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots\ldots} \quad (52)$$

If inductances L_1 and L_2 are placed in parallel, and their mutual inductance is M (Case H), the total inductance will be given by

$$\frac{1}{L} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M} \quad (53)$$

The attention of the reader is again called to the rules given earlier in the series, wherein it is stated that the current through any of the above combinations can be found by dividing the impressed (sinusoidal) voltage by the impedance (or reactance, in cases where the impedance is not given). Furthermore, if the voltage is divided by the effective resistance, the quotient is the component of the current which is in phase with the applied voltage, that is, the "power component." If the voltage be divided by ω times the equivalent inductance, that portion of the current which *lags* behind the voltage by 90°, that is, the "wattless component," will be obtained.

A quantity called the coefficient of inductive coupling, or, briefly, the coupling is of considerable convenience in connection with transformers and couplers. If we represent the inductance of two coils by L_1 and L_2, respectively, and their mutual inductance by M, the coupling, k, is given by

$$k = \frac{M}{\sqrt{L_1 L_2}} \quad (54)$$

Roughly speaking, the energy transfer between the primary and the secondary is closely related to the coupling, but it by no means follows that the larger the value of the coupling, the greater the energy transfer. In particular, when dealing with circuits coupled to a primary fed by a Poulsen arc, if the coupling is too close the reaction of the secondary on the arc itself will extinguish it or cause unsteady operation. In fact, the best energy transfer under such conditions is obtained with astonishingly loose coupling.

Section 20. Measurement of Large Inductances by the Drop of Potential Method (at Audio Frequencies and Low Voltages).

(a) Theory of the Method.—Generally speaking, accurate measurements of capacity are more readily made than measurements of inductance. The reason for this is that while reasonably "pure capacities" can be easily obtained (that is, capacities almost entirely free from resistance and inductance), a "pure inductance" is practically impossible to secure. Particularly is this the case for radio frequencies, where the resistance and distributed capacity of the inductance must be carefully reckoned with. Furthermore, the resistance is markedly dependent on the frequency itself because of the "skin effect" for alternating currents of high frequency. Because of the skin effect, the distribution of the current through the cross-section of the conductors of the inductance will change as the frequency changes. For very high frequencies (radio frequencies), the current will be practically confined to the surface layer, and the resistance will therefore be much higher than for direct current or for alternating currents of audio frequencies.

A still more serious variation in inductance itself occurs when the coil contains an iron core. As is well known, the permeability of iron varies with the intensity of the magnetizing force instead of remaining constant as is the case with air, oil and most other substances. The result is that the inductance of a coil containing an iron core is a meaningless term unless both the *frequency* and the *current* passing through the coil are given at the same time. We shall see in the sample measuremen tgiven at the end of this article how serious this effect is.

In the method employed, we determine the current (I) passing through an inductance (L_x), the voltage (E) at its terminals, and the frequency (n) of this alternating current. By means of a Wheatstone Bridge, employed in the usual way, the direct current resistance (R) of the coil is measured.

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Then from equation (38) above we obtain directly

$$E = I \sqrt{R^2 + L_x^2 \omega^2} \qquad (55)$$

Remembering that

$$\omega = 2 \pi n \qquad (56)$$

we obtain finally

$$L_x = \frac{1}{2 \pi n} \sqrt{\left(\frac{E}{I}\right)^2 - R^2} \qquad (57)$$

We must, therefore, measure the quantities E, I, R and n.

(b) Arrangement and Description of the Apparatus. A complete wiring diagram of the alternating current portion of the apparatus is shown in Fig. 34. Here B is an alternator, D a regulable resistance (or inductance), A an ammeter calibrated for alternating current of the frequency employed, V a voltmeter similarly calibrated, and L_x the unknown inductance. It will be seen that ammeter A records the quantity I, voltmeter V the quantity E. R may be measured on the usual Wheatstone Bridge, a description of which is out of place here, inasmuch as it can be found in any elementary text book on Physics or Electricity. To obtain the quantity n, the best way is to employ a speed counter (tachometer), and find the speed of rotation of the alternator. Suppose this to be U revolutions per minute. Let V be the number of poles of the alternator. Then the frequency n is given by

$$n = \frac{U V}{120} \text{ (cycles per second)} \qquad (58)$$

The reading of the speed should be taken while the observations of the quantities E and I are in progress, because the speed may change. In case the generator is inaccessible, it becomes necessary to use a frequency meter of any of the usual types; e. g., the vibrating reed type. Or, finally, the frequency may be assumed to be that stated by the company supplying the power. Usually the frequency varies only very slightly, and hardly to a sufficient extent to be objectionable in an experiment of this order of precision.

In the actual experiment, the apparatus employed was as follows: B was a 500-cycle 220-volt alternator. It was operated by a motor with speed control through field rheostat. The generator voltage could likewise be controlled by the alternator field rheostat. D was a large resistance, variable between 252 ohms and 4.9 ohms, and capable of carrying 7 amperes. A was a Hartmann & Braun hot band ammeter, 0-5 amperes. V was a 0-250-volt voltmeter, calibrated to read correctly on 500 cycles. The unknown inductance was L_x.

In Fig. 35 is shown an assembly of apparatus of interest in this connection. In the rear are shown three air-core inductances, ranging in value from 0.003 to 0.04 henry. The inductance to the extreme right is the one employed in the measurement described below. To the left and in front is seen a special speed counter (tachometer), with registering apparatus and stopwatch. The ammeter, A, is visible behind it. To its right is placed an iron core inductance, variable in steps, which was employed in the measurement. The voltmeter used was mounted on the switchboard of the motor generator set.

(c) Procedure. It is advisable here to get a definite idea of the range of inductance which is measurable by this method. Let us assume that the lowest current which can be read accurately with the ammeter A is 1 ampere, and the lowest accurately readable voltage on the voltmeter V is 10 volts. Each of these quantities should be readable to 1 or 2 per cent. Then, using 60-cycle current, the lowest inductance which should be measured by this method is found to be about 0.03 henry. This will exclude practically all air core coils found in the usual laboratory, but will be a convenient value for most of the iron core inductances. If, however, 500-cycle current be employed, the lowest inductance to be measured by this method is found to be 0.003 henry. If a low reading voltmeter (say from 0-1 volts is available) and the coil can stand as much current as 5 amperes, it is possible to measure down to 0.0005 henry (500 μ h) on 60 cycles, and to 0.00006 henry (60 μ h) on 500 cycles. This brings the measurement well within the range of the inductances used in radio communication.

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In performing the measurement, care is taken not to overheat the inductance by excessive current. The ammeter and voltmeter are read as nearly as possible simultaneously, the speed being taken at the same time.

(d) Errors of the Method; Their Elimination; and Probable Accuracy.

The voltmeter and ammeter should be calibrated for the frequency at which they are to be used. An instrument graduated at 60 cycles and then used at 500 cycles will very probably read very inaccurately, particularly if it is a so-called "soft iron" instrument. The hot wire instruments are less likely to be influenced unfavorably by change of frequency.

In measuring the resistance, R, a Wheatstone Bridge was employed. Strictly speaking, the resistance thus obtained is not the true resistance at 60 or 500 cycles, because of the increase of resistance for alternating current caused by the skin effect. However, if the resistance is small compared to the quantity (E/I), and this is usually the case, the error thus introduced will not be serious.

Two sample measurements follow:

I. Large Air Core Inductance.

$E = 38 \pm$ volts; $I = 4.0 \pm 0.05$ amperes; $R = 0.33$ ohms.

$n = 493 \pm 2$ cycles per second; $\omega = 3080 \pm 19$.

Whence $L_x = 0.00311$ henry. (Accurate to approximately 3 per cent.)

II. Closed Iron Core Inductance.

The following table shows clearly how the inductance of this coil varies with the current through it.

E	I	L_x (calculated)
50	0.60	0.028 henry
71	0.80	0.031
93	1.0	0.033
122	1.2	0.035
147	1.4	0.036
168	1.6	0.038

This is the sixth article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The seventh will appear in an early issue.

GREAT LAKES VESSEL OWNERS ADOPT WIRELESS

Captain Edward Smith, president of the Great Lakes Towing Company, has contracted with the Marconi Wireless Telegraph Company of America to install a wireless outfit on the wrecker Favorite. The towing company agreed some time ago to put wireless on the Favorite as soon as 100 lake ships signed contracts to put such equipment aboard. E. C. Newton, Great Lakes manager for the Marconi Company, has announced that at least 100 lake ships will have been equipped with wireless when navigation opens this year.

About sixty per cent. of the ships that will have wireless are passenger ships, and the rest freighters. Instruments especially designed for lake use will be built and a reduction will be made in the charges for wireless service in proportion to the number of vessels so equipped.

"Last September the manager of one of the largest boat lines on the Great Lakes said to me that if the rates for wireless were reduced and instruments designed to meet the conditions on the Great Lakes he would put wireless on his ships, and expressed the opinion others would do likewise," Mr. Newton said. "At that time the company was not inclined to consider the idea, but the storm of November 8 and 9 demonstrated the remarkable efficiency of wireless on the lakes, and it was decided to meet the demands of the lake vessel companies.

"Managers who a few months ago would not consider wireless under any circumstances are now inquiring about it, and are seriously thinking of putting it on all of their ships."

SERVICE BETWEEN ENGLAND AND SPAIN

The British Postmaster-General has consented to a license being granted to the Marconi Company's Poldhu station for the purpose of conducting a commercial telegraph service between England and Spain. Arrangements are being made to open this service to the public at an early date.

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Keeping Alaska's Trees Alive

THE advantages of wireless telegraphy in conserving the forests of this country were pointed out by J. R. Irwin, of the Marconi Wireless Telegraph Company of America, in an address delivered by him to the members of the Western Forestry Association at Vancouver, B. C., on December 17 last. Mr. Irwin said at the outset that he wished to remove the idea that wireless telegraphy is still in its experimental stages in the exact sense of the words. The experimental part of any scheme necessary in placing wireless in the forest service would not be in the laboratory, but in the field in locating that portion of the district where wireless could be utilized and the telephone eliminated.

No better confirmation of the fact that wireless is efficient could be found than in the fact that it is used in war and was effectively employed in two recent conflicts—those between Italy and Turkey and Turkey and Greece. It is in general use in the armies of the United States and all European countries, and is turned to account on small torpedo boats, as well as on the largest dreadnoughts. Neither are airships without the wireless, for it is in use on flying machines as large as Zeppelin's, and on others as small as a monoplane.

Outfits Can Be Carried by Mules

The Marconi Company is in a position to supply portable outfits which can be carried upon muleback and are built for strength and efficiency. It is estimated that the average mule pack is ninety pounds on each side of the saddle. The saddle is adapted to the peculiar use to which it will be put, and is utilized after it has been offsaddled as a stand or instrument table. Upon one side of the saddle is carried a small gasolene engine somewhat similar to a motor-cycle engine, although smaller. This is directly connected to a small alternating-current generator which supplies the electrical power necessary to operate the wireless equipment.

This piece of apparatus is the heavy part of the outfit, and occupies one side of the load. Upon the other side is a half-kilowatt transformer, or smaller, the size to be determined by the use for which it is required. The half-kilowatt transformer is the heaviest piece of the actual wireless set, and weighs approximately twenty-five pounds. On the same side of the saddle are the condenser, helix, operating key and other small parts weighing comparatively but a pound or two. Here also is the receiving outfit, which weighs a trifle and can be carried in the pocket. On top of the saddle is the spool upon which is wound the antenna wire used for the aerial; this is of light, flexible aluminum wire. A portion of it is also used as ground connections.

Central Stations Advocated

Fuel is carried in tubes or tanks conveniently fitted on the saddle; also light bamboo rods fitted like a fishing pole for a mast where high trees are not available. The plan of carrying gasolene in these mast tubes, thereby saving weight and space, had been considered, but no determination reached as to its practicability. This entire outfit could be off-saddled and quickly adjusted, as it is practically set up on the saddle.

Mr. Irwin said he was given to understand that the average distance for forest communication was from fifteen to twenty-five miles. The set described would easily accomplish this and greater distances, according to the conditions, which, of course, vary; but, even given the worst which would be figured upon, these distances would be a simple matter.

He had listened to a paper describing a system of lookouts and the towers provided which, he undertsood, was in more or less general use in all States, provinces or territories where there are forests. In forming a scheme for the use of wireless in forest work, central permanent stations could be used to advantage. No better sites could be ob-

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tained than the lookout points, situated upon high peaks or hills—the patrol, with his portable set, could then report at stipulated periods to these stations, which in turn could communicate to the other stations interested. In this way a chain or network of stations that would form a system covering a huge territory would be made up. The system should provide for certain periods of time to be set aside for given stations to report or "listen in."

Say station A is to speak to station B during the first quarters of an hour on the hour every one, two or three or four hours, as the case may be. This was entirely a matter of organization., such as Marconi wireless men are confronted with daily, and their experience is always to be obtained. For the convenience of patrols and to expedite the setting up of apparatus, permanent and ground connections should be installed on the trails and at other convenient points. This would be inexpensive, as the antenna wire is not costly, and the aerial could be built very easily. It would also save the patrol time and energy, however small, in setting up his own aerial carried on the spool, the spool of wire to be carried and used only when urgency and necessity demanded.

Trees Could Be Used for Masts

High trees form excellent masts. The spreaders needed to keep the two or four wires generally used in parallel could be quickly cut in from any convenient sapling or stick. They are usually about eight or ten feet in length, according to the number of wires employed. After one season enough permanent aerials could be hung at convenient distances apart to obviate the necessity of using the antenna carried on the pack.

The apparatus used at the permanent stations would be of greater weight, and would therefore be much more powerful. Perhaps portable sets would be more suitable, inasmuch as they could be utilized in a contingency. Portable sets could, perhaps, be operated without unsaddling from the animal, providing, of course, that the mule would not be startled by the noise resulting.

Operators at Home in the Forests

It had been pointed out that the Marconi system requires skilled operators. This was true to a certain extent, but fully fifty per cent. of the operating staff is made up of men from the villages and small towns of the interior—men familiar with forests and country life, young fellows able to jump in and turn their hand to anything. These men were for the most part of good physique, a very large number having been discharged from the army and navy after honorable service, with an excellent training; they were also thoroughly subservient to discipline. Mr. Irwin was sure that men of this class could be adapted to service in the forests. The men of the wireless telegraph would make splendid lookout men; most of them, having been to sea, were accustomed to looking out over great distances. Many of the wireless stations are located in lonesome places, where the men are forced to look out for themselves and adapt themselves to conditions of isolation. They were able through experience to be content under these circumstances—furthermore, they were able to break the monotony by the use of their wireless telegraph instruments.

The wireless would be an excellent auxiliary to the system of weather reports and forecasting fire winds. Several times daily throughout the year the large government wireless stations on every coast send out at stated intervals weather reports and forecasts for the guidance of ships at sea. The wireless stations used in the forest service could interpret reports or receive special reports for their benefit from the stations in touch with the Weather Bureau at Washington, D. C., or with the district forecaster.

STATIONS IN MOTION PICTURES

The Pathe Frere's Moving Picture Company, which puts out Pathe Frere's Weekly, is to take pictures of the Marconi high-power station, near New Brunswick, N. J., in the near future. The Marconi station at Marshalls, Cal., will also be shown in motion pictures.

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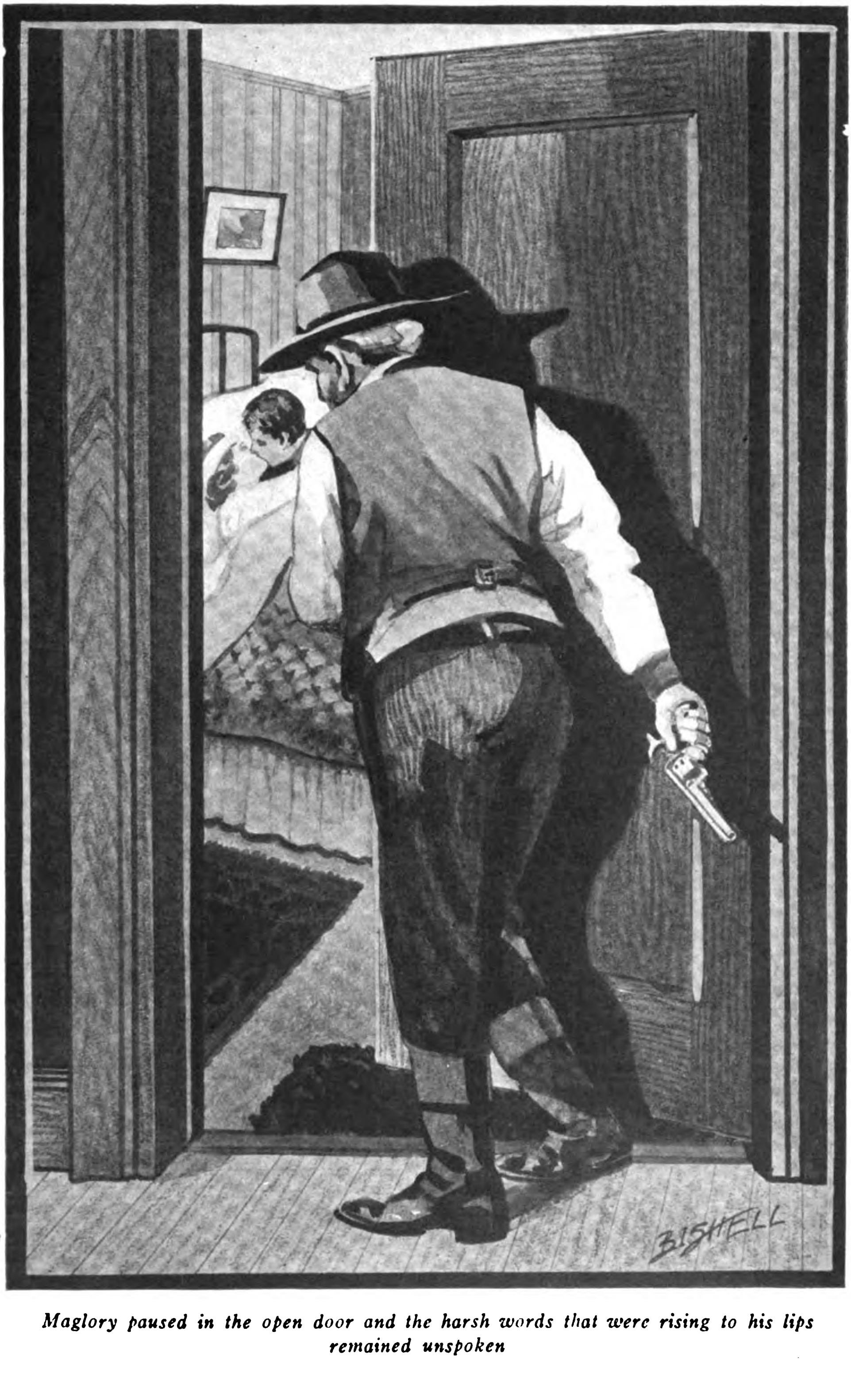

Maglory paused in the open door and the harsh words that were rising to his lips remained unspoken

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Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Soon afterward Rance finds on the deck of the steamship a wireless message from Kennedy, superintendent of the mine, telling Sidney that the Burton-Slocum syndicate is prepared to offer Maglory $200,000 for the property. Maglory declines to credit Rance's statement. Arrived in Arizona, Maglory becomes enraged at finding one of the despised wireless stations right in his home town; it belongs to the son of one of his neighbors, who continues to operate it in an amateur way, despite Maglory's hostility. Four days after the return a representative of the Burton-Slocum Syndicate calls and makes a spot cash offer of $200,000 for the Bonanza Mine. Maglory is prevented from accepting it by the option given to Sidney. As the stranger is leaving in his motor car Bonnie's horse takes fright and the girl is seriously injured. The nearest doctor is twenty miles away, and in the emergency the amateur's wireless station sends out an appeal for aid.

CHAPTER IX

OLLIE RYCKMAN proved conclusively that his wireless outfit could be depended upon in an emergency. No operator on a sinking boat, scattering his frantic calls over the face of the treacherous deep, could have fought harder for his passengers than Ollie fought for the life of Bonanza Denbigh.

WANT DOCTOR QUICK AT RAGGED EDGE. BONANZA DENBIGH THROWN FROM HORSE AND BADLY HURT.

This is the message that darted in every direction across the deserts, the mountains and *mesas*. Intended for San Simone, it also made a bull's-eye at Poco Tiempo; and had an immediate effect in each place.

Dr. Quigley happened to be passing the San Simone wireless headquarters just as Pegleg Cartwright had finished taking the message and had stumbled wildly to the street door. In half a minute, Quigley knew what was wanted. In front of the Emporium stood an automobile. Without so much as a by-your-leave, Quigley cranked the engine, and was away. He stopped but an instant at his office to snatch up the materials he thought he would be likely to need, and then went licketty-split over the trail to Ragged Edge. Out for a record, he made such good time that he earned a sobriquet—for ever afterwards he was referred to as "Dr. Quickley."

Whether or not Bonanza's life was saved by the celerity with which the doctor had reached her side must remain an open question. She might have lived if the doctor had been slow in getting to Ragged Edge, or if he had not got there at all. But the preponderance of testimony favored Ollie and his wireless no less than the immediate enterprise and the skill employed by the doctor during the anxious hours that followed.

As Dr. Quigley was leaving the house, after pronouncing Bonanza out of danger, he stood on the running-board of the "borrowed" car and watched a cloud of dust slide towards him down the trail. It whipped aside, presently, to reveal a man on a lathered horse.

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The smoking cayuse sat down in the trail and slid to a halt amid a rain of flying pebbles. The man dropped from the saddle and rushed toward the doctor.

"How is she?" he gasped.

Quigley's eyes glimmered genially behind his spectacles.

"Jeff Rance, well, well," he murmured. "Miss Denbigh is doing well, I'm happy to say, and with proper care she'll come along nicely." He put out his hand and his face softened. "Jeff," he added, "I'm glad as blazes to see you. Which I reckon is more than Uncle John will be if you go bunting into his 'dobe."

"I'm going to see Bonnie!" declared Rance, firmly. "Uncle John will have to make allowances at a time like this."

"That's you!" and Quigley nodded and chuckled. "But where were you, to get here so quick?"

"At Poco Tiempo."

"No!" said the doctor, astounded. "However did you know what had happened?"

"The wireless call that brought you was picked up at the station near the mine. The operator"—a flush dyed Rance's face—"knew I was interested, and hurried to get news to me," and the young man dashed for the house, and vanished through the front door.

At just that moment Bonnie was alone in her own little room. John Maglory was out by the horse corral, back of the house, wiping his eyes and thanking God.

"Oh, You who boss the Big Range!" he whispered, "I've been more kinds of a fool than I know how to tell! The things I ought to do I've passed up, and the things I done I ought to have sidestepped! I've landed in my declinin' years with a warped judgment and a feeble intellect, and the best I know ain't one-two-seven with the best I ought to know. You've spared the *mujercita,* and if my own miserable life can settle the bill—*only say the word!"*

As he hung over the corral fence, he stifled a sob. A brief struggle with emotion terminated as he flung back his grizzled head. For most of his life he had felt that God was too far away to bother much with him, but now he knew differently.

Abruptly he started. A voice came to him from the depths of the house—a familiar voice that knotted his brows in a hard frown and started him post haste for the kitchen door.

From a nail in the kitchen wall hung a belt with a revolver. In passing through the room he paused for a moment to jerk the weapon out of its dangling holster.

The door of Bonnie's room stood open. Maglory stepped to it, clutching the revolver fiercely, eyes a-gleam with determination. But he paused in that open door, and the hard words that were rising to his lips remained unspoken.

Jeff Rance, dusty and travel-stained, was kneeling beside the bed. One of Bonnie's arms was encircling his neck, and her head, with the white bandage around the temples, lay on his shoulder.

A pang struck at Maglory's heart. He had doubted that Bonnie loved this black sheep of the family. He could doubt no longer.

Softly, Maglory turned away. He took a chair across the room and laid the revolver on his knees. Unintentionally, he had robbed Bonnie of $150,000. Should he rob her also of the man she loved?

"Don't stay any longer, Jeff," came the tremulous voice of Bonnie through the open door. "If Uncle John should find you here, he—he might—." The voice died in a hopeless sigh.

"You're going to live, Bonnie," answered Rance, tenderly. "That's enough for me to know. . . I've got something to say to Uncle John, though, and, while I'm here, I might as well say it."

"No, no!" breathed the girl in a frightened tone. "He doesn't know you as well as I do, Jeff, and he wouldn't listen to you."

"I have a proposition to make, and he's got to hear it!"

There was determination in Rance's voice. Presently he came out of Bonnie's room; his eyes rested on the form in the chair, and he gave a start of surprise.

"Came to see Bonnie, did you," sneered Maglory, "after what I told you on the boat?"

A cry echoed from the sick room—a cry of fear. Maglory was quick to read

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its significance, and it seared his soul.

"Don't you be afeared, Bonnie!" he called. "I'm not going to raise a hand against Jeff. He says he has a proposition to make me. Well, let him make it!"

"If you love me, Uncle John—if you love him—"

"I'm not saying a word about *him,*" said Maglory; "but as for you, *mujercita,* there's nobody on earth I'd do more for. And just now, I don't pack the nerve to say no to you. What's that proposition?" he added, sharply, to Rance.

"You've seen Hall, of the Burton-Slocum Syndicate?" asked Rance.

"What's that to you?"

"Nothing. But if you have seen Hall, and talked with him, you know by now what the syndicate people will give for the Bonanza Mine."

Maglory twisted in his chair.

"You know, too, by now," proceeded Rance, "whether I was right or wrong in calling Bill Sidney a schemer and a thief, and trying to keep you from selling him that option. When does the option expire?"

"The twenty-fifth, at ten in the evening," was the husky response.

"Well, Bill Sidney is on the way. If he comes here with forty-five thousand dollars and asks for a deed, you'll have to give it to him!"

"Give it to him?" roared the exasperated old man. "I'll shoot him down like a dog if he dares to come here and ask for it!"

"Oh, he'll dare to come, fast enough! What's more, you'll not shoot him, and he'll get his deed. There is just one way, John Maglory, to save that mine from Bill Sidney."

Maglory started forward in his chair. "What way is that?" he demanded.

"That's my part of it," answered Rance, "and you'll have to leave it to me. Here's the proposition: If I get Bonnie out of this muddle you have got her into, and if she sells to Hall for the Burton-Slocum Syndicate for two hundred thousand, instead of to Sidney for fifty thousand, you are to give your consent to Bonnie's marrying me—and—and give us your blessing."

Rance spoke calmly. He did not bat an eye as the wrathful red dyed the old man's face, and he shot from his chair.

"Get out!" gasped Maglory, chokingly.

"Whenever you send me word that the proposition is accepted," said Rance, "I'll get busy. But don't wait too long-"

"Get out!" bellowed Maglory, "before I break you in pieces!"

Rance laughed softly as he crossed the room to the door.

CHAPTER X

On a calendar, hanging on the wall of the living room, Maglory had drawn a heavy black line around the figures "25." He divided his time between watching Bonnie slowly regain her health and counting off the days between him and the fateful 25th.

He heard that Hall, of the Burton-Slocum Syndicate, was staying in San Simone, waiting there to deal with the person who owned the Bonanza Mine after the 25th of the month. He heard, too, that Sidney had agreed to sell to Hall for $200,000 just as soon as the mine had come into his possession.

The days dragged past, however, and no Bill Sidney arrived in Ragged Edge. Maglory learned indirectly that Sidney was waiting for the $45,000 to come to him from the East. A faint hope rose in the old man's breast that the money might not come at all. He sent Derry to town to keep track of Sidney, and to report as soon as he began planning a trip to Lost Horse Cañon.

Bonnie had wrung from the old man a promise not to use violence in dealing with Sidney. If he came with the $45,000, then Maglory was to accept it, and the deed to the mine was to be executed.

Not one word did the girl say about Rance's proposition.

Bonnie's silence on this point puzzled and annoyed the old man. She was throwing the entire responsibility upon his shoulders, when she might at least, he thought, indicate a preference one way or the other.

The night of the 24th came. Maglory did not close his eyes between sundown

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and sunup. When he was not walking the floor he was smoking his pipe and burdening his mind with endless questions.

The situation made Maglory nervous, and his reflections made him uncomfortable. He was glad when, at the first ray of dawn, a diversion was caused by a knock on the door.

He pulled the door wide, and found old Joe Derry at the threshold. There was a look on old Joe's face that promised evil tidings.

"It's up-sticks, John," announced the visitor, stepping into the room.

"What do you mean?" demanded Maglory, grabbing him by the shoulders in his anxiety.

"This Sidney person got his spondulix at the bank jest before closin' time yesterday afternoon. It's in the shape of one o' these here certified checks. He's hired an automobile, and figgers to leave town for Ragged Edge at three-thirty to-morrow afternoon. I allow you'd better fix yourself to kiss that mine good-bye. She's sure gone!"

Maglory choked up so he could scarcely speak. After a time he managed to clear his throat, but the look of haunting remorse still remained in his dull eyes.

"What's he delaying for?" he asked. "If he got his certified check yesterday, why does he wait till this afternoon before comin' out?"

"I hear he's to see that syndicate feller in the forenoon."

"All right, Joe; all right. Go home now and put up your horses."

About the middle of the forenoon Maglory went in for a few words with Bonnie.

"Sidney'll be along this afternoon, *mujercita,* with the money," he announced.

"I expected he'd come, Uncle John," Bonnie answered, passively.

"Haven't you got a hard word to say to me?" asked the old man, plaintively; "and me cheating you out of a hundred and fifty thousand, this-a-way?"

"Come over here," she commanded, dropping her book.

He crossed the room to her, and she pulled him down, clasped her arms about his neck, drew his lips down, and kissed him.

"I hope I may die if I ever give you a hard word about anything!" she whispered.

His eyes grew misty and his throat began to tighten.

"You don't say a thing about Jeff," said he.

"I love him, Uncle John," was the quiet reply; "and I reckon you know it. What is the use of saying anything?"

Gently Maglory disengaged her arms. For a moment he stood over her, smoothing the hair from her brow. His eyes, lifting a little, rested on a photograph of Rance which Bonnie had placed on a table near by. Abruptly, Maglory turned on his heel and left the room.

What could Rance do? If he could do anything, why didn't he go ahead and do it, instead of waiting for the word from him? It was all a scheme, the old man persuaded himself, to have him go on record.

Rance was using the Bonanza Mine matter as a club to force him into consenting to a marriage of which he disapproved. It was a mean way for Rance to take advantage of him; and yet, if Bonnie really loved Rance, as she said. . . . It was a disagreeable subject, and he would not pursue it farther. His sleepless night had left him in no pleasant temper, and he tried to calm himself by a walk through the dying town.

In passing Ryckman's house, his feet slowed to a halt. Frowning and ill at ease, he leaned on the gate. Fate was working that day, for young Ollie bobbed out of the front door.

"Howdy, Mr. Maglory!" the boy called.

"See here, son," returned Maglory, in sudden desperation, "can you shoot a message into Poco Tiempo?"

"Surest thing you know," Ollie answered.

"Then send one to Jeff Rance, and send it on the jump. Just say: 'Proposition accepted.' Get that?"

"I'll begin calling right off," said the boy, starting back into the house. "How many p's in 'proposition,' Mr. Maglory?" he paused to ask, doubtfully.

"How the devil do I know?" snapped the old man, striding off down the trail.

(*To be Concluded*)

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The Wireless Age, with wonders manifold,
With wonders that surpass the airy flights
Of those tale-tellers in the days of old
Who wrought the fabric of Arabian Nights.

For now man's messages go flashing on
To leap the long leagues of the trackless sea,
As swift as silver sunbeams of the dawn
They span the watery wastes at man's decree.

Or when the mighty storm-tossed ocean rolls,
Until the ships are playthings of the storm,
The wireless brings new hope to luckless souls
Whose wrecked crafts welter in the wild alarm.

The wireless robs the storm king of his right
To levy on the sails that brave the deep;
It rips away the emblems of his might
And rules the ocean in its breadth and sweep.

The Wireless Age, what wonders manifold;
What wonders that surpass the airy flights
Of those tale-tellers in the days of old
Who wrought the fabric of Arabian Nights!

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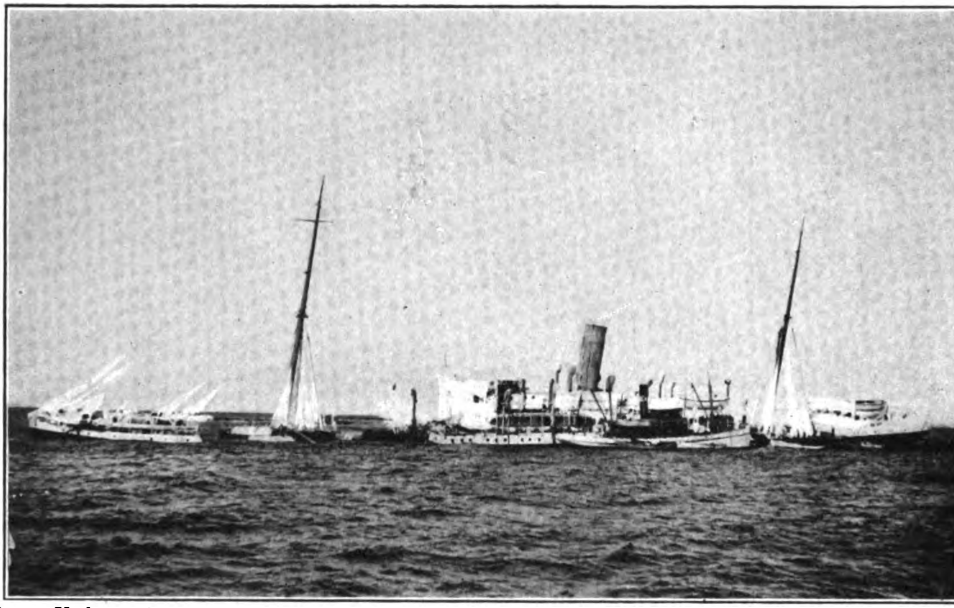

Photo., Underwood & Underwood.

Photograph showing the Cobequid covered with ice and almost submerged, and boats rescuing the passengers and recovering the mails.

Wrecked on Trinity Rock

IN the story of how wireless telegraphy brought succor to those aboard a vessel in distress—stranded on a rock and pounded by angry seas—is another striking illustration of the value of the art. For thirty-six hours the passengers and members of the ship's company awaited with all of the intense anxiety induced by their peril the outcome of the efforts to find rescuers. Uncertain as to the exact location of the stranded ship, the wireless operators were unable to give definite directions to rescuing craft, yet, notwithstanding this disadvantage, the vessels that had been searching for the grounded ship finally succeeded in reaching her.

The Royal Mail Packet Company's steamship Cobequid, which had lost her bearings in a blizzard, was stranded on Trinity Rock, in the Bay of Fundy, on the morning of January 13. Thirty-six hours after the first wireless appeals for aid had been sent out the 108 persons on board were rescued. Help came to the vessel just as the cannonading of the terrific seas was beginning to break her to pieces.

The crash came just before dawn, and a few minutes later the S O S was flashing over the waters. The Cobequid's chief operator, J. W. Hitchner, of Manchline, Scotland, was unable to give her location, for no one on board knew it definitely. Four hours later flood tide and gales had driven her still further on the rock, breaking her back and flooding the engine room. This put out the fires and interrupted the wireless apparatus. The passengers were greatly alarmed, but the courage of Captain Hawson, of the Cobequid, and his abiding faith in his vessel reassured them time and again. The steamship made water rapidly and the cargo began to tear away. Throughout the day and the night that followed the officers scanned the sea for passing craft, and the operator worked heroically to restore his wireless outfit.

The Westport, a coastal steamship, was the first vessel to reach the stranded craft. Under the supervision of Captain McKinnon, of the Westport, the rescuers from that vessel took off in three lifeboat loads seventy-two persons, including

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all of the passengers, the purser, several deck officers and part of the crew. Then the John L. Cann came up and aided in the work of rescue.

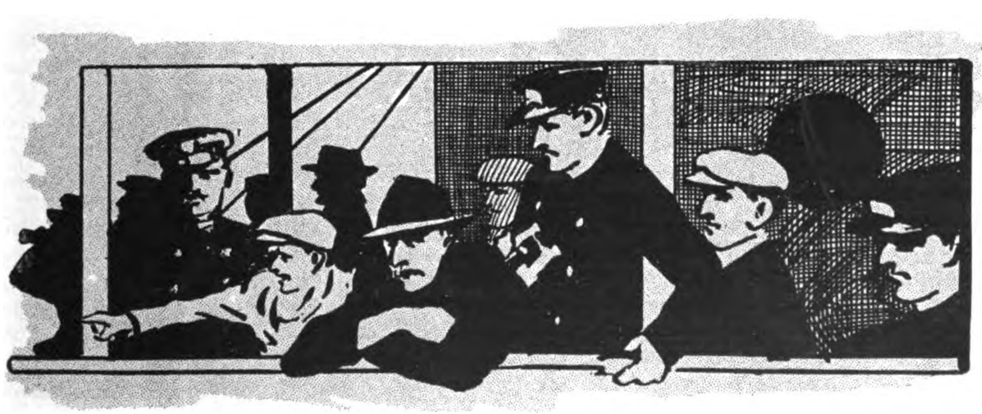
Darkness was gathering fast when the rescue began, but the boatmen from the coast steamships knew the wreck and the surrounding shoals as they did their own front yard ashore, and they went at the work before them with perfect confidence. Less than five hours later those who had faced death for two days were being warmed and fed at the hotels in Yarmouth.

Hitchner, who is an operator in the Marconi service, talked interestingly of how wireless was used to bring aid to the Cobequid. He said he started calling S O S six minutes after the vessel struck and established communication with Cape Sable. The captain reported he thought they were on Brier Island, but was not sure.

"At ten minutes after seven o'clock in the morning the dynamo gave out," said Hitchner, "and we changed over to the emergency set. Communication was established with Partridge Island and we were informed that the Lansdowne was leaving to assist us. At seventeen minutes after eight a heavy sea rolled over the boat deck and into the wireless room, smashing the lifeboats on the starboard side and carrying away the aerials. We made repairs and after a time succeeded in re-establishing communication. We heard the Kronprinzessin Cecilie calling with a message, via Cape Sable, that she could not come to our assistance owing to a shortness of coal, and saying that she had informed the steamer Belvedere of our plight.

"We were unable to acknowledge the signals from Cape Sable, owing to the great difficulty under which we were working. We called S O S continually until high tide, when we were no longer able to stay in the wireless room. At 3 o'clock the aerial again was carried away, but was repaired. We again called S O S and reported that we now thought we were on Trinity Rock, or possibly Brier Island. During the high tide the room was swamped and the receiver flooded, making it useless, but the transmitting set was working.

"We stayed in the room until the next high tide. At eleven o'clock in the morning on January 14 we again went into the wireless room and rerigged the aerials and got signals working fairly well. We worked up to fifteen minutes after eight o'clock in the morning, when we were again forced from the room by the tide. At low water we again called, and we remained in the wireless room until taken off. My assistant, E. T. Shimpton, rendered very valuable assistance and showed excellent courage under the most trying circumstances."



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MARCONI'S EFFICIENCY EXPERT

The man who makes his mark in New York, as a rule, has achieved reputation in his home town—West, South or Middle West—but Elihu Cunyngham Church has demonstrated the exception by making his mark in New York City along the line of efficiency work. He has recently been engaged to apply the principles of scientific management to the Marconi Wireless Telegraph Company of America.

Mr. Church has evolved his own theories of efficiency, which he acquired in the hard school of the engineering service. After his graduation from the School of Mines in Columbia University his first efforts were applied toward the construction of a bridge on Long Island. His next activity was in railroad construction in Western Pennsylvania, an experience never to be forgotten, for it included ninety consecutive meals of fried ham.

Mr. Church obtained the first chance of developing his peculiar talents in the line of appraisal work when he was appointed cost expert of the Railroad Commission of the State of Washington, which involved a valuation of all the railroad companies of that State; this was during the trying period of the famous Spokane rate case.

At this time he was impressed with the fact that only too many railroad lawyers are insufficiently acquainted with the intrinsic necessities and requirements of the country's great transportation companies. He therefore returned East, and again entered Columbia University to pursue a law course, in order to familiarize himself with the legal end of railroad and engineering work. He taught engineering while pursuing these studies, and lectured, with the rank of adjunct professor, at Columbia, being the youngest man by six years that ever held that position.

The efficiency principles that he had acquired by close observation during his early years of engineering attracted the attention of many progressive minds in New York, and he was invited to join in the activities of the Bureau of Municipal Research, in that city, where he further developed his talents. Next he was appointed secretary of the Department of Water Supply, Gas and Electricity of New York, and Chief of the Bureau of Supplies, achieving the distinction of being the first man to organize a branch of a municipal department on a scientific basis.

The Bureau at that time was in a state of demoralization, and there was inefficiency and lack of coördination everywhere. After the reorganization effected by Mr. Church, its functional organization is a model of its kind, while its activities have been so systematized, its methods so standardized and its employees so instructed and trained that its present operation is well night automatic.

Mr. Church's principles, especially as applied to the purchasing end of a corporation, have since been widely adopted by many of the leading industrial corporations of the country, and the commercial world is watching with interest the operation of his plans for scientific management of commercial wireless telegraphy.

THE SHARE MARKET

NEW YORK, February 21.

This morning the securities market is apathetic; trading is hardly nominal, and the only changes worth noting over the preceding weeks are fractional declines. The market's rather habitual caution in "discounting" events which may, or may not, take place no doubt accounts for the recent spectacular rise in stocks. That a month has elapsed since the important change for the better in the share market, with no equally important change for the better occurring in business seems to be the reason for the slight declines in standard issues. The brokers report that Marconis are inactive, but the market for these issues remains firm.

Bid and asked prices to-day:

American, 4¾—5; Canadian, 2½—2¾; English, common, 19—22½; English, preferred, 15—17½.

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TRAIN WIRELESS AGAIN PROVES ITS EFFICIENCY

Wireless telegraph messages were sent and received January 22 without a hitch by an operator on a special train on the Delaware, Lackawanna & Western Railroad, which carried 500 members of the American Society of Civil Engineeers from Hoboken, N. J., to Nicholson, Pa., and back. At Nicholson the engineers inspected a concrete railroad viaduct construction. The special train's speed was from fifty to seventy-five miles an hour in the open country.

George A. Cullen, passenger traffic manager of the Lackawanna Road, who was on the train, sent to The New York Times what was described as the first wireless dispatch from a moving train to a newspaper. Here it is:

"On board Lackawanna Civil Engineers' special, thirty-five miles east of Scranton, Pa., going sixty-four miles an hour. Greetings in the first wireless message from a moving train to a newspaper. Cullen."

This message was flashed ahead of the train to Scranton and sent from the wireless station there direct to that on the Wanamaker Building, from which it was delivered to The Times office. It was six minutes from the time the message was handed to the Marconi operator on the train until it was copied by the operator in the Wanamaker Building, and no wire transmission was used. The distance is about 125 miles.

More than thirty wireless messages were received and sent by the Marconi operator on the train during the day. Greetings were exchanged between passengers and their friends in New York, and news items from Scranton were received on the train.

When the train was thirty-two miles east of Scranton in the afternoon on the return trip, The Scranton Times sent bulletins of news to it.

Wireless stations are now being constructed at Lake Hopatcong, N. J., forty-six miles from New York, on the Lackawanna Road, and Bath, N. Y., 100 miles east of Buffalo. When they are finished the Lackawanna, with the stations at Scranton and Binghamton, will have four stations on its line with overlapping radii, so that at no time between Hoboken and Buffalo will a train equipped with wireless instruments be out of communication with a fixed station.

Both the east and west bound Lackawanna Limited trains, which run between Hoboken and Buffalo, will begin to handle commercial messages as soon as these stations are completed.

WIRELESS ON ROTTERDAM POLICE BOATS

Wireless telegraphy has been installed on two of the small boats and on the floating offices of the Rotterdam river police. The work of the police had previously been considerably impeded by the time wasted in the transmission of information and in waiting for instructions from headquarters. Now it is possible for the boats to make their way to various points, and either send information by wireless to headquarters and receive instructions; or they can be notified at any moment to take part in plans which require immediate execution. The chief difficulty to be overcome in the installation of the wireless apparatus was not so much that of distance; there was need, however, to overcome any obstructions which might happen to lie between any two of the vessels, such as buildings, large steamers and bridges.

Perhaps the intricate nature of the work will be understood when the class of vessel on which the installations were placed has been described. The two police boats are very small. One is a motor boat, provided with two hinged masts. The other craft is an electric boat having one hinged mast. The hinged masts are used in order to enable the boats to pass under low bridges, for, as is well known, Rotterdam is built on the delta of a river and consequently the harbor is divided up into sections by the diverging outlets. The floating office is much larger than the other two craft. It was decided to adopt a short-range apparatus on all three of the vessels. The work of installation was undertaken by the Société Anonyme Internationale de Télégraphie sans Fil.

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Working the Set on a Stranded Ship

WIRELESS telegraphy was recently employed to advantage in summoning vessels to the assistance of the steamship Pectan after she had run aground off Adams Cove, Point Bennet, Cal. H. W. Dickow, Marconi operator on the Pectan, told the following story of the stranding in a communication sent from the vessel while she was aground:

"While en route from Taltal, Chile, and being only sixty-five miles from our destination, the forward watch reported a bell-buoy on the starboard quarter, and immediately land was sighted ahead. It was just fifteen minutes to nine o'clock in the evening, and I had finished sending a message to San Luis telling of our arrival at Port Harford at daylight. Then the vessel struck the beach, and so easily did she ground that no one knew that we were stranded.

"The weather was thick and we could not see where we were, but the captain came to the conclusion that we were at Point Bennet, and asked me if I had heard any of the Union Oil ships working that evening. I told him that the Argyll was abreast of Point Arguello and the Lansing was off Port San Luis. He ordered me to call the Argyll and tell the captain of that vessel to proceed to Adams Cove to render assistance.

"This I did, and the Argyll's captain said that he was coming to assist us entirely by soundings, as he himself had lost his course. Then the Stetson's captain asked the Argyll if he could help us, but our captain told me to thank him and say that we would not need him. Afterwards the Lansing called and asked if she could be of any help, and the captain told me to bring 'em all down to us. All night long I worked with the two ships, and they were willing to stand by with me till I gave them further orders.

"They arrived about 11 o'clock in the morning, but the weather was so bad that no ship could render assistance. We were exceedingly lucky, as there were rocks on all sides of us, and just where we landed there was soft sand. The Argyll made an attempt to enter, but in vain. Then the Lansing tried it, and came a little closer in, but a ship of that size was far too large to be of any assistance to us, situated as we were. Later we received word that the wrecker Iaqua was on her way to us, and we also ordered two tugs to come to our help, as the big oil boats were useless in the place where the Pectan was aground.

"Captain Ferris arrived on the Iaqua the following day and took charge. The Lansing was ordered to proceed to Port Harford, and the Argyll left for San Pedro for fuel, and received orders to proceed on her way.

"Many messages, ranging from ten to three hundred words, were sent, and a large number of communications was received in return. Excellent service was rendered by the operators on the Argyll and Lansing and at the San Pedro, San Luis Obispo and other navy stations. The Marconi operator at San Pedro asked if a revenue cutter was wanted. Our captain replied in the negative, but, to our astonishment, the revenue cutter Manning was dispatched to render assistance. She arrived the following morning at daylight, but she was unable to pull us off. We shall have to wait for the high tides. That is our only chance to get off."

The Iaqua, to which Dickow refers in his account of the Pectan's stranding, is a wrecking vessel owned by the Union Iron Works Company, of San Francisco. The Marconi Wireless Telegraph Company of America installed wireless apparatus on her a short time ago. The day following the completion of the equipment she was called upon to make an attempt to salvage the steamship Pomo, which turned turtle while being towed into San Francisco, and broke away from the towing vessel. The

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Pomo had just weathered a severe storm. Constant communication was maintained with the Iaqua during that trip. She was unsuccessful, however, in salvaging the Pomo.

New Marconi installations have been made recently on the Cetriana and Korrigan III. The Korrigan III is a Mexican vessel, and the owners find the use of the equipment very valuable to them, as they are able to communicate from the vessel to the "States," while the steamer is cruising between ports in the Gulf of California. The Cetriana was recently chartered by the North Pacific Steamship Company for trade between San Francisco and Mexican ports.

The lumber schooner Yellowstone required aid during one of the big storms a short time ago. She does not carry a radio equipment, but she hailed a passing vessel having wireless, which placed a line aboard. The line parted and the vessel giving assistance was unable to get another one aboard.

She communicated with other vessels having wireless, however, and one of these, a lumber vessel, responding to the call for aid, stood by the Yellowstone and succeeded later in towing her to San Francisco. A tug was sent out from San Francisco to meet the vessels, but failed to locate them because it did not have wireless equipment.

A contract has been obtained calling for the installation of Marconi wireless apparatus on the new steam schooner Celilo, owned by the C. R. McCormick Company.

WARNING TO OPERATORS

The Bureau of Navigation of the United States Department of Commerce has issued the following general letter to wireless inspectors and examining officers:

"It has come to the attention of the bureau that several operators holding operators' licenses under the Act of August 13, 1912, have not taken the oath of secrecy, as required by the International Radiotelegraphic Convention and the Department of Commerce regulations.

"The attention of licensed operators should be invited to the fact that the license is not valid until the oath of secrecy has been executed. Radio inspectors may recommend the suspension of the licenses of operators in cases where oaths of secrecy have not been taken. Where practicable, radio inspectors or examining officers should not affix signatures to the licenses until the oaths have been properly executed.

"The attention of radio operators holding licenses should also be invited to the service record on the back of the form. Operators should make every effort to have the service record properly filled in by their employers, as the record will be an important factor in determining whether or not an applicant will be re-examined for a renewal of license, and in determining whether an applicant is eligible to take the examination for the 'Extra-Grade' license."

OPERATOR DISCIPLINED

The Department of Commerce, Radio Service, has suspended for a period of thirty days the license of a radio operator who had indulged in unnecessary and unauthorized wireless conversation and used profane and obscene language by radio. This is the second case where an operator's license has been suspended by the Department because of not complying with the requirements of the law.

STATION JURSIDICTION CHANGED

By an order recently issued by the Navy Department, the naval radio stations at the Puget Sound Navy Yard and Tatoosh Island have been transferred from the jurisdiction of the commandant at the Puget Sound Navy Yard to the wireless officer at Mare Island, Cal. This places every station in Alaska and on the Pacific Coast under the direct supervision of the Mare Island Navy Yard.

Another order states that every enlisted man who has served two years as a radio operator on shore duty will be sent to sea as soon as practicable, and men who have seen considerable sea service will be sent to take their places.

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WIRELESS RULES ADOPTED BY LONDON CONFERENCE

The London International Conference on Safety at Sea was ended on January 20, fourteen nations, through the delegates sent by them, having signed a convention providing for regulations that will insure greater security for vessels and their passengers. Mr. Moggridge, of Great Britain, was appointed chairman of the Wireless Telegraphy Committee. A speech, delivered by Lord Mersey, chairman of the Conference, in which he moved the adoption of the convention, contains an outline of the principal provisions of the latter. That part of the speech relating to wireless telegraphy was as follows:

"The convention provides that all merchant vessels of the contracting states when engaged upon international (including colonial) voyages, whether steamers or sailing vessels, and whether they carry passengers or not, must be equipped with wireless telegraphy apparatus if they have on board fifty persons or more (except where the number is exceptionally and temporarily increased to fifty or more owing to causes beyond the masters' control). The contracting states have, however, discretion to make suitable exemptions from the requirement to carry wireless apparatus in certain cases, of which the most important is that of vessels which in the course of their voyage do not go more than 150 sea miles from the nearest land. The classification of the vessels required by the convention to be provided with wireless apparatus follows the categories contemplated by the Radiotelegraphic Convention. The precise classification is too complex to be summarized, but, broadly speaking, the fast passenger steamers are placed in the first category, other steamships, intended to carry twenty-five passengers or more, in the second category, and all other vessels required to be fitted with wireless apparatus in the third category. It need hardly be said that the owner of any vessel placed in the second or third categories can claim that his ship shall be placed in a higher category, if it complies with all the requirements.

"A continuous watch for wireless telegraphy purposes is to be kept by all vessels required to be fitted with wireless apparatus as soon as the government of the State to which the vessels belong is satisfied that such watch will be useful for the purpose of saving life at sea; and meanwhile (subject to a transitional period for fitting wireless installations and obtaining the necessary staff) the following vessels will be required to maintain a continuous watch, in addition, of course, to all vessels placed in the first category:

"(1) Vessels of more than thirteen knots, which carry 200 or more passengers, and which make voyages of more than 500 miles between two consecutive ports.

"(2) Vessels in the second category during the time they are more than 500 miles from land.

"(3) Other vessels, required to be fitted with wireless apparatus, which are engaged in the transatlantic trade, or whose voyage takes them more than 1,000 miles from land.

"Vessels placed in the second category, but not required to keep continuous watch, are nevertheless required to keep such watch for at least seven hours a day, besides the watch of ten minutes in each other hour required by the Radiotelegraphic Convention. Vessels concerned with the fishing and whaling trade are not required to keep a continuous watch. The continuous watch may be kept by certificated operators or by watchers qualified to receive and understand signals of distress, and provision is made for the possibility of the future of an automatic apparatus which will take the place of watchers. The wireless installations must have a range of at least 100 miles and an emergency apparatus, placed in the condition of the greatest safety possible, must be provided unless the main installation is placed in the highest part of the ship, and in conditions of the greatest safety possible. The convention provides that the master of a ship in distress shall have the right to call to his assistance from amongst the vessels which have answered his appeal for help the vessels which he thinks can best render assistance, and the other vessels which have received the call may then proceed on their way. A transitional period is provided to enable wireless apparatus to be fitted and operators and watchers obtained."

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ARCTIC EXPLORATION

HOW WIRELESS HAS BEEN EMPLOYED

REAR ADMIRAL ROBERT E. PEARY U.S.N.

CAPTAIN ROALD AMUNDSEN

THERE was a time when members of Polar expeditions, once they had left behind the last points of civilization, were as completely cut off from the outside world as if they were buried. From the time they actually started on their journey to the frozen lands, it was a matter of conjecture whether they were alive or dead. Whatever accidents or dangers they met with did not become known till they had left the scenes of their adventures far behind, and sometimes the tragedies of the ice fields were concealed beneath the snow, perhaps never to be told.

Wireless telegraphy has done much to minimize the perils and aid the work of those venturing into the Polar regions. Now they are able to send home reports concerning their welfare, their adventures and their discoveries; they can gossip with passing vessels or other stations, and they are even publishing an Antarctic newspaper containing current news.

The most notable achievement of wireless in Polar exploration was accomplished by Dr. Mawson and the members of his expedition. The party left Hobart, New Zealand, for the Antarctic on December 2, 1911. There were fifty-two persons in the expedition; thirty-one were for service on shore and the remainder were employed to serve on board the Aurora, which carried the party to its destination. The purpose of the expedition was the exploration of the coastal region of the Antarctic continent lying south of Australia, for Dr. Mawson believes that a scientific and accurate survey of the region will probably prove the possibilities of economic development. The Aurora is a vessel which has long since made her maiden trip to Polar regions, having taken part in the search for the ill-fated Greely Expedition, thirty-six years ago. She is a whaler, heavily timbered to withstand ice pressure, and is well supplied with all things needful for her present purpose.

The Aurora reached the mainland of Australian Antarctica in due time, and Mr. Ainsworth, of the Commonwealth Meteoreological Service and a party of four were landed at Macquarie Island on December 13, 1911. One of the four was A. J. Sawyer, who at that time was a member of the Gisbourne and Wellington telegraph staffs, from which he resigned in 1908 to take up wireless telegraphy. He was afterwards commissioned to su-

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perintend and man the proposed wireless station on the island. His description of the difficulties encountered in his work is as follows:

"All stores and wireless equipment had to be landed through the surf—not a difficult proceeding, but a wet and cold one. A barrel containing a part of the wireless equipment came adrift and we thought it was lost for good. But it was cast up on shore two days later, though the contents were scarcely improved by the long immersion. Owing to the fearful gales and the bad weather, the task of erecting the wireless plant was a difficult one. We had to haul everything up a 300-foot hill and several minor accidents occurred during the work of transit, while a good many of the instruments had to be repaired before the actual work of erection could be proceeded with. Throughout, my only assistant was a Sydney wireless amateur.

The earliest illustrations of Arctic Exploration by Gerrit Veer, who accompanied the Dutch Expedition led by William Barentz in 1594. The text refers to the capture of walruses.

"On the 6th of February everything was ready for the initial trial. Unfortunately, a violent hurricane sprung up that afternoon, carried the aerials away, and damaged the masts; but in a week's time repairs had been effected, and on the 13th communication was established with shipping and Sydney."

This station supplies meteorological data each night to Melbourne and Wellington by wireless and has proved so valuable that it has been taken over from the expedition by the Commonwealth of Australia. Several excellent results in the way of long-distance communication have been recorded; for instance, messages were transmitted to and received from the Port Moresby land station, 2,800 miles away; the Suva land station, 2,400 miles away; the Freemantle land station, 2,200 miles away, and from the steamers Manuka and Cooma, both more than 2,300 miles away.

At Macquarie Island the Aurora bumped heavily on the rocks and sustained severe damage, which necessitated almost continual work at the pumps and subsequently cost approximately $10,000 to repair.

Dr. Mawson and the remainder of the party had in the meantime set out for the lesser known districts farther south. They successfully weathered the stormy conditions of the "Roaring Forties, Howling Fifties and Shrieking Sixties" and eventually discovered a magnificent harbor, afterwards named Commonwealth Bay, where it was decided to establish a base. Provisions, coal and Greenland sledge dogs for eighteen men were landed, and the ceremony of hoisting the British flag in the new territory was performed. It was called King George V. Land. Afterwards a wireless station was erected here, which has been working successfully since January, 1913.

The Aurora then proceeded westward to land the third party of eight men, but that vessel traversed 1,100 miles without being able to find a landing place. Where ice floes did not intervene they were thwarted by unscalable ice cliffs and when their supply of coal began to run

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short they were forced to consider the advisability of returning to Australia with their ambitions unfulfilled. But such a prospect went against the grain and the little company took their lives in their hands and chose to land on a glacier with their camp seventeen miles distant from land and with 200 fathoms of water beneath them.

This ice tongue, which is 120 miles in length, was named the Shackleton Glacier, while the adjoining land, which was afterwards explored by the party, has been christened Queen Mary Land. The members of the expedition were in considerable danger during their stay on Shackleton Glacier, for there was a possibility that the ice tongue would break away during the vernal thaw. Their work, under the direction of Frank Wild, justified the hazard, however, and when they returned to Australia they had completed the charting of a great part of the Antarctic coast and accomplished a considerable amount of research in oceanography.

It was imperative that Wild and his men should be relieved, because the season was late and a vessel penetrating the pack ice under such conditions is likely to be frozen in and jammed among the bergs in the darkness. As the efforts of the searching parties to discover the missing explorers were unsuccessful, Captain Davis decided to proceed to Wild, when a wireless message which came from Adelie Land caused him to change his plans.

Dr. Mawson, Mertz and Lieutenant Ninnis, it seems, were 300 miles from the main base when Lieutenant Ninnis, with a team of dogs and nearly all the food, was suddenly precipitated down a crevasse. He was killed, and the position of the two survivors—deprived of their supplies—became desperate. They retraced their steps and struggled on for thirty-five days without provisions. Then, on January 17, Mertz died from privation. For another three weeks Dr. Mawson continued his lonely journey, and finally reached the base on February 7.

This news was made known to Captain Davis in the wireless message he received from Adelie Land. With the information came the order for the Aurora to return at once and take off all the members of the expedition. An effort to do this, however, was frustrated by storms, and Captain Davis, exercising his own discretion, determined first to relieve the heroic little band stationed on the far-off glacier to the west.

"On February 9," his report says, "we were brought up by heavy ice, and it appeared unlikely that we should get through at all. The presence of countless bergs made navigation in the darkness almost impossible, and as daylight came we were thankful that we had passed another night without disaster. These experiences continued until February 23. The morning of that day dawned bright and clear and we calculated that we ought to be near Wild's base. So, with eyes glued to our glasses, we searched the coast and perceived a little hut on the glacier with a solitary figure outside it. Soon there were eight gesticulating black

In the photograph Captain Amundsen is seen taking an observation of the sun through a sextant, while one of his assistants examines the "artificial horizon." The flag is planted at the point determined upon as the exact location of the South Pole.

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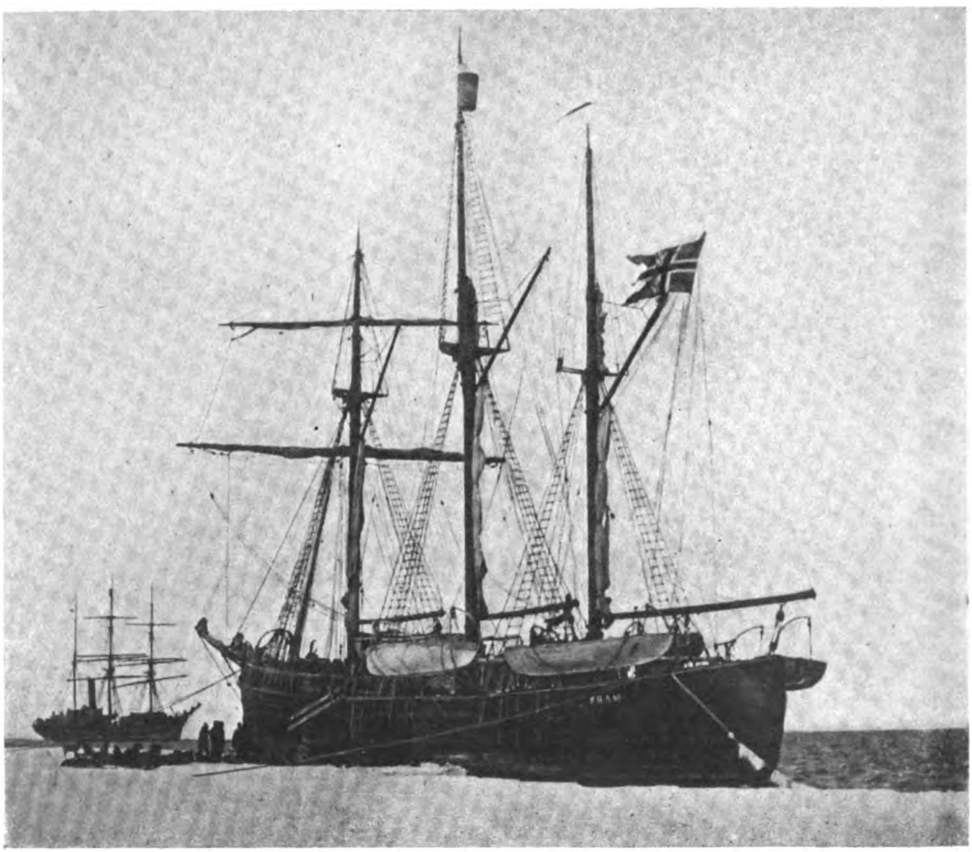
figures and we knew that the whole of the party was safe and sound. Then began the work of bringing aboard the members and all their specimens and collections, and this we did in a remarkably short space of time."

With the rescued the Aurora then sailed for Hobart, arriving there in March, 1913. But Dr. Mawson and his party, which includes six of the men sent out by the Aurora to search for their leader, have been forced to spend another year in the Antarctic. They are well supplied with coal and food and there is no reason to suppose that they are running any further risks by the delay. Besides, they have the wireless to keep them in touch with the outside world.

According to reports which reach civilization from time to time, they have found the art an invaluable aid both to their work and recreation. Not only can they transmit messages, but they are able to hear communications between other stations. They pick up messages which Wellington, Melbourne and Sydney exchange with one another and sometimes they get communications between warships and other craft. Occasionally Dr. Mawson discusses, through Macquarie Island and Hobart, how Sydney shall dispose of certain scientific specimens already brought back to Australia by the Aurora. The Polar adventurers send news of the weather, of the good spirits they manage to keep up, and of the team dogs' puppies. They have also conveyed their sympathy by wireless to Lady Scott on the loss of her husband. But perhaps their most noteworthy achievment is the publication of an Antarctic newspaper with "all the latest news."

It is reasonable to suppose that had



Sisters of the Antarctic; in the foreground the Fram, which carried Amundsen in his dash to the South Pole, and in the middle distance the Terra Nova, Captain Scott's vessel. This picture was taken by Captain Amundsen while the ships were lying in the Bay of Whales.

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The difficulties encountered by explorers and the absolute necessity of dependable communication are shown in this picture of the Devil's Glacier, looking down Hell Gate. Three days were required before the glaciers could be surmounted, and snow bridges like the one seen in the center had to be employed in crossing the great crevasses.

Captain Scott's expedition been equipped with the wireless apparatus the brave men who lie buried beneath Antarctic snows would have completed a triumphant journey. They were only eleven miles from One Ton Depot, where there was a store of food, and if they had been able to communicate they could have received assistance, for some of the party had quitted it to return to the ship only a few days before the disaster overtook their fellows.

Captain Scott remarked on the lack of means for communication in Polar exploration. A paragraph in the log of the Nimrod reads:

"One of the most annoying circumstances was, that until we had a solid sheet of ice about us, we could not set up our meteorological screen, nor communicate regularly with the magnetic huts, nor, in fact, properly carry out any of the routine scientific work."

Captain Amundsen apparently realizes the value of wireless as a means of communication in Polar travel, for the Fram, on which he is about to start on a trip to the North Pole, had been equipped with radio apparatus. He has also arranged for a wireless equipment to be carried on the sledges on which he will make his final dash to the pole.

NEW CANADIAN LAWS

New wireless regulations governing navigation throughout the Dominion came into effect January 1, when all provisions of the act governing Canadian Wireless passed last session became effective. Roughly speaking, the result of the new regulations is that no vessel carrying 50 or more passengers or going 200 miles or more may hereafter be without wireless apparatus. Navigation on both coasts of Canada will feel the effect of the regulations immediately, but it is understood that most vessels engaged in ocean traffic are already equipped with wireless as required. The main changes necessitated by the act will be in lake vessels, but this will not be till the resumption of navigation in the spring.

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Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By William H. Priess

ARTICLE IV—(Continued)

THE USE OF THE BRIGGS TABLE

SINCE

$$10^0 = 1, \quad \log_{10} 1 = 0$$
$$10^1 = 10, \quad \log_{10} 10 = 1$$
$$10^2 = 100, \log_{10} 100 = 2, \text{etc.},$$

and

$$10^{-1} = .1, \quad \log_{10} .1 = -1$$
$$10^{-2} = .01, \quad \log_{10} .01 = -2$$
$$10^{-3} = .001, \log_{10} .001 = -3, \text{etc.}$$

therefore the logarithms of numbers between

1 and 10 lie between 0 and 1,
10 and 100 lie between 1 and 2,
100 and 1,000 lie between 2 and 3, etc.,

and the logarithms of numbers between

1 and .1 lie between 0 and — 1,
.1 and .01 lie between — 1 and — 2,
.01 and .001 lie between — 2 and — 3, etc.

The logarithms of numbers may be expressed as a positive or negative integral number known as the *Characteristic,* which may be determined at sight, and a decimal portion called the *Mantissa,* which is found in logarithmic tables. The Characteristic—as shown above—is positive, and one less than the number of figures to the left of the decimal point if the number is greater than unity. When the number is less than unity the Characteristic is negative and equal to one unit more than the number of zeros between the decimal and the first figure in the given number. After the operations have been performed by the logarithms the anti-logarithm is found to bring the answer into the usual arithmetical form. This is done by taking the decimal portion of the logarithm and writing down the number to which it corresponds, this number being found in the tables. Then, after pointing off the proper position for the decimal point as indicated by the Characteristic, the answer is in the desired shape. (The reader may find a logarithm table in the last pages of any book on mathematics, physics or engineering hand-book. If these are not at hand he should secure a copy of a logarithmic table.)

EXAMPLE (1)

Numerical Calculation by Logarithms

In the design of an oscillating transformer for sending or receiving, or a variometer the inductance of which varies with the mutual inductance of the coils forming it, it is necessary to know the mutual inductance of the two coils forming the couple; in the first case, so that the coupling coefficient of the two circuits may be determined by means of the relation.

$$K = \frac{M}{\sqrt{L_1 L_2}} \qquad (1)$$

where K is the coupling coefficient, M is the mutual inductance between the two circuits, and L_1 and L_2 are the inductance of the first and second circuits, respectively. In the second case for the determination of the equivalent inductance of the variometer, which will have a maximum value when the fluxes from the coils L_1 and L_2 assist.

Then

$$L = L_1 + L_2 + 2\,M, \qquad (2)$$

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and, as an intermediate value when $M = O$,

$$L = L_1 + L_2 \qquad (3)$$

and as a minimum value when the fluxes from the coils L_1 and L_2 oppose,

$$L = L_1 + L_2 - 2M \qquad (4)$$

We shall calculate M for two concentric, coaxial coils of the same length by means of Maxwell's Formula, which appears in Electricity and Magnetism, Vol. II, p. 678, and also in the Bureau of Standards' publication, Vol. 8, No. 1, pages 53-55. Fig. 6 represents a section through the two coils where l is the common length, A and a are the radii of the outer and inner coils, respectively, n_1 and n_2 are the number of turns per cm. on the outer and inner coils, respectively.

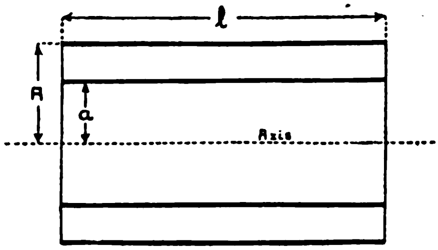

Fig. 6

$$M = 4\pi^2 a^2 n_1 n_2 [l - 2A\alpha] \qquad (1)$$

where

$$r = \sqrt{l^2 + A^2}$$

$$\alpha = \frac{A - r + l}{2A} = K_1$$

$$-\frac{a^2}{16A^2}\left(1 - \frac{A^2}{r^2}\right) = K_2$$

$$-\frac{a^4}{64A^4}\left(\frac{1}{2} + 2\frac{A^5}{r^5} - \frac{5}{2}\frac{A^7}{r^7}\right) = K_3$$

minus a series of terms the sum of which is extremely small as compared to the first term given. As a typical case, take two coils the values of which are $l = 8$ cms, $A = 6$ cms, $a = 5$ cms, $n_1 = 3$ turns per cm, $n_2 = 6$ turns per cm.

$$\text{Log. } r = \tfrac{1}{2} \text{ log. } (8^2 + 6^2) = \tfrac{1}{2} \text{ log. } (100) = 1$$

$$r = 10$$

$$K_1 = \frac{6 - 10 + 8}{12} = 0.3333$$

$$K_2 = \frac{5^2}{16 \times 6^2}\left(1 - \frac{6^2}{10^2}\right) = \frac{25}{16 \times 36}\left(\frac{782}{1000}\right)$$

$$\text{Log. } K_2 = \text{log. } 25 = 1{,}39784$$
$$+ \text{log. } 782 = 2.89321$$
$$4.29115 \qquad (1)$$

$$- \quad + \text{log. } 16 = 1.20412$$
$$+ \text{log. } 36 = 1.55630$$
$$+ \text{log. } 1000 = 3.00000$$
$$5.76042 \qquad (2)$$

Subtracting (2) from (1) 4.29115
5.76042

$$\text{log. } K_2 = -2.53073$$

$$K_2 = 0.03394$$

$$K_3 = \frac{5^4}{64 \times 6^4}\left(\frac{1}{2} + 2\frac{6^5}{10^5} - \frac{5}{2}\cdot\frac{6^7}{10^7}\right)$$

$$\text{Log. } 2\frac{6^5}{10^5} = \text{log. } 2 = .30103 = .30103$$
$$+ 5 \text{ log. } 6 = 5 \times .77815 = 3.89075$$
$$4.19178 \qquad (1)$$

$$- \text{log. } 10 = 5.00000 = 5.00000$$

Subtracting (2) from (1) $= -1.19178$ (2)

$$\text{log. } 2\frac{6^5}{10^5} = -1.19178$$

$$2\frac{6^5}{10^5} = .1553$$

$$\text{log. } \frac{5}{2}\frac{6^7}{10^7} = \text{log. } 5 = .69897 = .69897$$
$$+ 7 \text{ log. } 6 = 7 \times .77815 = 5.44705$$
$$6.14602 \qquad (1)$$

$$- \quad + \text{log. } 2 = .30103$$
$$+ 7 \text{ log. } 10 = 7.00000$$
$$7.30103 \qquad (2)$$

Subtracting (2) from (1) 6.14602
7.30103

$$\text{log. } \frac{5 \times 6^7}{2 \times 10^7} = -2.83499$$

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$$\frac{5 \times 6^7}{2 \times 10^7} = \quad .06839$$

$$\left(\frac{1}{2} + 2\frac{6^6}{10^6} - \frac{5}{2}\frac{6^7}{10^7}\right) =$$

$$(.50000 + .15530 - .06839) = 0.58691$$

$$K_3 = \frac{5^4}{64 \times 6^4} \times 0.58691$$

$$\begin{aligned} \log. K_3 = 4 \log. 5 &= 4 \times .69897 = 2.79588 \\ + \log. 0.58691 &= -1.76856 = -1.76856 \\ & \overline{2.56444} \quad (1) \end{aligned}$$

$$\begin{aligned} -\Big| + \log. 64 &= 1.80618 = 1.80618 \\ + 4 \log. 6 &= 4 \times .77815 = 3.11260 \\ & \overline{4.91878} \quad (2) \end{aligned}$$

Subtracting (2) from (1) 2.56444 3.11260

$$\log. K_3 = \overline{-3.64566}$$

K_3 = .004422

K_4 is negligible as compared with K_1

$$\alpha = K_1 - K_2 - K_3$$
$$= 0.33333 - 0.03394 - 0.00442 = 0.2949$$

Substituting in equation (1) the value of α

$$2\, A\, \alpha = 12 \times .2949 = 3.54$$
$$[1 - 2\, A\, \alpha] = 8 - 3.54 = 4.46$$

From equation (1)

$$M = 4 \times \pi^2 \times 25 \times 3 \times 6 \times 4.46$$

$$\begin{aligned} \text{Log. } M = \quad & \log. 4 = 0.60206 \\ + & 2 \log. \pi = 0.99434 \\ + & \log. 25 = 1.39794 \\ + & \log. 3 = 0.47712 \\ + & \log. 6 = 0.77815 \\ + & \log. 4.46 = 0.64933 \\ & \overline{4.89894} \end{aligned}$$

M = 79,200 cms.

The inductance of the outer coil—considered as a current sheet—is 60,900 cms.; that of the inner coil is 181,400 cms. Therefore, if the inductances of the outer and inner coils are, respectively, the total inductance of a primary and a secondary circuit, the coupling coefficient is—from equation (1)—equal to

$$K = \frac{79{,}200}{\sqrt{60{,}900 \times 181{,}400}} = 0.754$$

This value of coupling is much too great for the usual resonance work; i. e., transfer of energy in the form of a single wave from one circuit to another. It is decreased by the inductance of the leads and loading inductance in either, or both, circuits, and may be further reduced by varying the distance between the centers of the coils, and the angle between their axes. In practice the coupling coefficient is about 0.2.

As a variometer the maximum inductance is—from equation (2)—equal to

$$L = 60{,}900 + 181{,}400 + 2\,(79{,}200) = 400{,}700 \text{ cms.,}$$

and the minimum inductance is—from equation (4)—equal to

$$L = 60{,}900 + 181{,}400 - 2\,(79{,}200) = 83{,}900 \text{ cms.}$$

It is of importance in the design of a variometer to have the ratio of maximum to minimum inductance as large as possible, in order to obtain the greatest wave length range, of the apparatus in which it is used. This is accomplished by making the inductances of the two coils equal. In the given example the ratio is 4.77 : 1. If we increase the number of turns on the outer coil to 5 turns per cm., instead of 3 turns per cm., we increase its inductance to 169,100 cms., and the mutual inductance to 132,100 cms. The maximum inductance of the apparatus is then 614,700 cms. and its minimum inductance is 86,300 cms. The ratio is 7.13:1. On the other hand, if we decrease the number of turns per cm. on the inner coil from 6 to 3½ we decrease its inductance to 60,300 cms., and the mutual inductance to 46,200 cms. The maximum inductance of the apparatus is 213,600 cms., and its minimum inductance 28,800 cms. The ratio is 7.41 :1.

EXAMPLE (2)

Change of Base

Example—Calculate the wave length of a vertical antenna 60 meters high composed of a single No. 14 copper wire. The formula for the capacity of a vertical wire of height h and radius P is

$$C = \frac{h}{2\left(\log_\epsilon \frac{h}{\rho}\right) 9 \times 10^5} \mu. \text{ fs.}$$

The formula for the inductance of the same wire is

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$$L = 2h\left[\log_\epsilon\left(\frac{2h}{\rho}\right) - 1\right] \text{cms.}$$

Therefore, the wave length λ is equal to

$$\lambda = 59.6\sqrt{\frac{h^2\left[\log_\epsilon\left(\frac{2h}{\rho}\right) - 1\right]}{9 \times 10^6 \log_\epsilon \frac{h}{\rho}}} \text{ meters,}$$

$$= \frac{59.6 \times h}{300}\sqrt{\frac{\log_\epsilon \frac{2h}{\rho} - 1}{10 \log_\epsilon \frac{h}{\rho}}} \text{ meters.}$$

The reader will notice that the logarithms are to the base ϵ, while the tables are to the base 10. But we have seen in the last issue that log $_\epsilon x$ may be put into the form of log $_{10}x$ by the following relation:

$$\log_\epsilon x = 2.3026 \log_{10} x$$

Introducing this fact, the equation of the wave length becomes

$$\lambda = \frac{59.6 \times h}{300}\sqrt{\frac{2.3026\left(\log_{10}\frac{2h}{\rho}\right) - 1}{23.026 \log_{10}\frac{h}{\rho}}} \text{ meters.}$$

Substituting for h, its value, 6,000, and ρ, its value, 0.081,

$$\lambda = \frac{59.6 \times 6000}{300}\sqrt{\frac{2.3026\left(\log_{10}\frac{12000}{.081}\right) - 1}{23.026 \log_{10}\frac{6000}{.081}}} \text{ meters.}$$

$$= \frac{59.6 \times 6000}{300}\sqrt{\frac{2.3026 \times 5.17 - 1}{23.026 \times 4.87}} = 372 \text{ met.}$$

Fleming has found that the measured wave length of an antenna of this type is about 10 per cent. above the calculated wave length. Therefore, the corrected wave length is about 409 meters.

The Slide Rule

An illustration of the application of logarithms to engineering practice is found in the slide rule. The slide rule consists of two identical rulers on which distances are laid off, proportional to the logarithms of the numbers from one to ten. The intervening spaces are subdivided decimally. For example, the distance corresponding to the number 8 is three times the distance corresponding to the number 2; for the logarithm of 8 is three times the logarithm of 2. By means of the slidng rulers we can add to or subtract from a distance on the first scale, a distance on the second scale; i. e., we can add or subtract the logarithms of numbers and read the result as an anti-logarithm. This furnishes a simple method of performing long chains of multiplications and divisions by mere mechanically setting of one slide over another and reading the result, requiring caution only in the remembering of the Characteristic or position of the decimal point.

If above the first rule, and fixed to it, is placed a second rule plotted with distances half the scale of the first rule, lines drawn perpendicularly to the length of the rule cut off corresponding second-degree relationships; i. e., give direct readings of the squares and square roots of the numbers. The simplest way for the student to understand the slide rule is to make practical use of it. After a few hours' practice his skill will be sufficient to enable him to perform calculations in much less time than that necessitated by the use of logarithmic tables. At the same time errors due to addition and subtraction are avoided and the desired 0.5 per cent. accuracy is obtained.

This is the conclusion of the fourth article in a series on mathematics by Mr. Priess. The fifth will appear in an early issue.

NAVAL STATION IN TEXAS

Announcement has been made that Point Isabel, a coast town twenty-two miles from Brownsville, Tex., is to have a wireless station erected by the United States Navy Department. Lieutenant-Commander A. J. Hepburn, U. S. N., has closed an option with land owners at Point Isabel, and within six months it is expected that actual work on the station will be under way. There is now an appropriation of $50,000 for this station, but Lieutenant Hepburn stated that before the contract is let it is expected that this amount will be increased to at least $70,000.

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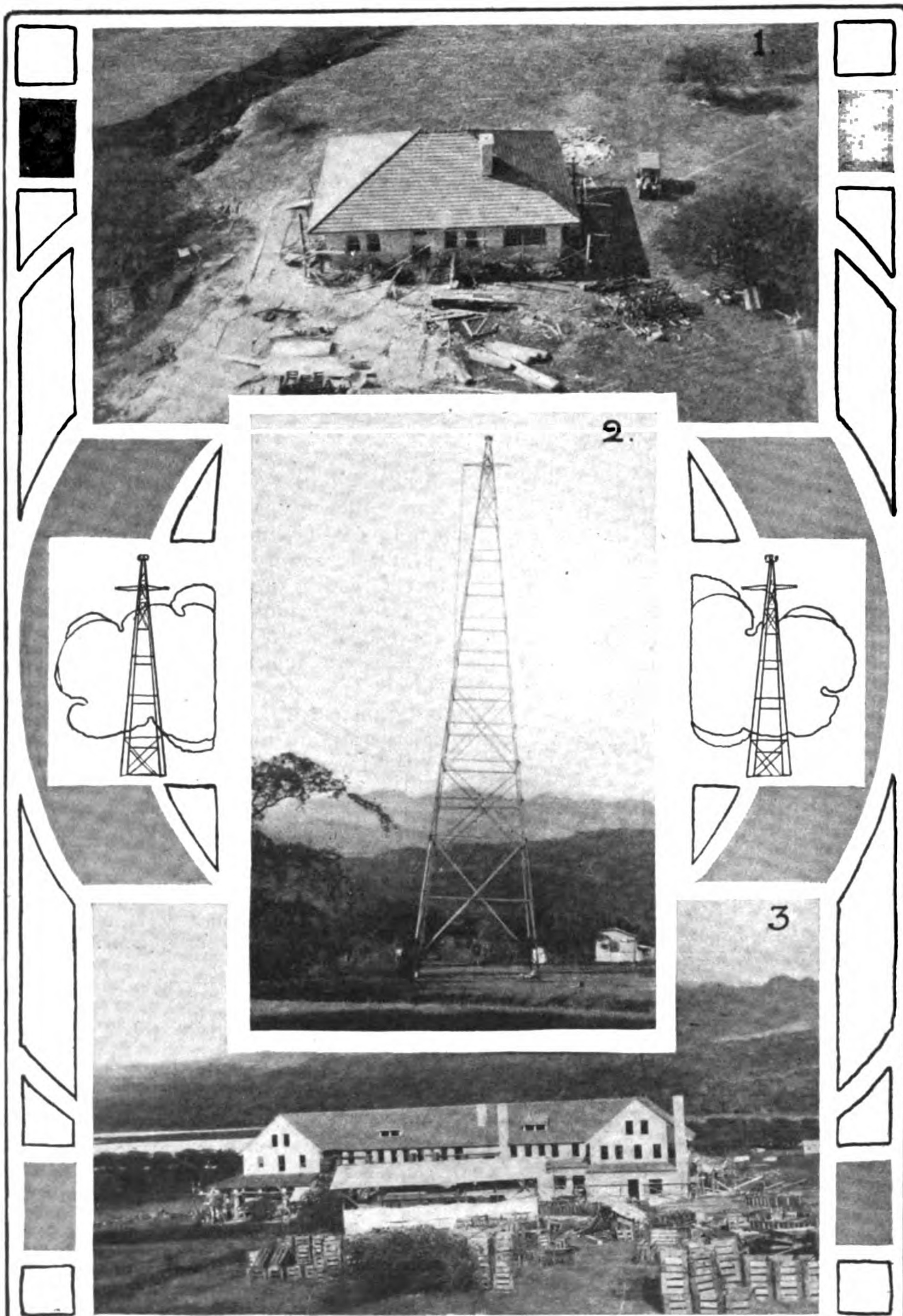
The Trans-Ocean Stations



(1) *A residence at Koko Head, Island of Oahu, Hawaii. The photograph was taken from the top of No. 1 balancing tower.* (2) *Balancing tower at Koko Head.* (3) *A rear view of the hotel at Koko Head, showing the quarters of the men who will operate the station.*

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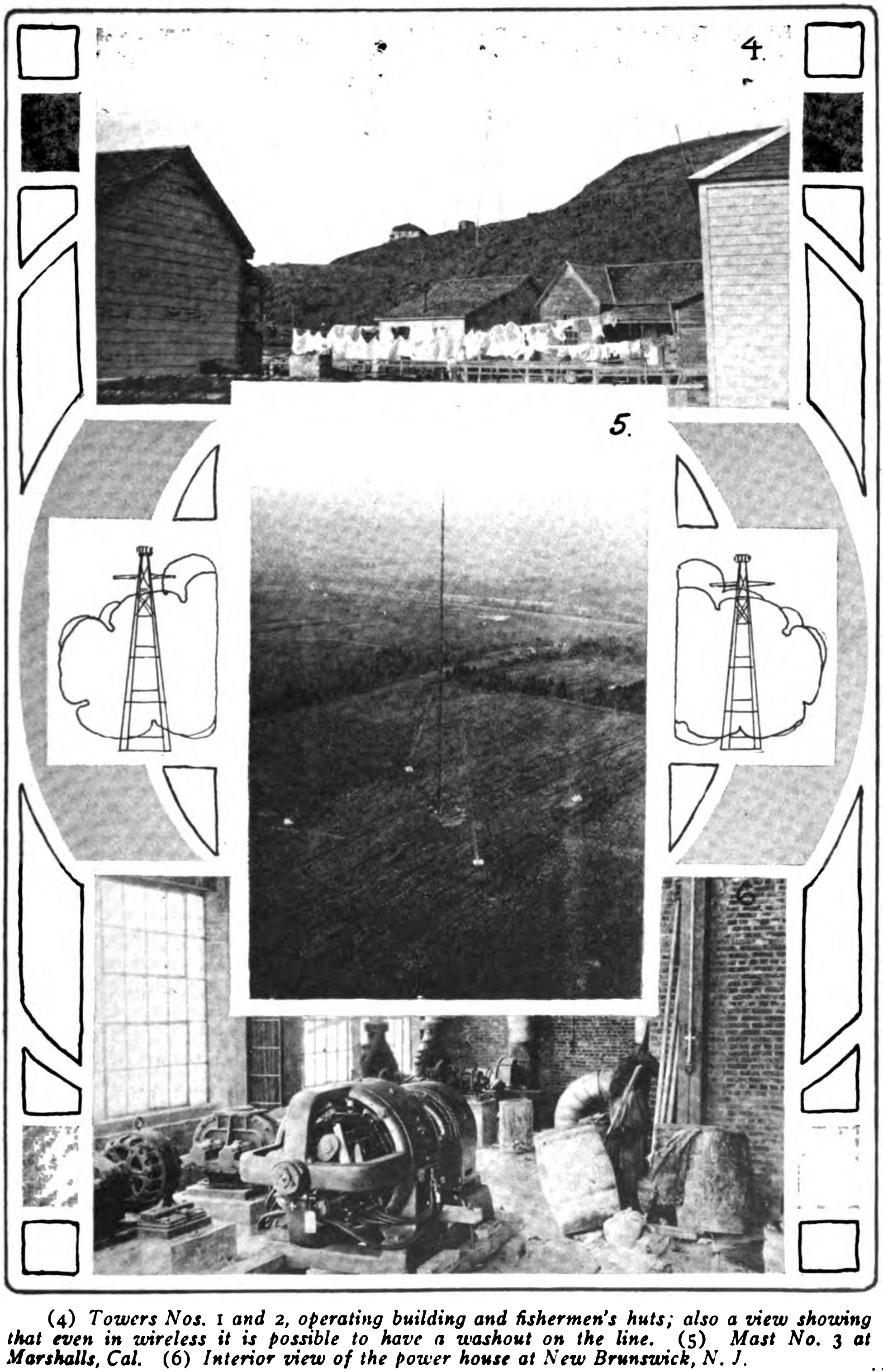
As They Near Completion



(4) *Towers Nos. 1 and 2, operating building and fishermen's huts; also a view showing that even in wireless it is possible to have a washout on the line.* (5) *Mast No. 3 at Marshalls, Cal.* (6) *Interior view of the power house at New Brunswick, N. J.*

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Donald Perkins Memorial in Los Angeles

A BRONZE tablet will be hung in the lobby of the Y. M. C. A. in Los Angeles, Cal., as a mark of respect to Donald C. Perkins, wireless hero of the steamship State of California, which sank in Gambier Bay, Alaska, on August 18, 1913. Perkins, who was a graduate of the wireless school of the Y. M. C. A. in Los Angeles, sacrificed his life in order to save others.

A letter from Secretary of Commerce William C. Redfield to General Secretary Luther, of the Y. M. C. A., eulogizing young Perkins, together with the wireless operator's photograph, will be framed, by order of the directors, and hung in the Y. M. C. A. lobby. The students of the wireless school fathered the movement to place the tablet in the lobby.

Secretary Redfield's letter is as follows:

"The school of wireless telegraphy maintained by your institution is honored in having as one of its graduates Donald Campbell Perkins, first radio operator on the steamship State of California, who went calmly to his post when the vessel struck, and stood there facing certain death, sending out the distress call continuously during the few minutes that elapsed while the vessel was sinking, and went down with her and was lost.

"The evidence shows that Mr. Perkins was off duty at the time of the disaster and that he presumably could have saved his life, if that had been to him the supreme thing. He went, instead, back to his post, sent his subordinate to assist in getting out the boats and remained himself, like a faithful soldier, at his station.

"The brief story of his self-sacrifice should be high among the honored traditions of your institution. It shows that there are heroes of peace as well as of war, who, without the inspiration and excitement of battle, can face death with a quiet mind, fearlessly doing their duty to the end.

"The Department of Commerce that issued Mr. Perkins the license under which he served thinks this brief tribute to his memory due to the institution that taught him.

"Very truly yours,

"WILLIAM C. REDFIELD,

"Secretary."

The wireless school was established in August, 1912. Lessons and recitations are carried on daily, the pupils being trained especially for the Marconi service. After the student has acquired a certain amount of knowledge, written examinations are held. Thirty-four questions are asked concerning wireless, and nine tests are made of the student's knowledge of the London Convention and the United States regulations. Unless the student averages seventy per cent. or over in his work he is expelled. The text-books used include the 1913 Navy Manual, Fleming's Elementary Manual of Radiotelegraphy and Telephony, Timbie's Essentials of Electricity, books by Pierce and works from the Bureau of Standards. THE WIRELESS AGE is included among the reference works in the radio library.

The wireless apparatus used by the scchool was leased from the Marconi Wireless Telegraph Company of America. The antenna is located on the roof of the Y. M. C. A. building, which is eleven stories in height. One aerial pole 45 feet in height is placed on an elevator housing, the top of which is twenty feet above the roof of the main building. One end of the antenna, therefore, is sixty-five feet above the top of the larger structure. The other pole is twenty-five feet in height. The antenna, which is eighty-five feet in length, consists of four 7/22 phosphor bronze wires on a 14-foot spreader. The lead-in wire is brought over the edge of the building by means of a 10-foot arm. In order not to parallel the building, the lead-in is brought into the radio room

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at an angle of forty-five degrees from the top of the roof. The school room and instruments are on the fifth floor. The vertex of the angle is made round by means of a seven-foot aerial strap insulator to reduce the loss of energy due to brush discharges. Although the antenna current is fifteen amperes, no trouble is experienced in the building.

During the last world's series of baseball games a direct wire was run from the office of the Los Angeles Times to the Y. M. C. A. Every half hour a summary of the innings was sent broadcast by means of the Y. M. C. A. set. At half past nine o'clock every night a summary of the day's game was dispatched by wireless for the benefit of the trans-Pacific boats and the craft running to Mexican and Central American ports. The scores were copied at a distance of 2,000 miles by the Pacific Mail steamship Persia. They were also received by the United States cruiser South Dakota while she was off the Mexican coast, 1,500 miles away. These results were obtained in spite of the fact that the Y. M. C. A. building is located in the heart of Los Angeles, fifteen miles from the ocean.

NEW RUSSIAN STATIONS

Wireless telegraphy is making rapid strides in Russia. The program for 1914 of the Russian Central Administration of Posts and Telegraphs provides for the erection of stations as follows: At Markov, on the River Anadyr, with a radius of 200 miles; at Tigila (Kamchatka), with a radius of 1,000 miles; at Sredne-Kolmynsk, with a radius of 535 miles; on the islands of Sakhalin Solovetz, each with a radius of 200 miles; at the settlement of Obdorsk, on the River Obi, with a radius of 670 miles; at Krasnovodsk, for the improvement of communication with Turkestan, with a radius of 200 miles; at Abo and Poti, for communication with vessels, each with a radius of 400 miles; and at Skobolvesk, with a radius of 400 miles.

The origin of wireless telegraphy in Russia is due to the foresight and enterprise of S. M. Wisenstein, who formed what is known as the Russian Company of Wireless Telegraphs and Telephones, and the development of the wireless telegraph network has been so well advanced by the Russian Government that a radiotelegraphic service between the Sea of Ochotsk, the Bering Sea and the Bering Strait has been established. The Russian Company has erected several stations on the northern coast of the empire for the Post and Telegraph Department. These stations are situated at Waigatz, Yugorsky Schar and Cape Maare-Saale in the Kara seas, which are open to navigation for three months of the year only.

REDUCTION OF TOLLS TO FOLLOW MARCONI-WESTERN UNION AGREEMENT

A working arrangement has been effected between the Marconi Wireless Telegraph Company of America and the Western Union Telegraph Company. It is conceded to be the most important deal that has been negotiated in the history of the telegraph-telephone and cable business in the United States.

The new service will be started with a thirty-three and one-third per cent. reduction from the existing cable rates. Every Western Union office will be a Marconi wireless office, and the trans-Pacific wireless service will be operated in connection with the Western Union. The arrangement still existing between the Western Union and the Bell Telephone Company makes it possible for a person to telephone his cablegrams.

MARCONI COMPANY PURCHASES LAND

Dr. H. S. Kinmouth has sold to the Marconi Wireless Telegraph Company of America a small piece of land from his farm in "The Garden of the Gods," near the Marconi plant at the head of Shark River, Belmar, N. J. The tract is three-cornered and contains about 300 square feet. It will be used for a tower to hold a balancing line to run east and west with the Marconi plant. The company has a "balancing line," as it is called, running north and south. The lot sold by Dr. Kinmouth is at the west side of his farm, on the road leading from Corlies avenue to Glendola.

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INSTRUCTION TO BOY SCOUTS

By A. B. COLE

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CHAPTER IX

A Portable Receiving Set

SEVERAL different types of tuning coils and receiving transformers are in general use at the present time, but probably the ordinary type of coil with some improvements will be found most satisfactory for portable use. In the preceding chapter we explained the purpose and use of receiving transformers, showing that this device has two windings, a primary and a secondary, the former being a part of the open oscillation circuit and the latter part of the closed oscillation circuit.

The same general results may be obtained with a tuner having only one winding, by causing two different parts of the single winding to act as two distinct coils. The diagram in Fig. 47 will show that the open circuit is ACG and the closed circuit is DBC. By changing the positions of the points B and C, the wave length to which each of these circuits best respond will be altered.

Instead of using sliding contacts at B and C to connect with the various turns of wire in the winding, it has been found that a rotary switch will give better results for our purpose because sliding contacts offer more or less resistance to the flow of the small currents passing through them, and are also liable to make connection with two or three turns of the wire at one time, which results in loss of energy from the circuits where it is most needed. Moreover, sliding contacts are not so positive in action as a switch.

Two ordinary ten-point switches are employed for the purpose, and the method of connecting the contact points and levers is illustrated in Fig. 48, in which corresponding parts are lettered

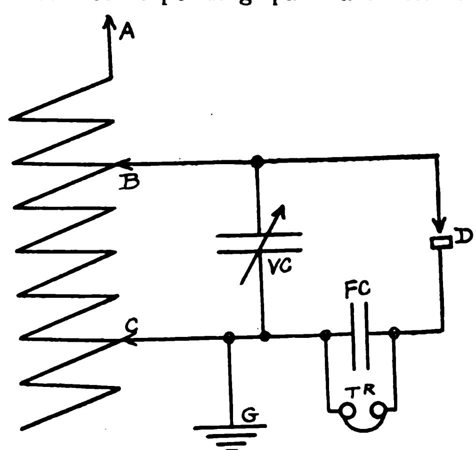

Fig. 47.—Connections for double contact tuner

the same as in Fig. 47. It will be observed that the switches accomplish the same results as sliding contacts, except that they will not permit connection with

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every turn of the wire. The use of an adjustable condenser, E, in connection with this arrangement, will, however, accomplish the equivalent of the effect of sliding contacts.

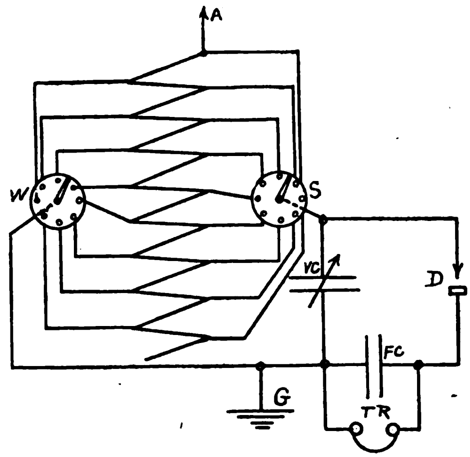

Fig. 48.—Connections for switches

The diagrams, Figs. 47 and 48, represent what is termed a double slide or double contact tuning coil. Another type is known as the three-slide or three-contact tuner, and this has certain advantages. In Fig. 49 we show a diagram of connections for a three-slide tuner. It is superior to a two-slide tuner because the inductances of the open and closed circuits may be varied independently of each other, since no slider is common to both.

This type of coil may also be arranged with three switches instead of sliding contacts and is one of the best tuners for our purpose when so arranged.

The tuning coil for the portable set should consist of one even layer of No. 22 double-cotton covered-copper magnet wire, wound on a cardboard tube four inches in diameter and eight inches long. The tube should be immersed previously in hot paraffine wax or be painted with it to make it waterproof and to prevent its shrinking at a later time. The winding space itself is seven inches long, and the ends of the wire are passed through the tube to secure the winding in place, leaving a margin at each end of ½ inch.

As the wire is being wound on the tube, loops should be made every half inch along the length of the winding, as illustrated in Fig. 50, which shows the method of making three of the thirteen loops.

Two ten-point switches are used, and the contact points are connected as shown in Fig. 48. In place of using regular wood-base switches for this purpose, the builder should purchase the switch levers and contact points from an electrical supply house and set the switch points in the case of the outfit, as illustrated in Fig. 54.

If the loops are considered as being numbered from 1 to 14, starting from and including one end, and ending and including the other end, the contact points of switch S, Fig. 48, are to be connected in rotation to contacts 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, so that as the lever is moved over them in a clockwise manner, it makes connection successively with these loops. In the same way the contact points of switch W are to be connected to loops 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14, which is the opposite end of the winding.

By this arrangement, loops 5 to 10 are common to both switches, so that two wires can be run from each of these loops

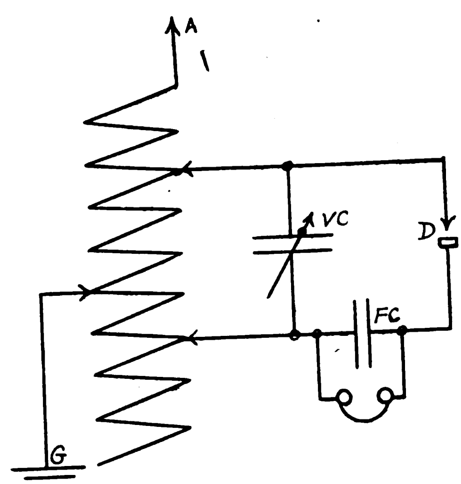

Fig. 49.—Connections for three-contact tuner

to the proper contact points of both switches.

To make connection with the loops, the insulation of the wire must, of course, be

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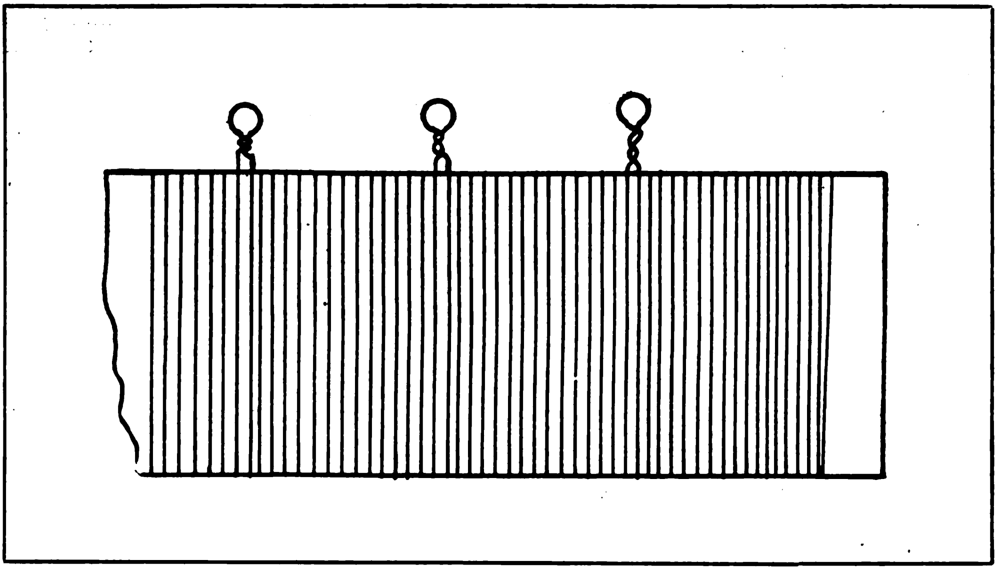

Fig. 50.—Loop connections of tuner

removed first, and after twisting this wire and the connecting wire tightly together, so that both are in good electrical and mechanical contact, the joint should be soldered and taped.

After the wire has been wound on the core it should be given a coat of shellac to make it proof against moisture and to hold it more firmly in place.

Since the tuning coil and other instruments described in this chapter are to be mounted in a carrying case, the writer will first illustrate them and then show the method of mounting them to make a complete outfit.

The Condensers

In this set a small fixed condenser and one of the adjustable type will be used, since the latter is very satisfactory, simple and inexpensive and is not likely to get out of order. The adjustable condenser consists of three sections and a switch of special type arranged to connect one, two or all three sections into circuit at the same time, thereby giving three separate capacities.

The three condenser sections, which, in fact, are three individual condensers, are made of sheets of tinfoil separated by somewhat larger sheets of a good quality of paraffined paper.

The method of building the condensers is illustrated in Fig. 51. Each consists of three strips of paper four inches wide and thirty inches long, and two strips of tinfoil three inches wide and thirty inches long. One paper strip is placed on a table and one of the foil strips is laid upon it, leaving a margin ½ inch wide on the two sides and two inches on one end (A). A second strip of paper is placed on the foil sheet so as to be directly above the first paper strip, and the second foil strip is placed on this as illustrated, but leaving the two-inch margin at the opposite end, B. The third paper strip is now placed on top of the condenser, which is then rolled up and pressed out to make it flat and compact.

The projecting end of the first foil strip will then be inside the condenser, and that of the second foil sheet will be outside. These two ends form the terminals of the condenser, and wires are to be connected to them by wrapping the foil around the wires, so as to make a good electrical contact. Care must be taken in rolling up the condenser to prevent the foil sheets from touching each other, which would render the condenser useless.

The small fixed condenser, which is employed in addition to the adjustable one, is built of three paraffined paper sheets 2½ inches wide and 20 inches

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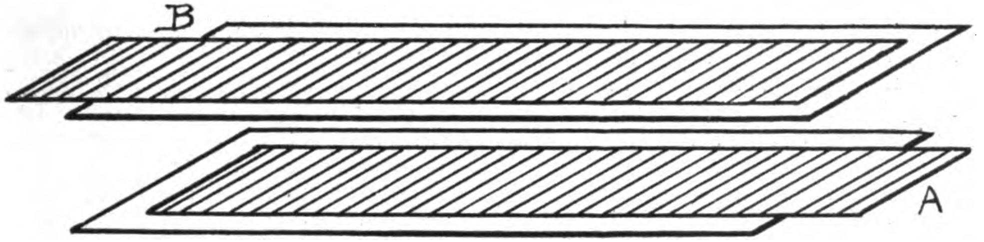

Fig. 51.—Condenser Construction

long, and two strips of tinfoil 1½ inches wide and 20 inches long, in the same manner as the three sections described above.

After the condensers have been completed, they should be dipped in hot paraffine and allowed to dry. This will cause them to hold their shapes and will prevent their unrolling. They should then be tested to determine whether the foil sheets are in contact with each other, (which would be termed a "short circuit"), by connecting them individually in series with a cell of battery and a buzzer or bell. If the buzzer indicates that the sheets are in contact the condenser will have to be taken apart and the trouble located. If a good grade of paper is employed in building these condensers, there will be no difficulty from this source.

The special type of switch to be used in connection with the adjustable condenser is illustrated in Fig. 52. It is made from a regular bell switch, which can be purchased from any electrical supply house by soldering a strip of brass or copper (A) to the lever. It is advisable to purchase the lever and contact points only, and to set the points in a circle in the case of the set, the same as with the tuning coil switches.

This is a progressive type switch, that is, it first connects with No. 1 condenser, then with Nos. 1 and 2, and finally with all three sections. Thus, three different capacities are readily available.

The condenser sections, C, have a common wire, W, connected to a terminal of each, and the other terminals are connected to contact points 1, 2 and 3, respectively, of the switch. The terminals of the complete condenser thus formed are the wires W and B, which latter is connected to the nut under the switch lever.

More condenser sections could be added by increasing the number of contact points and also the length of the arm, A, and thus would give a still greater range of capacities. In this case, the individual sections should be made of less capacity, so that the capacity range of the switch from point to point would be less, which would assist materially in close tuning.

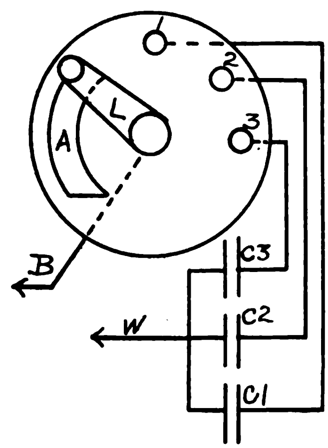

Fig. 52.—Condenser switch

The three-section condenser will, however, give a sufficiently wide range and satisfactory results in connection with the other instruments of this set.

The Detector

The detector used in this set is one of the mineral type, where galena, a lead ore, is the sensitive substance. The purpose of the detector is to change the character of the received oscillations so

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that they can be heard in the telephone receivers attached to the set.

The simplest and one of the most practical forms of this detector is illustrated in Fig. 53, where B is a binding post having two holes, R is a brass rod passing through the upper hole, and C is a brass cup fitted with three set screws to hold the mineral in place. Rod R is ⅛ inch in diameter and 1½ inches long, threaded at one end to take the hard rubber or fibre knob, D. The rod R is split by means of a fine hack saw for a distance of one inch of its length, and is spread apart so that it may be turned in the hole of the binding post with slight difficulty. A fine copper or phosphor bronze wire, W, of No. 30 or 32 gauge, 1¼ inches long, is soldered to rod R and makes a very light contact with the galena held in the cup, C. C is held to the base, which will be a part of the portable case, by means of a brass machine screw passing through its center. This screw is one terminal of the detector, and binding post B is the other terminal.

The galena may be purchased from any of the large chemical supply firms for about 25 cents per pound, and as no two crystals of this material are equally sensitive, it is advisable to purchase at least a pound and try out the various crystals to obtain an especially good one.

The less this mineral is handled the better, for oils and grease will decrease its sensitive qualities remarkably. The size of crystal generally used is about ¼ inch square, although this has apparently no effect on the results.

The Portable Case

The case for the apparatus may be made in two ways: to hold all the receiving instruments except the receivers, or to hold the receivers also. The use of a good double head set is recommended: for although a single receiver may be employed, the double set will give much better results. This consists of two receivers, each of preferably 500 ohms resistance, a headband and conducting cord.

Since a double head set is rather large compared to the rest of the outfit, the case would have to be made considerably larger to accommodate it, and for this reason most builders prefer to leave it outside the case. However, if so desired, the case may be made larger to include the headset.

In Fig. 54, A, we show a side view of the carrying case. This consists of two parts, a body, C, and a top, T, which are held together for carrying purposes by two clasps, E, placed at the sides. These may be obtained at a local hardware store at small cost. Two metal strips, D, are to be bent and secured to the case to hold in place a leather strap for carrying the set.

The case is 6⅝ inches wide, 7⅝ inches high and 8⅝ inches long, outside dimensions, and is made of wood 5/16 inch thick. The instrument base, F, is ½ inch thick, ¼ inch projecting above the top of the body of the case, so as to keep the top firm when clamped down.

In Fig. 54, B, we show a top view of the body of the case with the tuning coil and condenser switches in place. Fig. 55 illustrates a top view of the body of the case with the instrument base removed and the tuning coil in place. This should just fit the case and is held in position by four small wire nails at each end. There will also be room for the condensers in this part of the case. The set is to be wired, as shown in Fig. 48, and the binding posts, A and G, are the aerial and ground connections, respectively. Binding posts T and R are the connections for the telephone receivers.

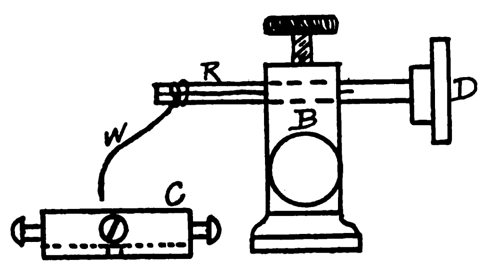

Fig. 53.—Galena detector

It is advisable to arrange a small buzzer at a convenient point in the case, connected to a vest-pocket flashlight battery and a pushbutton, to enable the operator to adjust the detector quickly to its most sensitive condition. The connections for this testing buzzer are shown in Fig. 56, and it will be seen that only one wire from

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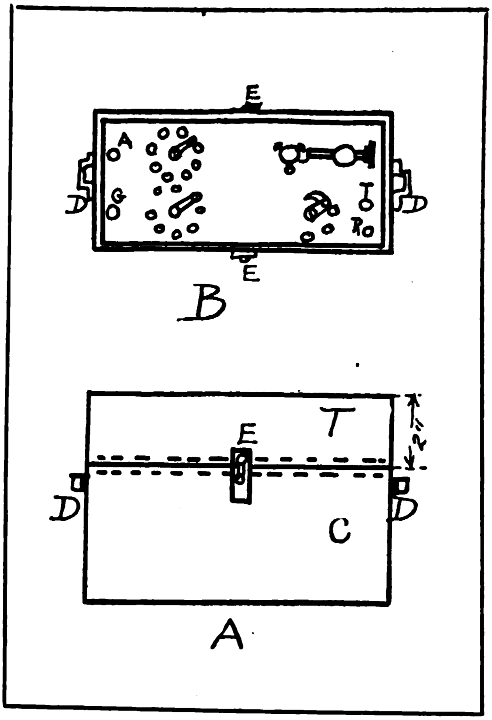
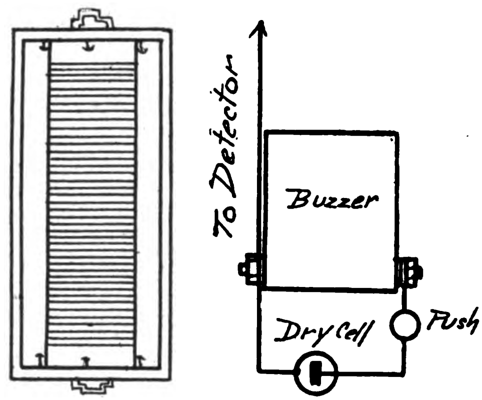


Fig. 54.—Carrying case

it is connected to the detector. When the buzzer is set in operation, it generates electromagnetic waves, due to the small spark which occurs at the contact points, and these will affect the detector, so that it may be readily adjusted at will.

The operation of this set is a very simple matter. The aerial and ground are connected to binding posts A and G, and the detector is adjusted by the aid of the testing buzzer until loudest sounds are heard in the receivers connected to posts T and R. Then the lever of switch S is revolved to a point where it is connected to a loop near the aerial end of the tuning coil, and that of switch W is moved to connect with one of the loops near the other end of the coil. If the capacity of the adjustable condenser is now varied by means of its switch, the set should be in condition to receive messages. As soon as a station is heard, adjustment is made for signals of loudest intensity by means of the two switches of the tuning coil and that of the condenser. These switches are used also to eliminate the signals of any stations which might interfere, and the result is accomplished by combinations of the positions of these three switch levers. This adjustment may cause a little difficulty at first, but as soon as the operator becomes sufficiently familiar with his set he will be able to make all necessary adjustments without delay.

In the operation of portable sets, the greatest source of trouble is that occasioned by a poor ground connection, so that the operator should always bear in mind the necessity for securing the best possible contact with the earth when setting up his station. In many cases a good



Figs. 55 and 56.—Top view of case and connections for buzzer

ground can be obtained by driving an iron pipe four or five feet into the earth at some moist spot.

This is the sixth installment of Instruction to Boy Scouts. The seventh lesson by Mr. Cole will appear in an early issue.

SIGNALS ON A SCREEN

The remarkable feat of recording a distant wireless message by magnified images of the signals thrown on a screen was the crowning surprise in a unique meeting held recently in London, England, to mark the start of the newly formed Wireless Society of London. The signals came from the top of the Eiffel Tower, Paris.

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From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE TEN DOLLARS

A Musical Spark for Amateurs

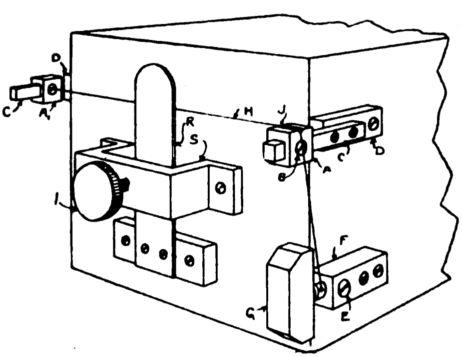
Efforts are invariably made by amateurs to attain a high spark note from an induction coil or transformer. A 500-cycle motor generator set is out of the question with most amateurs on account of the high price. The use of a commutator break has been tried, but at 500 breaks per second the arc formed soon burns away the segments or chars the insulation so as to make it conductive. The vibrators of induction coils, when properly adjusted, sometimes give a high note, but are never steady in action because of the arc at the contacts.

My attention was first called to the solving of this problem by the weird, unearthly and otherwise obnoxious sounds that were to be heard at receiving stations anywhere in the vicinity of New York, from amateurs trying to produce a high-pitch spark. It appeared more like a case for S. P. C. A. than for a radio experimenter. However, the following seems to solve the problem:

The break which I am about to explain is for induction coils only drawing less than 5 amperes. A slightly different apparatus is used for closed-core transformers.

An ordinary vibrator on the end of a spark coil, providing it be of the high-speed type, will do for the break. On the sides of the coil two brass plates, d, d, as shown in the accompanying diagram, are screwed (all dimensions depend upon the size, shape, etc., of the coil and vibrator). To each of these plates is screwed a square brass rod, c, c, which protrudes from the end of the coil. On these rods are put two sliders, a and a_1, one (a) of them having a groove J. The slider a_1 has a hole 1/64 inch in diameter bored through it either above or below the hollow. Each slider has a set screw, which will keep it in any desired place. Through the hole in slider a_1 pull an A string of either a violin or mandolin; knot the end so it doesn't slip through. Pull the string over the grove J and through the hole in the key (G). Now turn the key until the string has the required tension; then lock it with set screw (e).

Adjust the sliders so that the string just touches the vibrator when it is screwed to proper tension. Now that



we have the apparatus made and set up, let us proceed and get the high-pitched note.

Connect up the primary of the coil in usual manner, but do not use more than 5 amperes. Adjust the contact I. As you slowly turn it the frequency of the spark increases; suddenly the frequency

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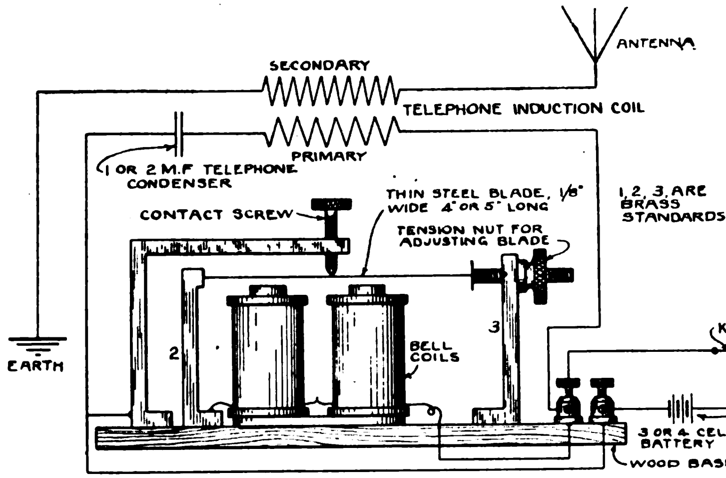

Diagram, Second Prize Article

will give a jump, say, from about 100 to 300 cycles. This is caused by the vibrator K coming in contact with the string. By adjusting the sliders a and a_1 the key (G) and the contact (I) you will soon acquire the desired frequency.

A brief explanation of the cause for this action is as follows: When you tighten up an ordinary vibrator it will not vibrate steadily because, owing to the brief time that the magnet is attracting the vibrator, it sometimes sticks and an arc will then form. However, it is quite different if we use the vibrating string. Let us consider that we have adjusted the instrument and are getting a pure, clear, musical spark (which will be the case when adjusted). The A string, which normally vibrates at 440, is tightened to vibrate at 1,000. The vibrator is adjusted to vibrate at 500. Now, when the current is turned on, the vibrator is drawn toward the magnet and hits the string just as the circuit is broken. The vibrator springs back to make contact while the string starts to vibrate at the rate of 1,000 per second. Now, at every other vibration of the string it meets the vibrator (K) and is kept in motion by it and in turn assists (K) in making contact. In short, (K) causes the string to vibrate and the string keeps (K) vibrating at regular intervals, the magnetism being the force giving the impetus to the vibrator K.

By using this apparatus the amateur will find himself able to increase the range of his experiments remarkably, and will be more than repaid for his work by the surprising distance he will be able to transmit, even though restricted by the Government.

Charles William Taussig,
New York.

SECOND PRIZE FIVE DOLLARS

An Amateur Transmitting Set for Short-Distance Work

A very good sending set that is not beyond the limit of the average amateur's pocketbook can easily be constructed out of an old battery bell, a telephone condenser and telephone induction coil.

Take a file and file a groove on the base of the coils as near the supporting frame as possible. Then take a pair of pliers and carefully bend the base of the coils back and forth a few times, and they will break loose along the groove made by the file. Now take a wooden or fiber base that is of sufficient size to mount the coils, binding posts and standards: then mount the coils in the center of the base.

Make two standards out of brass, as shown in the accompanying diagram. They should be ½ inch higher than the bell coils. Take a thin steel blade ⅛ inch in width, 4 or 5 inches in length, and solder to standard No. 2, as shown, and fasten to the base. Then solder the other end of the steel blade to the head of an old battery bolt. Standard No. 3

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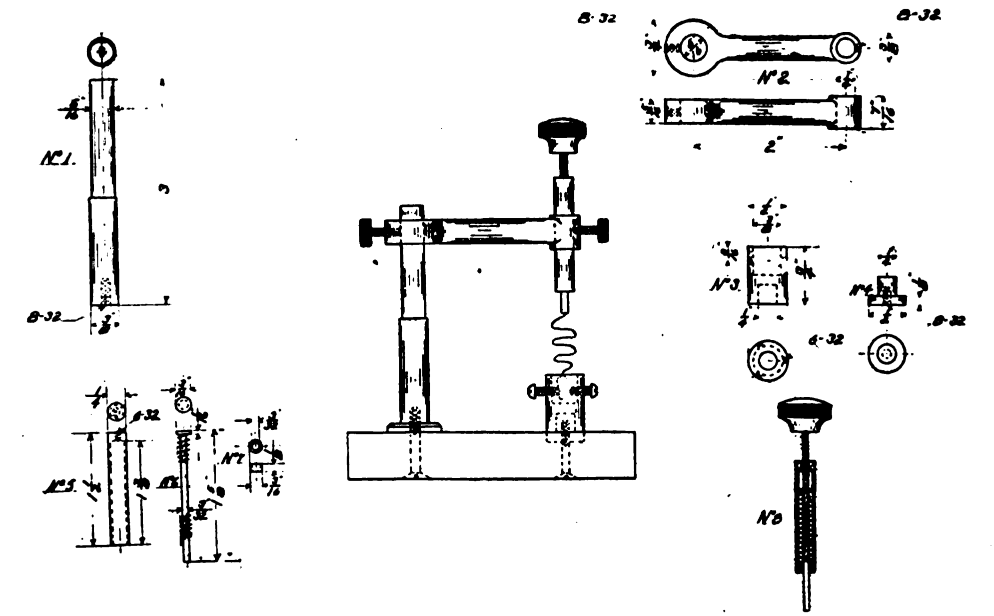

Diagram, Third Prize Article

has a hole large enough for the battery bolt to easily pass through the hole drilled near the top. Now mount this on the base, and place the battery bolt (soldered to the steel blade) through the hole previously drilled. If correctly spaced and mounted, the blade can easily be adjusted by tightening or loosening the tension nut, thus changing the tone of the vibrator.

Now make a standard for supporting the contact screw, and mount as shown at No. 1. The threads for the contact screw may be made by soldering a nut off an old battery bolt onto the standard. An old battery bolt will serve for the contact screw by filing a blunt point on the end and providing a lock-nut. Wire the coil as shown, and by adjusting the vibrator and contact screw you will be able to produce a faithful high-frequency sound. Now wire the induction coil and condenser across the vibrator as shown. Then connect the aerial and ground to the secondary leads. The condenser may be a 1 or 2 M. F. telephone condenser.

If carefully made and adjusted it will give surprising results for short-distance work. The tone is very pleasing, as it gives a singing, musical note.

Delbert Myers, Indiana.

Note.—No doubt this device will transmit over short distance, but we wonder what the wave length would be with the apparatus described. Resonance between the antennæ and the buzzer circuit (with condenser) is only probable; but the arrangement is productive of highly damped forced oscillations, which may carry a few hundred feet or even half a mile.—*Contest Editor.*

THIRD PRIZE THREE DOLLARS

A Neat-Appearing Detector Capable of Very Fine Adjustments

This is a description of a neat-appearing detector which is capable of very fine adjustments.

The parts of the detector can be made at any machine shop at a very small expense, or at home. The accompanying drawings, Nos. 1 and 2, are simple enough not to require explanation. No. 3 is the mineral cup; there is a ¼-inch hole at the bottom of the cup which fits onto a stud (No. 4) so that the cup can be turned, enabling one to find the sensitive spots on the mineral. Nos. 5, 6 and 7 when assembled will look like No. 8.

Directions for assembling these parts are as follows: Place No. 6 with an open coiled spring wound over it into No. 5 so that the shoulder on No. 6 is

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nearest to the taped hole in No. 5. Now take the brass washer No. 7 and slip it over No. 6 so that it comes flush with No. 5; take a chisel and chip the edges on No. 5 very lightly so that the washer cannot come out. Secure a six thirty-two screw and screw it in as shown. It will push No. 6 out of No. 5; then turn the screw the other way, and the open, coiled springs will push No. 6 back.

The knob and the 6/32 and 8/32 screws can be bought of any wireless dealer. The base is made of marble.

If all parts are carefully made according to the drawing a first-class detector for minerals requiring light contact can be obtained.

RALPH HOAGLAND, Massachusetts.

FOURTH PRIZE SUBSCRIPTION TO THE WIRELESS AGE

A Novel Type of Tuner

The tuner shown in the accompanying drawings is, I believe, of entirely new design. While experimenting with various types of loading coils I found that I had a tuner which brought in signals considerably louder than the ordinary "loose-coupler."

This instrument is especially adaptable to very long wave lengths. Although it is not very selective, it is just the thing for tuning in the far-distant, faint station. This tuner has two windings—a primary and secondary—both wound with the same size wire; the secondary has ten per cent. more turns than the primary.

The cores for these coils are of the shape and dimensions shown in Fig. 1. The diameter of the winding, marked X in the figure, is shown in the table at the end of this article. The cores can be constructed of hard rubber, black fibre or wood. The groove, ¼ inch deep, should be turned out in a lathe. However, if the use of a lathe can not be secured, a piece of wood can be sawed into circular shape by a jig or coping saw, and two heavy pieces of cardboard glued on each. Make sure these are glued on securely, for otherwise trouble will be encountered.

Two cores of the same size are required. The wire of both is wound in the grooves in the *same direction*. Taps are taken off at every seventh turn in both primary and secondary. I have found this number to give sufficiently fine tuning. If possible, these taps should be spliced and soldered, avoiding "loops" to the switches. Shellac each layer as soon as wound, and then cover with a strip of oiled or paraffined paper. This makes it much easier to wind the several layers.

After the windings have been finished the cores should be held together by a *brass* machine screw placed about an inch from the windings (Fig. 1B). This allows the coils to be moved back and forth, thus varying the coupling between them. The closest coupling is found when the two windings completely overlap each other.

The instrument may be mounted in a case and the switches placed on the outside. If this is done a rod should project from the case so that the upper core can be moved. If desired, no case need be used. The switches may then be mounted directly on the cores. In connecting the switches care should be taken that the taps are connected in consecutive order to the points of the switches. Connections to the set are the same as those used with the ordinary loose-coupler.

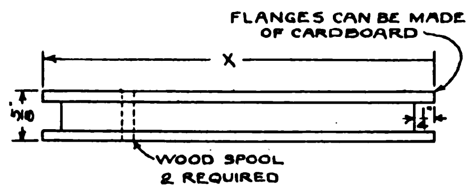

Fig. 1.—Fourth Prize Article

The compactness of the tuner makes it suitable for portable or cabinet sets, but the greatest advantage is in the efficiency obtained. I made a tuner of this type for a young man who now uses it altogether for tuning in stations using long wave lengths in preference to an excellent loose-coupler which he owns.

I have experimented with these tuners on several different antennæ in order to find the most efficient windings. As my own antenna has a natural wave length of 760 meters, which is greater than

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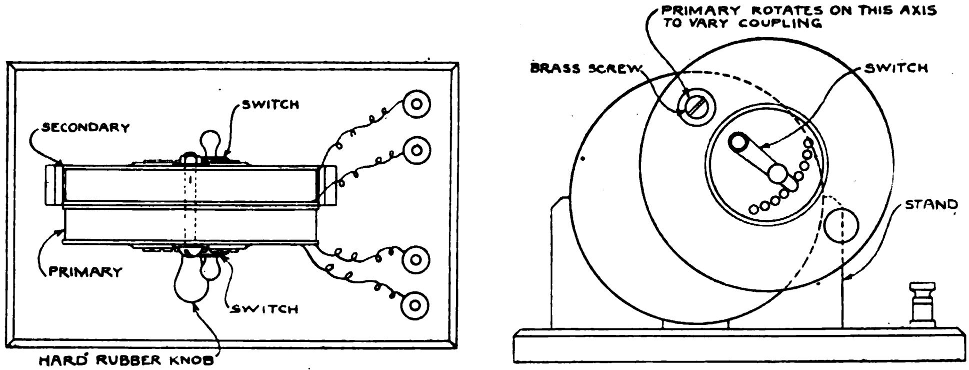

1A 1B

Figs. 1-A and 1-B.—Fourth Prize Article

that of the average amateur station, I have prepared the following tables showing the dimensions for tuning in certain wave lengths for 200-meter aerials. These results were obtained by a series of experiments on an aerial of this size. The tuner, whose dimensions are shown under A, is suitable for portable sets and for use with large antennæ when short waves are to be received.

2,500 meter wave-length (Time-NAA)	Size (B. & S.) & kind wire 28 DCC	No. Pri. turns. 80	No. Sec. turns. 88	X (see Fig. 1) 5½"
4,000 meter (NAA regular)	30 DCC	120	132	5½"
Short waves Boats and Amateur	24 DCC	50	55	4"
	FOR USE ON LARGE ANTENNAE.			
2,500 meter	26 DCC	80	88	4"
4,000 meter	28 DCC	120	132	4"
Short waves	22 DCC	60	66	3"
TYPE A	20 DCC	60	66	3"

PAUL H. GEIGER, Michigan.

HONORABLE MENTION

A Diagram of Connections Used to Get Base Ball Scores

This describes and shows a diagram of connections for a wireless receiving set that I worked out, principally to get base ball scores from Arlington to my home, a distance of about 50 miles. This connection in no way interferes with the telephone except when much pressure is applied to the detector a very slight hissing sound that would not be noticed unless it was known that the detector was connected to it, can be heard. This arrangement gives remarkable results.

In the accompanying diagram G represents the ground wire, D a silicon detector, P a telephone receiver, W a wire that connects the detector to telephone instrument, and S a switch that makes or breaks connection of the wire and telephone. The telephone's receiver should be left off the hook for best results.

1, 2 and 3 are telephone lines, as described. The telephone which I used is so arranged that one instrument is employed to work all three lines by placing the plug in either one of the holes 1, 2 or 3 as desired. When the plug is inserted in hole 2 I get Arlington best when they are working on 3,500 meters. When inserted in hole 3 I get them best when they are working on 2,500 meters, and also when working on 1,000 meters with small set I hear their signals best in hole 2. I receive these signals about as well in the day time as I do at night.

When Arlington is working on the small set on 1,000 meters their signals are not so strong, but very easily read; but when they are using the large set on 2,500 and 3,500 meters the signals are surprisingly strong. I can easily copy them direct on a typewriter, and the signals can be clearly heard 10 or more feet away from the receiver. I can sometimes hear boats on the Potomac River, especially the U. S. S. Mayflower (NJV), which I have heard very clear on several occasions.

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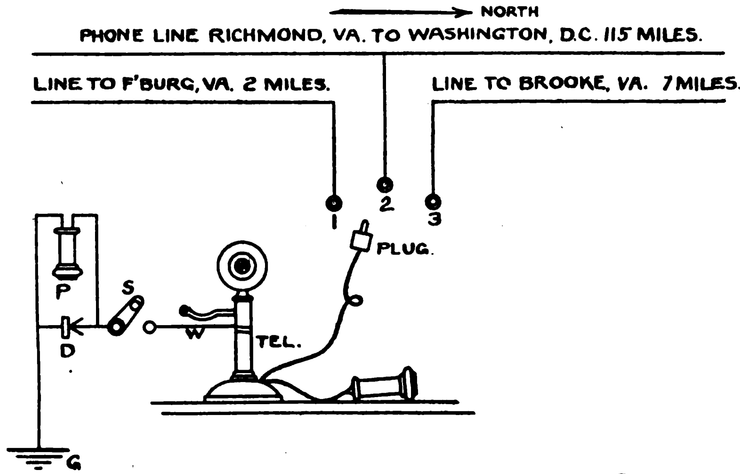

Diagram, Honorable Mention Article. A. L. Groves

What is most surprising of all is that since early in November, by placing the plug in hole 1, I can copy press from Sayville (WSL) practically every night. The signals are very weak, but somehow they are very distinct and easy to copy. The distance to Sayville is over 225 miles. I have on numerous occasions when Arlington and Sayville were working at the same time (Arlington's signals being very weak when plug is in hole 1) made a different adjustment on the detector, and, while this would in no way interfere with the signals from WSL (Sayville), it would cut out the signals from NAA (Arlington) entirely.

What causes this, or, in fact, how the signals get here at all, is a mystery to me. If anyone can explain the phenomenon, I shall be glad to hear from them.

I have tried many other experiments with this set, one of which is unscrewing the hard rubber mouth piece from the telephone and placing the wireless receiver against the transmitter of the telephone and letting all the operators between Richmond and Washington hear the time signals at 10 P. M. By placing the telephone's receiver to my ear I can also hear the time signals, too. The operators along the line and the train dispatcher in Richmond say the signals are quite loud, and some say the signals can be heard two or three feet away when everything is quiet.

A. L. GROVES, Virginia.

NOTE.—Exposed telephone and telegraph lines very often act quite efficiently as aerials. There is no reason why this should not be the case, for the effect of the oscillations on the telephone wire is to cause nodes and loops of potential at various points along the line. If the detector happens to be connected to a point on the line where the potential (due to the incoming oscillations) is high, the crystal should respond even without an earth connection, although better results are obtained by establishing connection with the earth.—*Contest Editor.*

A RECEIVING HOOK-UP

Which Will Respond to a Wide Range of Wave Lengths

For really satisfactory and efficient service, a receiving set should be able to respond to a wide range of wave lengths, should have a quick and effective control of the different circuits, and should consist of as few parts as possible. Such a set is shown in Fig. 1. It consists of a loose-coupler, two variable condensers, one fixed condenser, a detector, a pair of phones and two DP, DT controlling switches.

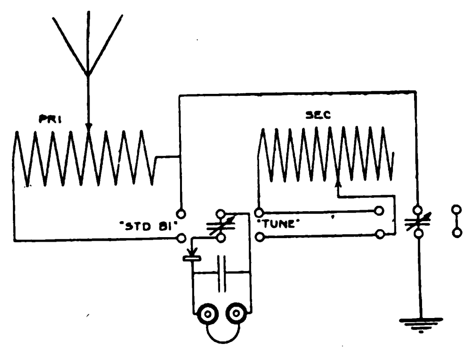

Fig. 1.—A Receiving Hook-Up

One variable condenser and the detector circuit are connected to the blades of one switch, and the remaining variable condenser and the earth wire are connected to the blades of the other switch, as shown in the diagram.

Throwing the detector circuit switch to the left gives the "stand-by" circuit shown in Fig. 2. Any station that is working can then be picked up by moving one slider.

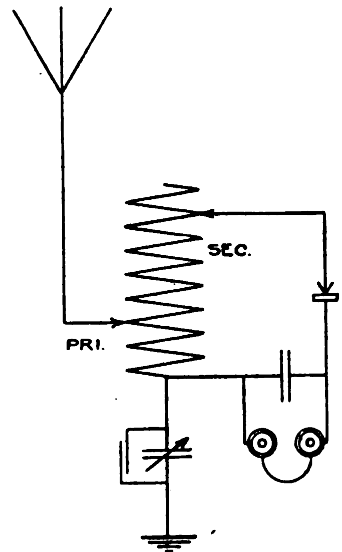

Fig. 2.—A Receiving Hook-Up

The detector circuit is connected directly to the ends of the primary winding unless this puts too much inductance in the detector circuit for it to respond to the shorter wave lengths, in which event a two or three-point switch should be used for varying the inductance in the detector circuit, as shown in the

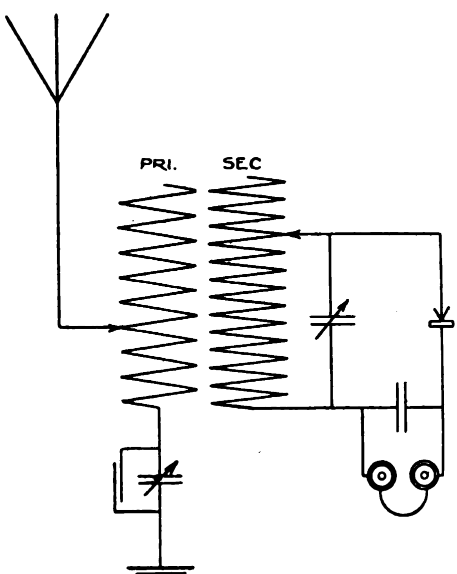

Fig. 3.—A Receiving Hook-Up

diagram. Throwing the detector circuit switch up disconnects the detector circuit while transmitting, and throwing it to the left gives the "tune" circuit for working through interference. This circuit is shown in Fig. 3.

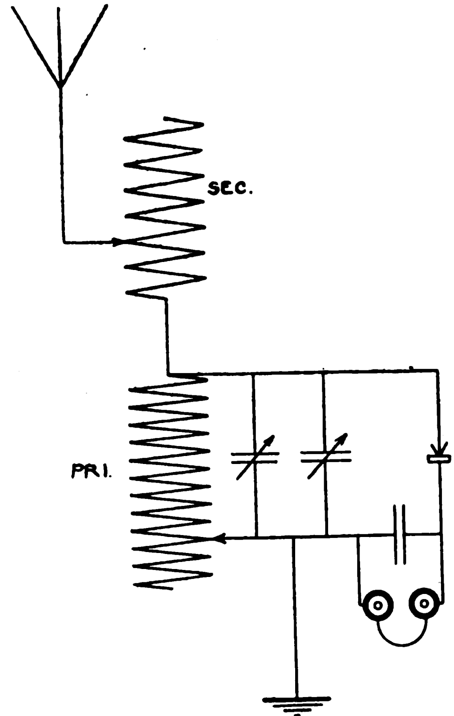

Fig. 4.—A Receiving Hook-Up

Throwing the earth circuit switch to the left gives the "long-wave" circuit, as shown in Fig. 4 The primary winding is now used as a loading inductance and both variable condensers are in parallel. Throwing the earth-circuit switch up leaves the variable condenser in series with the earth wire, and throwing it to the right short circuits the variable condenser.

The two variable condensers are not absolutely necessary for good results, but if the loose-coupler has switches for varying the inductance the use of at least one variable condenser is urged.

This hook-up is being used with a loose-coupler which has a moderate amount of inductance in each winding and is giving most excellent results. Any station, from amateur stations to those employing longer wave lengths, such as Arlngton, Va., can be readily picked up.

CHARLES D. HEINLEN, Ohio.

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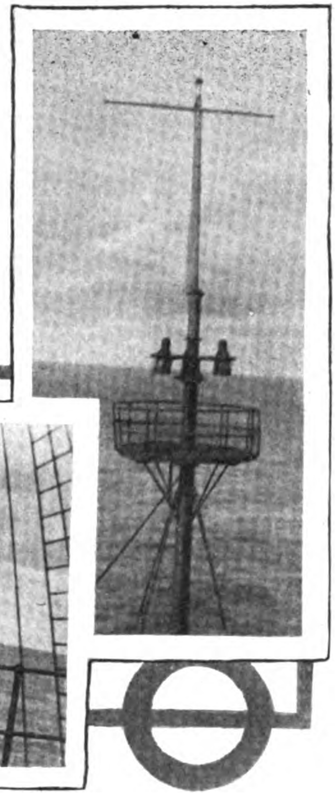
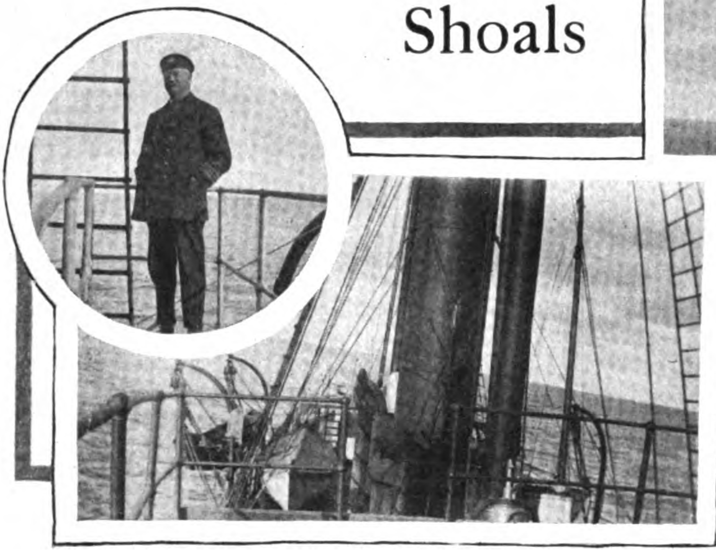
The Sea Sentinel at Lurcher Shoals





OF the many craft recently fitted with wireless by the Canadian Marconi Company, Lurcher Lightship No. 14, owned by the Dominion Government, is an object of interest, if only because of the fact that it is the first vessel of its description in Canada to be provided with a radio equipment.

The Lurcher Lightship is anchored in sixty fathoms of water, two miles from the shoals of the same name, a place of great danger to navigation, and located about sixteen miles off the southwest coast of Nova Scotia. The main shoal, which is known as the Southwest Breaker, is bar shaped, three-quarters of a mile long and 100 feet wide; the depth of water on the shoal at low tide is only one and one-half fathoms. The shoal is composed of rock and stone, and, although there is a gap in the middle, it fails to break the force of the rough seas.

Heavy gales and strong tides generally prevail about the lightship, and the members of its crew frequently relate to visitors a story illustrating the might of the ocean and the peril of their calling. The yarn is to the effect that on a stormy night the Lurcher broke away from her moorings and drifted over the shoal. Every moment those aboard expected her to crash on the rocks. Good luck was with the vessel and her crew that night, however, for she passed over the gap and found safety in the open waters.

The lightship not only serves to warn mariners of the proximity of the shoals, but is also a guide to seafaring men navigating the Bay of Fundy, marking the turning point in the paths of vessels bound to ports north of the reef.

Built of steel, the ship is fitted with electric lights throughout, and can be navigated under her own steam. She

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has two masts, each carrying a gallery sixty feet above the water line; to these galleries are attached the ship's lanterns, equipped with 100-candle-power lamps.

The lanterns show a light for eight seconds, with intervals of four seconds, visible for a distance of thirteen miles. During foggy weather a diaphone, operated by compressed air, is used, which emits three four-second blasts at intervals of three seconds. The vessel also possesses a submarine bell which strikes the ship's number, "14," every twenty-three seconds, and can be heard for about ten miles.

The wireless station that has been installed on the craft adds considerably to its efficiency as a safeguard for mariners. The station is of the Marconi standard ½ K. W. type, with an emergency set. The installation gives a range of 255 kilometres, with wave lengths of 300, 450 and 600 metres.

MR. MARCONI LECTURES TO A DISTINGUISHED AUDIENCE

Word has come from Rome, Italy, to the effect that a lecture delivered recently in that city by Gugliemo Marconi in the Circus of Augustus on the progress of wireless telegraphy, his first in Rome since he spoke on the subject at the capitol in 1903, attracted a great and very distinguished audience. The enthusiasm reached its height when King Victor Emmanuel shook hands with Mr. Marconi and congratulated him.

Lantern slides showed the stations at Glace Bay, Clifden and Poldhu, also that at Coltano, near Pisa, which Mr. Marconi succeeded in having built in less than two months so as to have it available during the Italian-Turkish war. The reproduction of the sounds at these stations when wireless messages arrive from 1,000 miles away produced a great effect on the audience, which cried "Viva Marconi!"

Mr. Marconi, in predicting the early success of radio-telephony, said the human voice could be sent across the Atlantic more quickly by this method than the cable could send a message.

In an interview in London a short time ago, Mr. Marconi talked concerning wireless and its use on ships.

"I have been trying to make an approximate return of the percentage of British ships fitted with wireless apparatus," he said. "If you take steamers of 100 tons and upwards on Lloyd's Register you find that less than 7 per cent. have wireless installation. Roughly, there are about 10,000 vessels of more than 100 tons and fewer than 700 of these have wireless.

"Twelve per cent. of Germany's ships have wireless equipment, and about 8 per cent. of those of France.

"Wireless seems to be even more necessary to-day than it was years ago, owing to the increase in the number of ships and in speed. Certainly, accidents appear more frequent than they used to be. Even to-day a ship may fail to report herself, may disappear and not be heard of again. In fact, there is a greater publicity when a ship is saved than when one goes to the bottom."

Mr. Marconi said he had never computed how many lives had been saved at sea by wireless, but he thought the number was between 3,000 and 4,000—certainly more than 3,000.

MADRID SCHOOL FOR WIRELESS OPERATORS

In the presence of leading officers of the Telegraph Corps, a school for the training of wireless telegraph operators was recently inaugurated in Berlin. The ceremony was attended by the director-general of Posts and Telegraphs, Mr. Arminan, who also represented the Minister of the Interior. The latter was prevented from attending by indisposition. Speeches were delivered by Lopez Cruz and Mr. Arminan. Afterwards the various classes were visited and demonstrations of wireless telegraphy were witnessed. The school is located at 23 Calle Echegaray, in the old Moctezuma Palace.

Dr. Filipi, with his exploring party for the Western Himalayas, is near Skardo, according to recent reports. He is erecting a wireless installation with which to obtain communication with the wireless station at Lahore.

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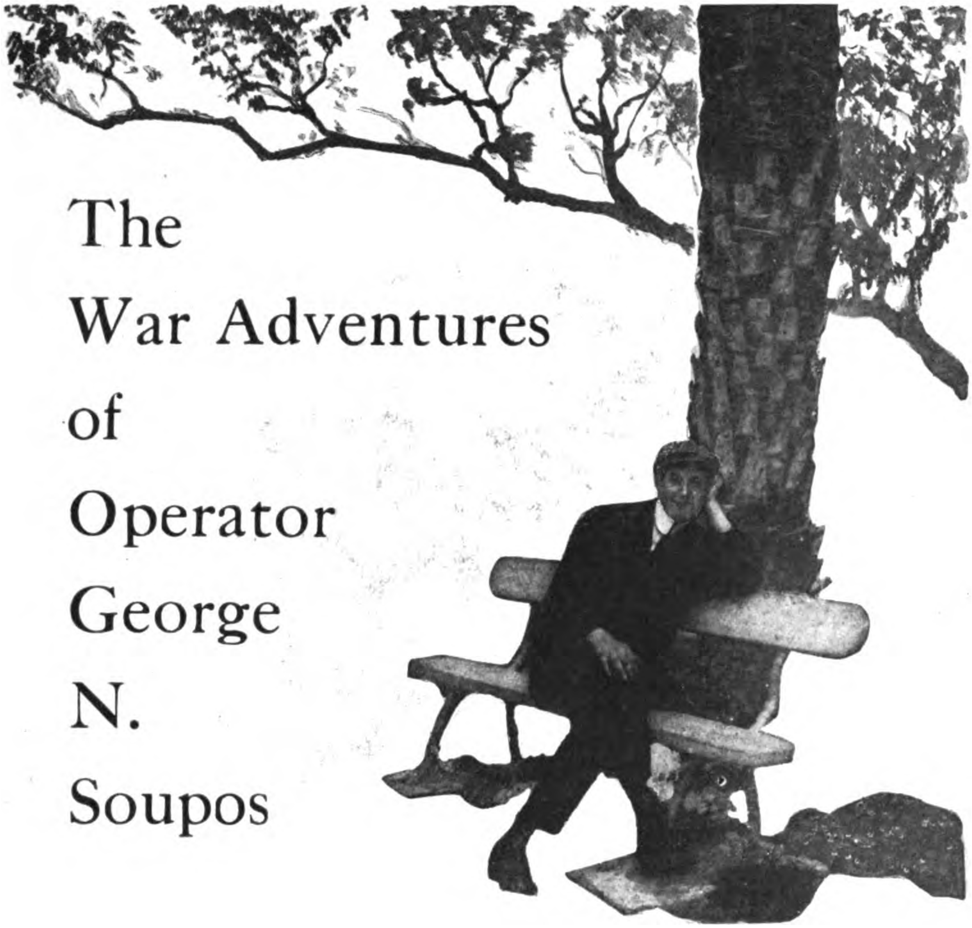
The War Adventures of Operator George N. Soupos



THERE are jobs and jobs nowadays for American youths. A fellow may elect to drive a grocer's wagon or an aeroplane. Again, instead of jumping over the back fence in the old-fashioned way of running off to sea, he may, after certain set preliminaries, become a pounder of the brass, ride the high seas, talk the world around, and thus meet adventures more wonderful to the stay-at-homes than this world's wonder of wireless.

Such was the case of George N. Soupos. One year he was eighteen years old and merely an aspiring wireless amateur with his little station in a New York City back yard. The next year he was returning home with ten years' war experience crowded into a few brief months of fighting in the Ægean Sea for the liberty of Greece. He had tucked away in his valise a comfortable supply of gold coin and a tattered uniform jacket with two diagonal stripes struck across the right sleeve to show that the wearer was a lieutenant in the Greek Navy.

Once he had been in irons, awaiting execution. He had taken part in the countless minor brushes and one big naval engagement. He had transmitted important war messages. He had refused Turkish bribes to reveal the import of these messages. He had, by wireless skill, saved his own vessel. He had helped to save women and children from assault and death at the hands of Turkish bandits.

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Here is Soupos' account of what he saw and did in the war-ridden Ægean:

It was through my love for wireless that I got the opportunity to show its value in war.

"Hey, Soupos! The chief wants you!" a fellow called to me one day as I was sitting at a bench in the operator's room of the Marconi Company, at 29 Cliff Street, New York, wondering when I was to be given a ship. "He's going to give you a chance, I guess." I got up and went over to the desk of Chief Operator Edwards.

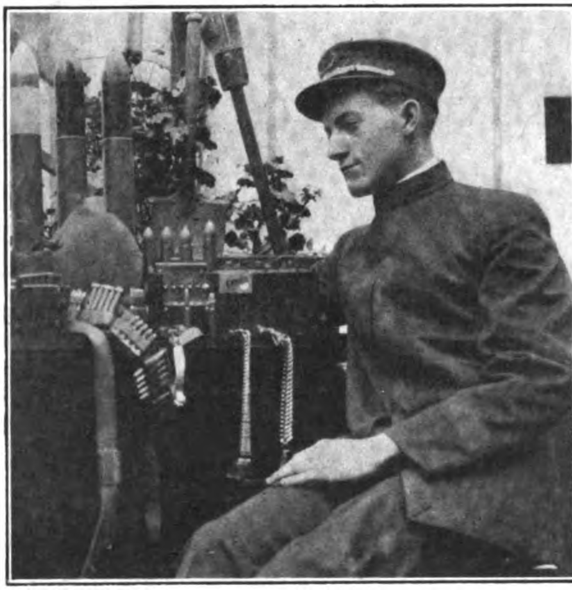
"You speak Greek, don't you?" asked the Chief.

"Yes, sir," I answered.

"Got your license yet?"

"Yes, sir; I passed at the Brooklyn Navy Yard last week, just after I finished at the Marconi school."

"Well, how'd you like to take a Greek ship to the Mediterranean?"



George N. Soupos, an aspiring wireless amateur, forsook his little station in a New York back yard to become a commercial operator. The first ship he was assigned to carried him to the Balkan war. When he returned a few months later he had seen many stirring adventures, narrowly escaped death by execution, and had won the rank of lieutenant in the Greek Navy.

"Fine!" I told him, and it was the truth. I was so anxious to get a ship would have gone on a trip to the North Pole.

"All right; we'll try you out," replied Mr. Edwards. "The Themistocles is her name. She's over at Pier 30, Brooklyn. Here's a note to her captain. She sails day after to-morrow; so you'd better go home right now, pack up and get aboard. Overhaul your set first thing."

And that was how I got my first ship. For two years I had operated an amateur station at home, and had often listened as the ship operators talked with one another and to the land stations. Sometimes I had caught messages as far south as Key West. During the Titanic disaster I sat up for three days and nights "listening in." Now I was going to be a real operator myself. But I did not dream how far and how deep into wireless my first ship would take me.

When the Themistocles, laden with arms, provisions and two thousand Americanized Greeks got to sea the talk was of nothing but war. The men, who were going home to volunteer for the war, talked about the trouble even when they were sea sick. Some of them had made sacrifices of considerable consequence in order to aid the Greek cause.

One fellow, Piperopoulopoulos by name, a fruit dealer, had taken $4,000 from his savings to give to the Greek government when we should arrive at Piræus, the seaport of Athens.

I had no wireless practice while the Themistocles was in the Atlantic, although I picked up not a little of the English Channel ship slang, which was difficult for me to make out. The passengers on the vessel, however, worried me constantly with requests to obtain war news for them. The first information of this description that I received was from a friendly operator on the Island of Malta, in the Mediterranean, who said a Lieutenant Votsis had blown up the Turkish battleship Fatihpoulent with a torpedo. I thought the passengers would go wild with joy when I told them this news. They hugged and kissed me, Greek fashion; the captain

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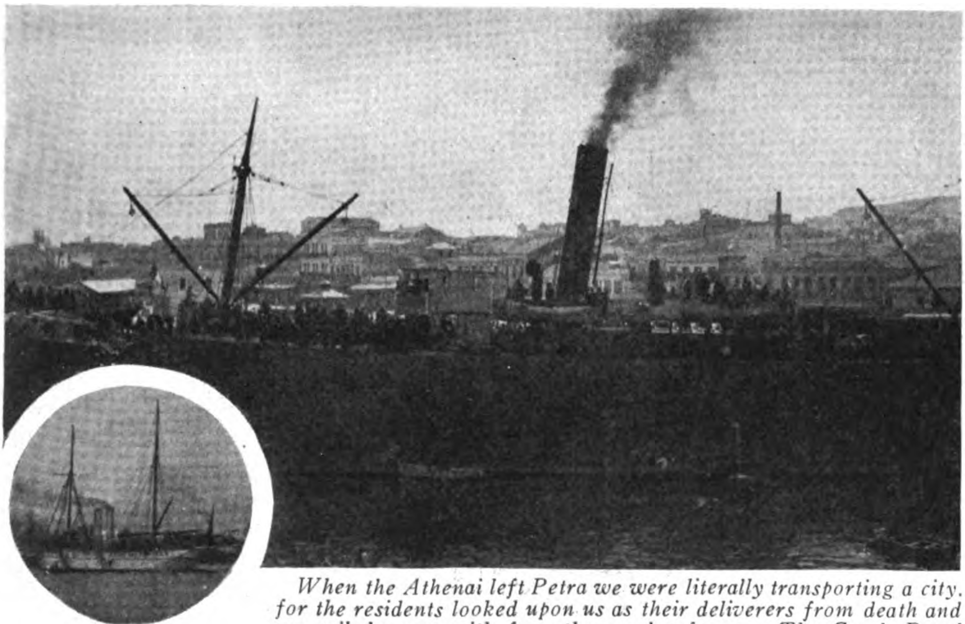


When the Athenai left Petra we were literally transporting a city, for the residents looked upon us as their deliverers from death and we sailed away with four thousand refugees.. The Greek Royal yacht aboard which I enjoyed a rest of a week or more is seen in ***the small circle.***

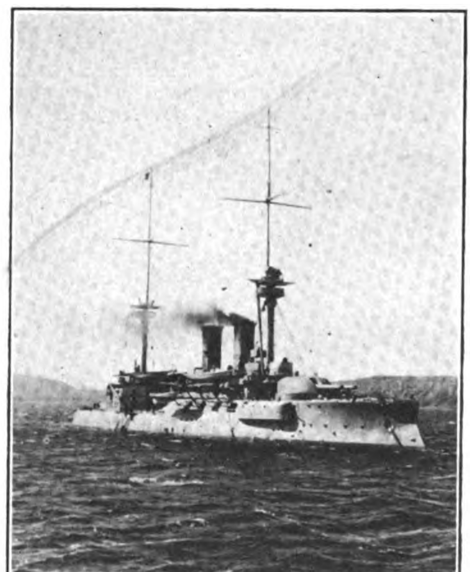
blew the giant fog whistle, and that night a celebration dinner was given aboard the vessel.

At Piræus the volunteers left us. Then several Greek naval officers came aboard the Themistocles and told Captain Nicholas Goulandris that arrangements had been made with her owners to take the vessel as a transport for the Greek naval service.

The captain and his officers were asked to remain with the ship, and they agreed to do so. One of the naval officers asked me if I would like to remain. He said the navy needed wireless men very badly, and that my services would be appreciated. I consulted the captain, who told me that I would be returned to my home if I cared to go.

"I don't like to advise you," he said; "as we will run great risk of being captured or sunk. I myself should like to have you with me, but then, war is not a boy's game."

Well, I took a whole day to think the matter over. It wasn't that I was afraid, but I had promised my mother that I'd be careful, and going to war isn't exactly being careful. Still, I didn't like that remark of the captain—"War is not a boy's game." While I was turning the question over in my mind the vessel was moved into dry-dock to be overhauled and to have steel



A Turkish battleship bottled up in the passage of the Dardanelles; when one of these vessels broke through the blockade unknown to Soupos an order for his execution was issued.

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The twenty-five thousand Turkish soldiers holding Saloniki were hardened and seasoned fighting men, with equipment of the highest standard. But for their Arabian turbans they might easily have passed for Anglo-Egyptian or German colonial soldiers.

plates bent about the bridge. It was also planned to mount four-inch guns on her decks.

The naval officer who had asked me to join the Greek forces came aboard again late in the afternoon.

"Well, what are you going to do?" he asked.

As he spoke there came to me the thought of how proud my mother would feel if I actually engaged in warfare and reached home safely.

The officer was beginning to look impatient.

"Why, I'm going along, of course," I said hastily.

"Very well," he said. "But be careful. A great deal may depend on some of the messages you send; even the fate of an army. We are surrounded by traitors and Turkish spies, and if you are suspected you will be shot."

This was earning glory at a great risk indeed. But, having made my decision, I stood by it. In fact, I was already burning to get into a fight; to be under fire.

Events followed thick and fast from there on. Three thousand troops were hustled on board for us to transport to Eleftherohore, a port to the west of Saloniki. A general movement of Greek forces was planned against Saloniki, which had been coveted by the Greeks for a long time. The city was held by twenty-five thousand Turkish soldiers, and a supposedly impregnable fort—Karampounou—at the entrance to the Bay of Saloniki.

The first day out from Piræus I found that my work would permit me little leisure. I was kept on the alert, with the head phones glued to my ears, practically every minute of the day. My duties consisted not only of intercepting stray messages from the Turkish warships and determining how far away the enemy's craft were; part of my time was spent in transmitting messages from Saloniki and relaying from other

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points to the central station at Athens. These messages were sent by inexperienced operators in a secret code with which I was none too familiar. The messages were dispatched at the average rate of about six words a minute, and it was necessary for me to have them repeated two or three times, in order to insure accuracy. What with sending without cessation, the fumes in my cabin became so thick that my eyes began to pain me. I had no mate to help me, and was awakened at all times of night to "listen in" or to take and send messages.

The night that the Themistocles neared her destination I was very near exhaustion. The ship was creeping along, with the captain trying to find the harbor, when, half dozing, I caught in my head phones the peculiar spark used by the Turks. It seemed very close. Believing it might indicate the proximity of a warship, I ran out to report my discovery to the captain.

"Great Cæsar's ghost! Know where it's coming from?" he said. "We're on the wrong shore side. We're near that fort, and they'll blow us out of the water!"

He ordered all the ship's lights extinguished at once. Then he put the vessel about and worked off shore. After we had proceeded about a mile, the searchlights from the fort began to play over that part of the Gulf of Saloniki which we were steaming away from. They made all of us apprehensive, because we knew that the fort's battery of twelve-inch armored guns might be trained on us at any moment; then, too, we readily recognized that by pressing an electric button in the stronghold one of the many mines with which the harbor and outer bay waters were filled could be set off.

The captain was in doubt as to the proper course to take, in order to reach Eleftherohore, and I got into communication with the Greek battleship Averoff, which was anchored off that port. She gave us the exact course to follow. Needless to say, perhaps, we increased the distance between the Themistocles

The ease with which the Greek forces captured Saloniki impressed me as one of the most remarkable features of the war; the fighting lasted hardly a day. In this picture is seen part of a division commanded by Constantine, Crown Prince of Greece, as the bugler sounds the call to charge.

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and the fort just as rapidly as steam could propel us. All on board the vessel were greatly relieved when the flashing lights of the stronghold looked like fireflies in the distance.

I was considerably gratified the next day when the captain of the Themistocles sent a wireless message to the Navy Department at Athens saying that his vessel might have been destroyed or captured but for my aid. A reply came back by wireless to the commander of the Averoff. It said that I had been made a lieutenant.

For the next month we were kept busy bringing in more troops and carrying away the sick and wounded. Battle after battle was fought on land, and I constantly handled messages to and from Athens and the army heads on shore. On various occasions when we were off Saloniki I picked up weak, short-distance messages sent out by apparatus operated under the direction of the Turks. The messages, which asked to speak with the Themistocles, were in continental code. I answered one call, and the operator asked if I wanted to earn some money. I questioned him concerning his inquiry, and, after sending several communications intended to deceive the operators on the French and German ships, he said if I would promise to relay my important messages in continental code, immediately after sending in the Greek code, a man would meet me in a day or two and hand me a handsome sum of money.

"I'm English, and you're American," he said; "and let's get what we can. It isn't our business if these fellows want to cut each other's throats."

I answered NIL, shut off, and told the captain about the conversation. I did this to protect myself. For I knew I should be shot if I were caught playing double.

"String him along," ordered the captain. "Some other fellow may fall for his money, and we ought to find it out."

I called him up, and told him I would think over what he had said. After that I kept track of stray messages and "listened in" frequently. I noticed that a Belgian operator on one of the Greek ships gossiped whenever he found an opportunity to do so.

When the Greeks were ready to march on Saloniki I detected the Belgian sending in continental the news of our plans. I was sure he was in communication with the operator working for the

A view of the landing dock at Saloniki, long coveted by the Greeks and finally taken through the capture of its supposedly impregnable fort, Karampounou, at the entrance to the bay.

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Turks, because I knew that a Turkish buzzer and spark were being used. I reported my discovery to the captain of the Themistocles, and, after a brief inquiry, the Belgian was put on a train and started for home.

The ease with which the Greek forces captured Fort Karampounou and Saloniki impressed me as one of the remarkable features of the war. The fighting hardly lasted a day, and at the end of that time the Turks ran up white flags and sent wireless messages saying that they would surrender.

I am unable to explain how we won our victory. During the bombardment I was on the cruiser Sfacteria, and I am sure that the fort could not have been taken by the Greeks. It may have been that the Turkish commanders were unable to induce their soldiers to fight; then, too, it is possible that the enemy lacked food supplies.

Greek patriarch (priest) and Servians on board the cruiser Athenai, the captain of which interceded successfully when Soupos' execution was demanded.

When we took possession of the fort all of the Greek ships anchored in the bay off Saloniki. I was transferred to Queen Olga's yacht, the Amphitrite, and enjoyed a rest of a week or more. The Queen was interested in wireless, and asked me one day if there was anything I would like to have.

"If you please, I'd like to have some mashed potatoes with plenty of cream," I said.

She laughed. Then she inquired why I wanted them.

"It's the dish I like best at home. Mother always makes a lot for me," I explained, "and I haven't had any for weeks."

The Queen then summoned a steward and told him to see that the cook gave me all the creamed potatoes I wanted. Thereafter, on the Amphitrite, it was frequently necessary to cook a considerable quantity of potatoes *a la Soupos* —so called by me.

This incident seems trivial enough, but it well illustrates the craving one has while in distant lands for the things he is accustomed to at home. Particularly among the prisoners and the wounded men I met ashore did I find this intense longing for small aids to temporary happiness. Some wanted tobacco, and some liquor. Plain water represented happiness for many.

One day I saw an army of men march in from the hills and mountains where they had been compelled to live for months with only a limited supply of water at hand. They swarmed aboard the ships at the docks and went on their knees to beg for fresh water. The members of one company found a boat loaded with four barrels of fresh water alongside the dock, and they drank every drop of it.

When I resumed active duty it was on the Athenai, commissioned to succor harassed cities on the coast of Asia and to patrol and blockade work. I had a new captain, but I was recommended to him by my old one. The new captain took a fancy to me, and called me "Mascot," instead of plain George. It was fortunate for me that I had impressed him favorably, as later events proved.

We had been out of port only two days when the monotony of life aboard ship gave way to exciting incidents. I was "listening in" early in the morning,

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Soupos, in civilian habiliments, is the central figure in this group of officers. This picture was taken shortly after his release from confinement on the ground that, being an officer, he could not be shot without court martial.

having turned out of my bunk at daybreak. Suddenly I caught a Turkish spark EX, which in the code of our foes meant the enemy. The spark was strong, and I concluded that the set which emitted it was not far away.

Awakening the captain, I told him of my discovery, and, with the aid of his glasses, he began searching the horizon. A cloud of smoke in the distance caused him uneasiness. He ordered the engineer to make ready for a fast run. In the meantime I sent out by wireless a call for aid, which I hoped would be picked up by the Greek cruiser Psara, dispatched to capture the fast Turkish warship Homidieh. The latter had broken through the blockade at the Dardanelles, where the Greek vessels had bottled up the Turkish craft.

We were almost certain after an hour had passed, that we were being chased, but we were at a loss to determine which way to turn in order to escape. After a long period of anxiety, the Psara, which was about forty miles east of the Athenai, answered my call. Our captain immediately decided to seek the protection of the Greek cruiser, and the engineer was ordered to send the vessel full speed ahead.

With the propellers of the Athenai revolving so rapidly that the vessel fairly quivered, we started toward the Psara. The Turkish vessel was not far behind us, and gaining rapidly. For a time the outcome of the race was in doubt. Then, just as the Homidieh began to train her guns on us and drop a few shots in our wake, we came in sight of the Psara.

Our safety was then assured, for the Homidieh put about and steamed away as the Psara came within hailing distance of us.

The first words uttered by the captain of the Psara foretold trouble for me. He asked the captain of the Athenai why he had given the Homidieh a chance to capture us. The commander of the Athenai replied that he had no information to show that the Turkish vessel was so close to him. The matter did not end with this explanation, however, for that night both vessels put into Kerkera, and the captain of the Psara summoned me before him. With two marines as an escort, I was taken to the commander.

"What do you mean by not reporting to your captain the presence of the Homidieh?" he demanded.

"I had no message that she was in these waters," I answered.

"You lie!" he said, curtly. "I'm going to execute you!"

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Then, at his order, the marines placed handcuffs on my wrists and locked me up in the brig.

After a while I managed to get word to the wireless operator aboard the Psara. In response to my request he came to the brig, and I asked him to tell the captain of the Athenai of my predicament. The wireless man returned in half an hour to report that the captain of the Psara and the commander of the Athenai were quarreling concerning the disposition of my case.

He went away leaving me to the companionship of thoughts far from consoling. I spent the rest of the night in speculating as to my fate. I had been so much behind the scenes of the war, figuratively speaking, that the idea of death in the abstract did not fill me with terror. But I did not want to die—in disgrace. Having volunteered to aid the Greek cause, and served my country faithfully, the prospect of being shot as a traitor was harrowing. That night will remain always in my memory. I never once closed my eyes. The next morning at eight o'clock my guards ordered me to accompany them to the captain of the Psara. I came before him with a calmness of bearing that belied my anxiety. He scarcely looked up at me.

"Your captain has interceded for you, so I am going to let you go," he said, and walked away.

Whew!

When I was again aboard the Athenai, the captain told me he had explained to the commander of the Psara that, as an officer, I could not be shot without court-martial. He added that if I was executed without a trial he would ask for an investigation. He was very angry, and did not hesitate to accuse the other captain of being afraid to fight the Homidieh.

After this, we cruised for a time in the waters from Corfu to San Guiani to protect steamers carrying soldiers; then we returned to Piræus for coal and supplies, and made a call at Prevasa. Here the operator of the cruiser Mykalli, whose skill was on a par with most of the men I met, asked me to repair his apparatus. He said it had not been working for a week. I discovered that the set needed only a new detector, and a few pieces of galena crystal borrowed from an operator on a French man-of-war fixed him up. The crystal made such a good detector that I used it myself, and was frequently able to pick up night calls as far as Poldhu station.

Knowing how much our safety depended on the wireless apparatus, I made it a rule to overhaul my 2-kilowatt set at frequent intervals. As a matter of fact, there was little news in those waters that I did not pick up, either from Athens, our ships, or the wireless men on the United States warships. It did me lots of good, too, to talk with the operators on home ships, for in this way I found out the names of the ships trying to break the blockade and get arms and supplies to the Turks. We captured two ships of the Hadgi Daout line trying to slip through by flying the American flag. The Regina, a fast Austrian ship in the contraband business, showed fight when she found she could not run away, but a

Greek soldiers in camp outside Jannina

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couple of shells fired over her bridge made her surrender.

To our captain I repeated news, picked up by wireless, of the horrible massacres of Greeks at Petra, on the island of Mitylene. Following this information, he asked for and received orders to carry the entire population of the little city to the island of Tenedos, located outside the Dardanelles. When we reached Petra the women had pitiful stories to tell. The majority of the men had left their homes to fight for the Greek cause, and bandits from the mountains had been preying on the city. It was customary for these outlaws to cut large crosses on the breasts of the women with their knives. Some of the soldiers and sailors were so incensed over the outrages that a party, of which I was a member, was organized to wipe out the bandits. We found a number of the outlaws, and took considerable satisfaction in putting bullets into them.

When we left the place the ship was simply packed with people.

The residents of Retra looked upon us as their deliverers from death or worse, and when the Athenai sailed away with about four thousand refugees she left behind her what was practically a deserted city. I gave up my cabin every night to a family of three, a mother and two beautiful daughters.

Soon after we put the refugees ashore at Tenedos we took part in the naval engagement off Lemnos. Here the Turkish craft were securely bottled up. They were compelled, because of their position, to come out of the geographical pocket one by one. The Greek fleet battled with one Turkish warship at a time, which, of course, resulted in overwhelming victories for our forces.

After eight months of battle-smoke and innumerable narrow escapes, I began to long for more peaceful pursuits. I found myself dwelling frequently on thoughts of home and its comforts. One night I had a wireless conversation concerning America and Americans with the operator aboard the U. S. S. Virginia. It brought such a flood of memories that I was seized with an acute attack of homesickness.

It did not pass, and soon afterward I asked for and received my discharge as a member of the Greek forces. Two days before I reached New York I sent my mother a wireless message, telling her that I was on my way to the United States. It was supper time when I entered my home and was greeted by mother. She was proud, very proud, of her son. She had thought a lot about me, too. For what do you think she had cooked for me?

A bowl of potatoes mashed in cream!

(*The End*)

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An Amateur's Wavemeter

By H. P. Nielson, M. D.

THE cost of constructing a wavemeter of sufficient capacity, efficiency and simplicity has in the past, so it seems, deferred the wireless experimenter from adding this important and essential instrument to his equipment. A description of an instrument of this type, as constructed by the writer, follows. It has met all requirements and will doubtless satisfy the needs of the average amateur. All of the parts and materials may be purchased from dealers in wireless telegraph supplies at prices within the reach of most experimenters.

A wavemeter consists of a known inductance or capacity, adjustable to a certain value, with indicating components, such as a telephone and detector, or a vacuum tube whereby resonance may be obtained between this known circuit and an unknown circuit. The set I have constructed is not complicated. The amateur duplicating my design will attain the same degree of satisfaction as from the more expensive sets at a cost within the limits of his financial resources.

The Condenser

The condenser as used by the writer and shown in the sketch published herewith is made up of thirty-one plates of aluminum, fifteen movable and sixteen stationary; the former are 2½ inches in diameter and the latter 3 inches in diameter. These may be purchased as a set, finished in every detail and ready for assembly (except that the edges should be carefully dressed with emery cloth or an emery stone, and care should be taken to see that the plates are not bent in smoothing the edges) at a cost of seventy cents. The rods, separating washers, nuts, bolts, rubber handle, pointer and bearings may be purchased for $1.75. If desired, a metal case rubber top and scales may be purchased for $1.75, or the complete condenser, ready for assembly, for $3.75. The top and case may be dispensed with and a glass case used that will cost about fifty cents.

The capacity of the condenser using air as dielectric is .0008 mf. If castor oil is used the capacity will be .004 mf. Capacity of the order of .0008 microfarad will meet all requirements and additional advantage is secured when air is used as the dielectric. From an engineers' and plumbing supply house a No. 6 oil glass, outside diameter 3½ by 4 inches in height, can be purchased. The glass is more suitable than any other enclosing material and considerably improves the appearance of the set. It should be cut off 1½ inches from the end. At the same time obtain two cork washers to fit the glass. These two items will cost about fifty cents. A scale in brass or nickel used by draftsmen may be purchased at a cost of from fifteen to twenty cents. When the parts for the condensers have been assembled, two pieces of hard rubber should be secured, one for the top having dimensions 5½ by 5½ by ¼ inches; the second for the base, 5½ inches wide, 8 inches long and ⅜ of an inch thick. Lay out the position of the condenser and have two grooves for the cork washers burned in a lath. The depth of the groove need not be more than 1/32 of an inch.

By reference to Fig. 1 it will be observed that four hard rubber posts as uprights between the cover and base are required. These may be cut from a single hard rubber rod ½ inch outside diameter and 12 inches in length. The rod should have a ¼-inch hole. Each upright should be 2 5/16 inches in length. Four 14-20 brass bolts, 3 inches in length, will also be required. These will allow the top to be pulled down tightly and with the assistance of the cork washers will make an air or oiltight joint. The top and base should be drilled as per the sketch and then assembled. The detector may be made as shown in the sketch or some other "time tried" favorite giving equal satisfaction may be employed, the principal requirement being that whatever the type used it will per-

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form its function without the assistance of a local battery. It will be of further advantage if the detector stand is of such construction that a number of crystals may be brought into use quickly if needed. It should also have provision for altering the pressure upon the crystals by an insulated knob or handle. The detector stand should be constructed of copper where metal is used. When completed the detector stand need not be nickelplated. Nickel will not materially improve its appearance and it will increase the resistance of the parts to the flow of high frequency currents which travel on the skin or outside of the conductors over which they are required to pass. It will improve a set in no small degree to have all parts finished in a polished or buffed surface and oxidation will be prevented if a coat of good brass lacquer is given. A neatly polished and lacquered instrument in brass is better both in appearance and in use than the best nickel instruments ever made.

At any electrical supply house obtain fifty-five feet of fine pigtail made up of 24 No. 36 B & S copper wires. This is rolled flat to 3/64 of an inch. Cut off such lengths as needed for connecting up the instruments, twist a strip of friction tape around the braid and when soldered in give the tape-covered connectors a coat of orange shellac. The pigtail is to be used for the windings of the inductance coils of the wavemeter.

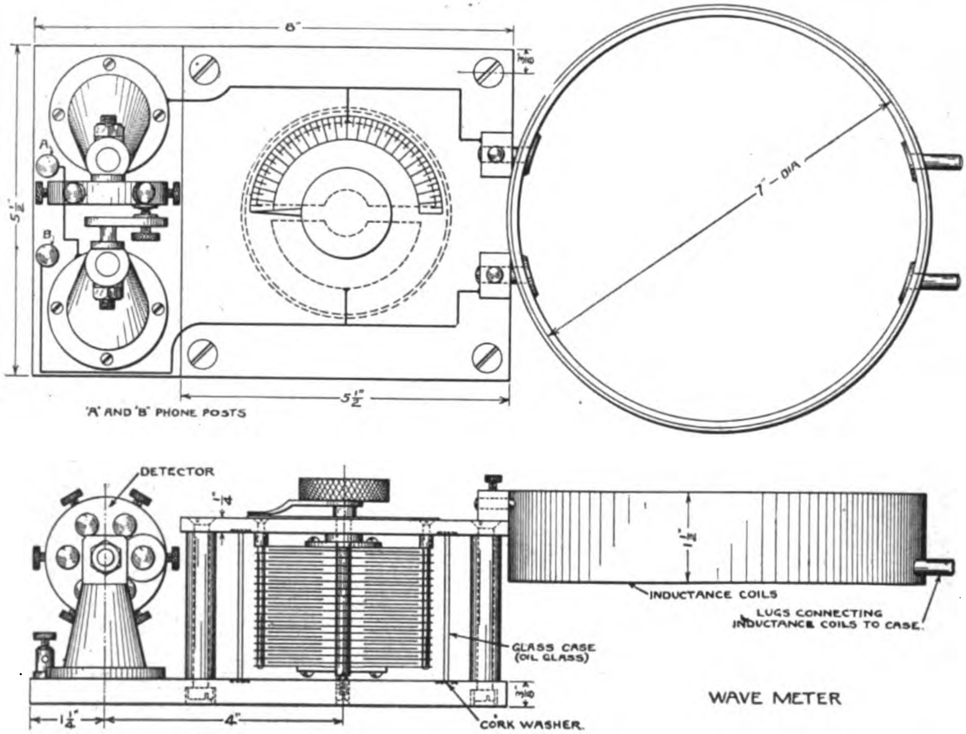

Fig. 1

Inductance Coils

Purchase a paper pulp tube that is 7 inches outside diameter by 3/16 inches wall and cut off a piece 1½ inches in length. On the outside of this tube, or rather ring, wind thirty turns of the same pigtail braid, as mentioned, placing between each turn of wire a strip of thin Empire cloth ½ inch in width. When wound give the flaps of Empire cloth a coat of orange shellac and seal them down flat. This forms a good insulating medium between the turns of the braid, as the braid is, so far as the writer knows, made only in the bare metal. Next make a form 6 7/16 inches in diameter and wind upon it fifteen turns of the same braid in the same manner as the thirty turns on the outside of the 7-inch

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ring, but do not shellac. Remove the fifteen turns from the form and place the same on the inside of the 7-inch ring, then shellac and solder the ends of both the thirty and the fifteen turn coils to lugs, as shown in the sketch. The coils should then be covered with friction tape, and to give a neat finish the coils may be covered with a piece of paper tape made up in the form of pebbled leather, which may be obtained from a book bindery. When so covered and thoroughly dried out, the pair of coils will look neat and will be so light in weight that they may be suspended from the lugs on the top of the condenser case without additional support. The fifteen-turn coil is for low wave lengths up to approximately 300 meters and the larger coil gives range above 300 meters.

Phones

Any good head set or a single phone may be used, but best results will be obtained if they are of 2,000 ohms resistance per set of two. The writer favors a set of 3,000 ohms. The amateur may use the headphones employed with his regular receiving set.

Calibration

The set is now ready for calibration. This is best accomplished by comparison with a standard wavemeter, but the writer recommends that the entire set be carefully packed and forwarded to the Bureau of Standards, Washington, D. C., where the work will be quickly and accurately done at a very nominal cost. It is well to have a curve sheet made up with a ten-point determination for each inductance coil, in which the wave length is found for ten places on the condenser scale and laid out (as shown in Fig. 2) in a curve for each coil. The scale may have the figures marked directly upon the same if desired, the figures to be in different colors for the two coils. To obtain the wave length for any particular capacity reading note that the figures at the left of the sheet are as per the scale on the condenser and those at the base of the sheet correspond to wave lengths in meters.

To illustrate a 200-meter wave reading: Suppose the reading of the condenser is, say, 48 degrees (if a degree scale is used). To the right run a dotted line until it intersects the curve line; from

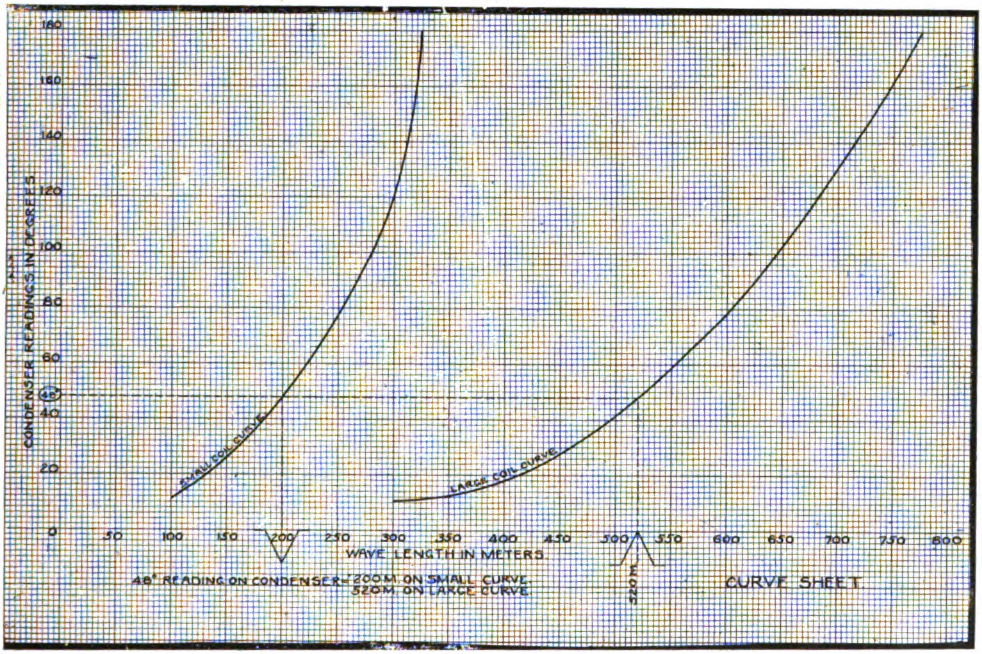

Fig. 2

this point drop a line to the base at right angles to the first line; this should correspond to the 200-meter point, as per the dotted line in the sketch.

The Wavemeter in Use

To tune a transmitting set, place the wavemeter a few feet away from the primary of your oscillation transformer. (Do not get too close or results will not be satisfactory, it being better to be far enough away to just clearly hear the signals.) First, the closed circuit is measured, i. e., with the secondary, aerial and ground cut out. Make a note of the reading. Then a reading of the secondary circuit is taken with the primary of the oscillation transformer and the condenser cut out. Make a note of this reading. By varying the turns in the oscillation transformer the circuit can be tuned to any desired wave length. When the two circuits have been tuned to resonance it will be noted that it requires a certain ratio of turns between the primary and the secondary for a definite wave length—say three turns of primary to nine of the secondary. Mark these points on the oscillation transformer and it is then only necessary to place clips at these points to connect up for the desired wave length.

To determine the wave length of a station from which signals are being received, place the coils on the wave meter near the receiving inductance or loose-coupler primary, so that both are parallel, in a manner forming another loosely-coupled detector circuit. Tune the receiving set to resonance and then tune the meter to resonance with the receiving set, using it in the same manner as with the transmitting set. In this way one may take the wave length of all stations within range.

VANDERBILT YACHT PASSENGERS RESCUED

Wireless telegraphy was employed to bring rescuers to the yacht Warrior, owned by Frederick W. Vanderbilt, which ran aground near Savanilla, on the coast of Colombia, on the morning of January 26 last. Aboard the yacht, besides Mr. Vanderbilt, were Mrs. Vanderbilt, the Duke and Duchess of Manchester and Lord Arthur George Keith-Falconer, son and heir of the Earl of Kintore. The Warrior is equipped with Marconi apparatus.

Eight lifeboats were lost, one after the other, in the first rescue attempt. The small craft were crushed like egg shells or overturned in the churning seas.

These boats were from the United Fruit Company's steamship, the Frutera. Captain Henschaen, of the Frutera, spurred his men to heroic efforts, but all were futile. While the men worked, the party aboard the Warrior looked on anxiously.

As they looked over the rail the Warrior's wireless operator told them the Frutera was making distress signals. She had begun to call for the Almirante, which responded quickly and finally effected the rescue.

Soon after the Warrior struck, the Frutera picked up her wireless appeals for aid and steamed toward the scene of the wreck. Although the waves were running high, Captain Henschaen lowered boats. One of them was capsized and the others were crushed.

The Almirante, which was at Santa Marta, about forty miles distant, then was called and succeeded in taking off all the Warrior's passengers, although the undertaking was attended with great peril.

WIRELESS ON FISHING VESSELS

An agreement has been signed between the Marconi Company and the principal owner of a large fishing fleet at Lowestoft, England, in which it is provided, among other things, that the company shall install wireless apparatus on board the principal vessel of the fleet, to be worked by an efficient operator. By means of this wireless installation the vessel in question will keep in touch with the other vessels of the same fleet during the whole of each fishing expedition off the East Coast. In the course of time all the fishing fleets off the coast of Great Britain will no doubt be provided with wireless, and this, obviously, must eventually lead to its general introduction among those of foreign nations.

This, it is believed, will mean a revolution, all over the European fishing grounds.

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Comment and Criticism

IN regard to experiments with undamped oscillations, amateurs on the Atlantic Coast are less fortunate than their fellow-workers dwelling in the shadows of the Sierra Madres, for, on account of the activities of the Federal Telegraph Company in that vicinity, a rare opportunity is afforded for obtaining data with continuous waves.

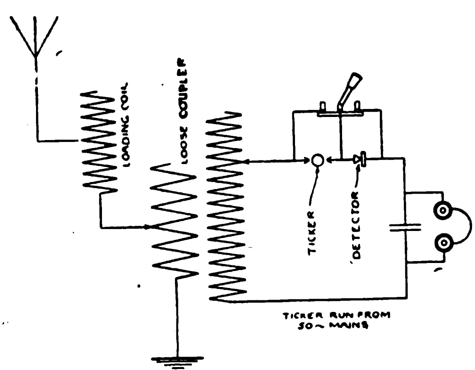
Readers of this class have, without doubt, noted the communication appearing in the Queries and Answers Department of the January number of THE WIRELESS AGE from H. V. R., of Los Angeles, Cal., in which he states that he is able to read undamped oscillations on the ordinary rectifying detector. The details given in that communication were insufficient to allow accurate diagnosis of the matter, but in reply the supposition was put forth of the possibility of a "heterodyne" effect on his aerial, due to the radiation of two Poulsen transmitters located in his vicinity.

It was further mentioned in the reply that the Poulsen transmitter may exhibit damped characteristics, making the signals audible. We have received more complete and detailed information from H. V. R., and are now satisfied that the latter explanation is correct.

The communication in question included a circuit diagram of the apparatus (published herewith) in use, and was accompanied by an interesting report of phenomena noted. It will clear up the matter somewhat if the operation of the Poulsen tikker, as used in connection with undamped oscillations, is understood.

Our correspondent's circuit diagram indicates no variable condenser in shunt to the inductance coil of the closed circuit of the receiving tuner, but at the wave length at which his set operates there is no doubt that the effective distributed capacity of the coil is of itself of sufficient value to act as a storage for the energy. During the intervals that the tikker is open, energy accumulates in the inductance coil which, upon the closing of the circuit by the tikker, is discharged into the condenser connected in shunt to the head telephones. It is very probable that the condenser and the head telephone (connected in shunt to each other) constitute another circuit of relatively high damping, and therefore a practically aperiodic discharge takes place through the receivers. It will then be readily understood that the note produced in the head telephones will be due to the number of interruptions produced by the tikker per second.

To explain the reception of undamped waves with the ordinary detector: It is a well-known fact that in the local circuit of an arc-transmitting set the frequency of a circuit is not always that due to the square root of the inductance times of capacity, but is to some extent affected by irregularities at the arc gap itself. Slight inequalities of frequency are thus produced, resulting in corresponding slight changes of the emitted wave length. This, in effect, will cause a slight variation of the amplitude of the rectified oscillations passing through the head telephones. The variation seems to occur just often enough to cause pulses in the head telephones within the limits of audition.



An excerpt from H. V. R.'s communication follows:

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The receiving circuit used for these tests is similar to the standard loose-coupler receiving circuit employing a crystal detector (as shown in Fig. 1). In the detector circuit the "tikker" (the interrupter which opens and closes the circuit at a rapid rate) is placed in series with the detector. A double-throw single-pole switch is wired up so that either the tikker or detector may be shorted at will. In all tests the tikker was operated from the 50-cycle lighting circuit, and at this frequency the tikker points open the circuit 100 times per second. The results obtained were noted on long wave lengths, as all Poulsen stations send on wave lengths over 2,000 meters.

He continues:

With the tikker shorted the signals from the Poulsen stations in Los Angeles (about 4 miles away) could be read within a radius of 20 miles. The tone in the receiver was very low, somewhat resembling the tone of air under slight pressure in a valve. With this hook-up no other stations could be heard. Of course, the signals from sending stations using a spark could be read, as this circuit is the regular loose-coupler receiver hook-up as used when receiving signals from spark stations.

The fact, as he explains, that the signals from the Los Angeles stations were inaudible on the crystal hook-up beyond a distance of twenty miles verifies our explanation that the phenomenon is due to slight changes of wave length. Theoretically, undamped waves should have no decrement, but when produced by the arc the statement is not strictly true.

To give a clearer idea it should be stated that, when rectifying crystal is connected to a receiving tuner which is being energized by undamped waves, the telephone windings are traversed by a practically continuous current, and hence no sound is produced except at the "start" and the "stop" of current flow. If, however, there are slight changes of wave length in the transmitter producing these waves, it will have the effect of causing the continuous current already flowing through the telephones to fluctuate (due to increase and decrease of resonance), and hence audible sounds are produced on the receiver diaphragm.

Certain results were then noted with the detector short-circuited using the tikker alone. H. V. R. states:

With the detector short-circuited, using a tikker alone, the signals from the Los Angeles Poulsen stations were very loud, and all Poulsen stations within the radius of 1,000 miles could be read. The tone in the receivers was rather low, as in the preceding hook-up. Spark stations using 500 cycles could be read in spite of the fact that there was no detector in the circuit. Signals from 500-cycle spark stations were about as loud on the tikker as on the detector, but the tone was not so pleasant, as it was very low. When using the tikker the signals from the 500-cycle spark stations were not so easily read as the signals from the Poulsen stations, for the reason that the signals from the spark stations were somewhat broken up. When nearby low-frequency spark stations were sending, their signals could not be read, as nothing but clicks were heard in the receivers.

This phenomenon is interesting, but has been known of for some time. It should be first observed that our correspondent's tikker operates at a very slow rate of interruption, and, taking into account the fact that the note produced depends upon the number of breaks made by the tikker per second, it will readily be seen that naught but a low note could be expected under the conditions. (When receiving undamped oscillations.)

It is also plainly evident that at this rate of interruption the tikker does not discharge the condenser at equal points during the cycle; hence a variation of energy is supplied to the head telephones, causing an irregular note. There is no reason why spark stations giving damped oscillations should not be read upon the tikker, as the effect of the tikker is simply to periodically charge the condenser in shunt to the head telephones.

Furthermore, it is immaterial whether the telephone condenser is charged by damped or undamped oscillations, with the exception that when damped oscillations are being received a mixed note is produced, partly due to the interruptions of the tikker and partly to the spark frequency of the transmitting station. It will then be understood that if the rate of interruption of the tikker is of the same order as the spark frequency of a distant transmitting station, practically no signals need be expected, the effect produced being, as our correspondent says, nothing more than a succession of clicks; for at certain periods the condenser of the receiving tuner will be connected to the head telephone circuit at times when there is no energy to be supplied.

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A higher note and better signals *should be* expected from the 500-cycle stations, for, on account of the increase in group frequency, the duration of contact of the tikker is sufficient to allow the telephone condenser to be charged from 3 to 5 times by the condenser of the receiving tuner.

Results were then noted with a detector and tikker, both in the circuit connected in series. With this arrangement H. V. R. says:

The signals from the Poulsen station at Los Angeles could be read and the note in the receivers was of high pitch. Using this arrangement the signals from the Los Angeles Poulsen station could only be read within a radius of 20 miles, and no other Poulsen station could be heard. The signals from 500-cycle spark stations could be read, and are about as loud as though the tikker was not in the circuit. There is only one Poulsen station in Los Angeles, and there is none other of like character within a radius of 100 miles. The phenomenon noted was constantly observed.

We are inclined to believe that this arrangement *will* respond to undamped oscillations and that the effect of the crystal simply amounts to the introduction of a resistance in series with a circuit to the telephone condenser, and therefore causes a reduction in the amount of energy that might accumulate. It also prevents surgings from the condenser (in this case an imaginary condenser connected across the closed circuit in the tuner), allowing only one-half of the oscillation to pass to the telephone condenser. Therefore, the total energy would be less than if the circuit were operated without the detector.

We have ample evidence that our correspondent is intent on going into the matter thoroughly, for he asks a series of questions in a second communication, which deserves notice. He says:

In receiving undamped waves by means of a tikker, is it not a fact that the diaphragm of the telephone receiver is actuated only by the energy of the first iscillation in each group?

This is not the case, for the sound in the head telephones is, without doubt, produced by the energy stored in the condenser in shunt with the head telephone. The amount of energy accumulating depends in a certain degree upon the duration of the contact when the circuit is made by the tikker. The assumption is therefore wrong.

He then asks:

If only the energy contained in the first oscillation of a group actuated the receiver diaphragm, then why is it necessary to use a detector when receiving damped wave trains which are already divided into groups?

Our correspondent should understand that, even though the oscillations from a spark transmitter arrive at his aerial in disconnected groups, yet the frequency of the oscillations composing each group is of such high order that the diaphragm of the telephone receivers could not possibly respond. Therefore, as far as the telephone is concerned, it is immaterial whether the energy arrives in continuous or discontinuous form. The first part of this query has been previously answered. He further inquires:

When receiving damped oscillations by means of a detector, does the pitch of the sound produced in its receiver correspond to the group frequency or half the group frequency of the sending station?

The pitch of the sound produced corresponds to the group frequency: For example, suppose the transmitter to be a 120-cycle truly synchronous spark set giving 240 sparks per second; then 240 disconnected groups of oscillations will be produced in the receiving tuner at the distance receiving station. While only half of the energy of the oscillations in each group will be productive of sound, there will be 240 groups of decaying direct-current pulses passing through the head telephones, each group causing a vibration of the diaphragm.

Still, H. V. R. is not wholly satisfied, and is at loss to explain another phenomenon. He inquires:

Please explain why it is possible to tune in a station emitting a pure sharp wave with different values of primary inductance, secondary inductance and coupling at the receiving station?

An exhaustive reply would require too much space, but we may enumerate a few facts:

This effect has often been observed, and in many cases is largely due to the nearness of the transmitting station, for, owing to the strength of the oscillations being radiated, forced oscillations will be produced, even though the wave length of the receiving aerial and its associated tuner are quite different from

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that of the transmitter. This, however, is not the condition of circuits for the best signals, as it is invariably found that the maximum strength of signals is obtained when the receiving circuits are in resonance with the distant transmitting station.

Again, the phenomenon may be accounted for in the following manner:

Let us suppose that the transmitting station is some distance off, and that its signals can be read at a receiving station with a fairly loose degree of coupling. Suppose, then, that the signals can again be heard with a complete change of primary and secondary inductance and coupling. It may be that the coupling has been "tightened" to such an extent that the tuner is responsive to two wave lengths, one of which may be in complete resonance with the transmitting station, yet the adjustments of the receiving tuner are wholly unlike that used with the "looser" coupling.

The "broadness" of adjustment may further be due to a poorly designed receiving tuner, the circuits of which have considerable resistance, and are therefore highly damped. If so, for a given wave length (provided the transmitting station is not too far off) the signals may be heard with a variety of adjustments.

Very close coupling between the primary and secondary of the receiving tuner is productive of increased damping, due to the rapid rate at which energy is extracted from the circuits. This, also, has the effect of "broadening out" the adjustments of the circuit.

Proper design of the receiving tuner, particularly for use with long wave lengths, is a factor often overlooked, but when taken into account the increase in efficiency is very marked.

* * *

Apparently there are amateurs in New York City and points nearby who hold ideas at variance with the winner of the second prize in the prize contest series in the January issue of THE WIRELESS AGE. In that communication, it will be remembered, the statement was made that a single long aerial wire was preferable for amateur long-distance work to an equivalent length of wire divided into four parallel lengths.

Of course, the article in question was quite general and did not give any specific data, for a complete verification of the case would require information as to the wave lengths employed both at the sending and receiving stations and surrounding conditions.

We believe, however, that some of the points were well taken, but that is not the opinion of the writers of the following communication:

In the January issue of THE WIRELESS AGE there appeared a letter by Carl Dreher on the use of single-wire aerials for receiving. We believe that Mr. Dreher has an erroneous opinion concerning aerials. In the first place he states that with a four-wire aerial, 100 feet long, the amateur will hear only local stations, which is radically wrong.

The writers have in use a 4-strand, 75-foot aerial of aluminum wire which has seen five years' service. With this aerial weather reports can be head every night from N. A. R. (Key West), and several times in a week it has been possible to hear N. A. W. (Guantanamo, Cuba). We do not dispute the fact that a long single wire will not give better results at times, as we are also using an aerial 500 feet long.

Where the amateur is located in the center of a great many other stations using high power, a long aerial produces forced oscillations, making it impossible to copy distant stations through the interference; whereas, with the smaller aerial it is possible to tune out unwanted stations.

If Mr. Dreher would do a little more experimenting with a long and short aerial he would, no doubt, change his opinion.

We have also experimented with a hundred-foot aerial, 6 strands, T connected, 7-22 copper, natural period, 186 meters, which was designed for transmitting. With this aerial, stations have been heard north as far as Buffalo, south to Key West, and most commercial stations intervening. These results have been achieved with the use of galena detector, receiving transformer and variable condenser. We have found with the use of the small aerial we can tune up to 3,000 meters without excessive loss by the use of variables. We do not advise the use of loading coils when using a properly designed receiving transformer that can be balanced by the condensers. Considering the trouble the city amateur has to contend with in getting permission to erect long aerials, it is not worth the effort.

If the average amateur will use a little patience, content himself with the smaller aerial and adjust his instruments, he will hear long-distance stations; but in most instances his time is occupied in trying to get local stations loud enough to burn out the receivers.

F. L. M.
W. W.
New York.

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There is a possibility that Mr. Dreher has been misunderstood, for we are of the opinion that if the available amount of aerial wire is limited the longer single wire antenna is apt to give better results while receiving the longer wave lengths, such as employed at the naval station at Key West, Fla.

It is true, however, as our critics state, that the longer aerial wire in the vicinity of high-power transmitting stations is more productive of forced oscillations than if it were shorter; but they should also understand that when using the short aerial, better tuning at all wave lengths is not entirely due to the fact that the antenna is actually shorter, but may be better accounted for by the fact that with the short aerial a considerable amount of inductance is required to be added in the receiving circuit to arrive at a certain wave length. This additional inductance (if its resistance is not too high) has the effect of "stiffening" the circuit; i. e., it decreases the decrement, and hence the sharper tuning.

To repeat, when employing the short aerial for receiving, it is necessary to add a considerable amount of inductance to arrive at a definite wave length, and therefore such a circuit will tune more sharply than if the same wave lengths were obtained by the use of a longer aerial and less inductance.

We are handling the case generally, and our statements must be taken with limitations, for we assume in the argument that the wave length of the receiving aerial is considerably less than that of the sending aerial.

There is a statement made by our critics upon which we would like more detailed information, viz.: the reference to the desirability of using condensers for tuning in preference to loading coils. Before commenting, we should like to know just where and how these condensers were connected. An ill-designed loading coil is without doubt productive of energy losses, but just how they propose to eliminate the tuning inductance by the substitution of a condenser is somewhat of a mystery.

The Talo Wireless Club has discussed the matter, and on behalf of the members its president has sent the following communication:

Referring to Mr. Dreher's article in the January issue about giving the average amateur 400 feet of wire, and how it should be strung to get the best results, I, as the president of the Talo Wireless Club, have been requested by the members who have read the paper, to give some of the results discussed at one of the meetings as to the proper size of aerial for receiving. Let me state before going further that when oscillations are set up in a receiving aerial, another wave is sent out by that aerial. This being the case, the more efficient the construction of the aerial for sending the poorer it is for receiving, and *vice versa.*

The argument tends to point to a long aerial for the best work, which works out fine for long distance if there is no local interference. When it comes to tuning out interference with a large aerial the results are far from being perfect.

Mr. Dreher speaks of hearing W S L (Sayville) 5 feet from the telephones. Good work, but he should be able to hear it 10 to 15 feet off with a 400-foot aerial.

The members were surprised that he did not get W S L (Sayville) further away that 5 feet, as with their own aerials ranging from mine, which is 40 feet long, to others which are 100 feet long, we get W S L as well as Mr. Dreher, and even better. Getting back to the working properties of an aerial, ask any commercial operator who has plenty of real work to do whether he likes signals to "pound in" and have interference through forced oscillations, or have a station come in loud enough to read well and not be bothered trying to tune out forced oscillations. He will invariably prefer the latter condition in locations having interference such as is encountered in New York City. This whole article boiles down to the fact that for practical use and to get the best operating results from an aerial, that aerial need not be over 100 feet long, composed of 4 or 6 wires.

Personally, I have found that my 40-foot aerial will do fine work, having picked up N A R very often, and, incidentally, few surpass my records as to distance. Of course, with a small aerial the apparatus has to be first-class, and much depends upon the operator. For those who wish to experiment, let them put up large and small antennæ and try them out. If the outfit is sensitive and correctly designed, ninety-nine out of a hundred amateurs will permanently use small aerials, at least in this location where interference is constantly received from wave lengths other than those to which they have their outfit tuned.

Some of the readers of this paper may like to have other "bugs" come to their houses and astonish them with the way things "pound in"; all well and good, but the minute you try and copy W C C (Cape Cod) there is intereference from W S L (Sayville) and a few navy yards, so that from the viewpoint of getting the best

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working results the small aerial for receiving beats every time.

It is interesting to note that the ideas held by the members of this club are in accord in many respects with the arguments of our two critics.

Undoubtedly, when energy is received by an antenna a portion of the energy is re-radiated into space. We therefore do not see how, as our critic states, that "the argument tends to point toward a long aerial to get the best work." We believe that if it is desired to prevent the receiving aerial from re-radiating its energy it would be an advantage to erect an aerial of a loop type; i. e., a closed-circuit oscillator. Then the energy picked by the antenna would be conserved, because it is a well-known fact that the closed circuit oscillator is a poor radiator of energy.

It should not be forgotten that the matter of location is an important one, and it is known that certain antennæ located in New York City, while properly erected and of large size, are hopelessly inefficient because of adverse local conditions.

For the general elimination of interference we agree with all parties concerned that the shorter aerial is productive of sharper tuning, although we must also keep in mind the fact that for long-distance work it is of value to have natural wave length of the receiving antenna somewhere near the wave length of the transmitting station.

HONORS FOR CAPTAIN INCH

Captain Francis Inch, commander of the steamship Volturno, which was burned in mid Atlantic on October 11. 1913, with a loss of many lives, was the recipient on February 4 of the freedom of the city of London, England, in a silver casket, and also of a gold medal, a gold watch and chain, a purse of gold and Lloyds' silver medal. The Lord Mayor and Mr. Marconi delivered eulogistic speeches, in reply to which Captain Inch modestly disclaimed having done anything but his duty.

JACK BINNS TO WED

Jack R. Binns, the wireless operator of the steamship Republic, who remained at the key and brought the aid that saved the lives of the passengers of that vessel when it was sinking off Nantucket, January 23, 1909, is to be married in June to Miss Alice A. McNiff, of Beverly Road and East Eighteenth street, Brooklyn. Mr. Binns and Miss McNiff met at the home of Mr. and Mrs. T. S. Tenney, in River Edge, N. J. At that time Binns was wireless operator on the steamship Adriatic.

Heretofore the sea had held a great fascination for him. Then, too, he was intensely interested in wireless telegraphy, and, like the majority of radio operators, his work was a part of his life.

All this was changed following his meeting with Miss McNiff. The voyages become somewhat irksome, and he looked forward constantly to reaching New York. That was why he left the wireless telegraph service and became a reporter on the New York American. He became a member of the staff of that newspaper the day before the Titanic wreck.

Miss McNiff is a daughter of the late Lothian McNiff. She and Mr. Binns will take a honeymoon trip to the Mediterranean.

FIRST S O S CALL FROM THE ARCTIC

The first wireless call for help ever received from the Arctic Circle is told about in an English publication:

"Bergen is working 'S O S' Wait and listen," was the message which, it is stated, went the round of Europe's wireless stations at 1 o'clock Tuesday morning, December 23 last. All did as requested, and the fact was then established that the Norwegian steamship Sagnivald Jarl had gone ashore on the Lofoden Islands, 600 miles north of Bergen, Norway. This is double the working distance of the ship, and to enable Bergen to communicate, all stations were asked to close down so that the faint signals might be read.

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Loosely Coupled Definitions

THE INTERRUPTER

WORKING HIS TRICK

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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

B. S., Newark, N. J., writes:

Ques. (1) I am constructing a receiving cabinet and have available space to the amount of 3½ by 6 by 18 inches in which to place a loading inductance capable of tuning to 6,000 meters. My Blitzen tuner and aerial respond to 1,000 meters. Will you please tell me the size of the tube, size and kind of wire and the number of taps necessary for this inductance? Is a loading coil of this size practical? If not, what is the maximum pactical size?

Ans. (1) Apparently you intend receiving wave lengths of 6,000 meters on a receiving tuner whose present maximum range of adjustment is but 1,000 meters. While it is possible to add sufficient turns in the antennæ circuit to reach a wave length adjustment of 6,000 meters, unless a corresponding change is made in the detector circuit no signals will be received. You apparently have made no provision for "boosting" the wave length of the local circuit. Keep in mind the desirability of resonance between the two circuits. For a 6,000-meter loading coil wind a drum 5½ inches in diameter, 18 inches in length, with No. 20 bell wire, bringing taps out at intervals. You will find that this coil will possess considerable high frequency resistance.

* * *

A. N., Cambridge, Mass.:

Loud speaking telephones may be obtained from the Western Electric Company, New York City.

* * *

L. L. C., Sumas, Wash., writes:

Ques. (1) Is there any way by which I can determine the secondary voltage of my transformer, which is home-made, and the voltage is therefore not rated. If so, please state same?

Ans. (1) You may measure the potential of your transformer with a fair degree of accuracy by mounting a pair of brass spark balls ½ inch in diameter, so that the distance between them may be accurately gauged and measured. They are then connected to the secondary terminals of the transformer and widened out to the maximum possible distance for discharge. The voltage will then correspond to the following scale:

Gap in inches.	Break down voltage.	Gap in inches.	Break down voltage.
1/16	5,000	9/16	22,300
1/8	9,000	5/8	23,500
3/16	12,000	11/16	24,500
1/4	14,000	3/4	25,700
5/16	16,000	13/16	27,000
3/8	18,000	7/8	28,000
7/16	19,500	15/16	29,000
1/2	21,000	1.0	30,000

Ques. (3) Please name a number of firms that handle books on electricity and wireless telegraphy and also mention several good, thorough books on these subjects.

Ans. (2) In the article appearing under the heading, How to Conduct a Radio Club, in the December issue of THE WIRELESS AGE, several books are tabulated which may be of value. Books may be purchased from D. Van Nostrand Company, 25 Park Place, New York, or the book department of the WIRELESS AGE.

Ques. (3) Please give me a good hook up for the following instruments: Loose coupler, variable condenser, Ferron detector and pair of receivers.

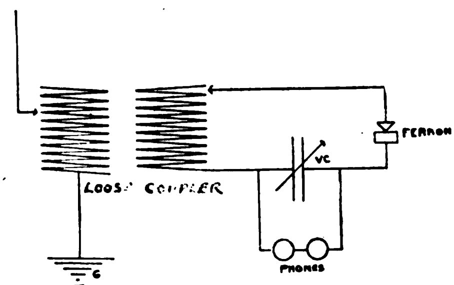

Fig. 1

Ans. (3) Proper connections for these instruments are indicated in Fig. 1.

* * *

A. R. M., Minot, N. Dak.:

Ques. (1) Which of the following is the best aerial wire, and why: 7-strand No. 20, phosphor bronze; 7-strand No. 22, copper; 7-strand No. 18, silicon bronze?

Ans. (1) Silicon bronze is supposed to have the greatest tensile strength. The greatest conductivity may be expected with the copper. However, all three, practically speaking, will give equal results.

Ques. (2) Where can I purchase this wire?

Ans. (2) From any amateur supply house.

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C. K., St. Louis, says:

I should like to know what I require to receive the time signals from Arlington. At present I am unable to hear them. My set consists of an aerial 78 feet high, 85 feet long, composed of four 7-strand No. 20 P. B. wire; lead in 80 feet long, 50 feet of which is 7-strand No. 18 copper rubber-covered wire. Ground lead, 7-strand No. 18 copper rubber-covered wire to the water mains. My receiving set consists of a Blitzen receiving transformer, Blitzen variable condenser across the secondary windings, Audion detector, one pair of Hotlzer Cabot 3,000-ohm phones and fixed condenser. I am using a loading coil wound in grooves—130 turns; taps are taken off every 14 turns. Is this correct for 2,500 meters, or what would you recommend me to use to receive time signals from Arlington.

Ans. (1) We have taken note of the diagram enclosed with the query and find it is quite correct, with the exception that the fixed condenser is connected in shunt to the headphones and not in series; for if it were connected in series the local battery current could not flow through the telephones. We are not familiar with the wave lengths obtainable in the secondary circuit of the Blitzen tuner. Probably there is not sufficient wire to reach a wave length adjustment of 2,500 meters. If so, the addition of a loading coil in the antennæ circuit will be of little value, as the two circuits are not in resonance. In the January issue of The Wireless Age, in the article, How to Conduct a Radio Club, data is given for a tuner suitable for receiving signals from Arlington at a wave length of 2,500 meters.

* * *

J. P. E., Jersey City, N. J.:

Your request for a complete description for the construction and operation of a Decremeter requires too much space in this department. You will find an interesting description of the Decremeter and its operation in a book entitled Wave Meters in Wireless Telegrapthy, by Lieutenant Mauborgne, U. S. A.

* * *

H. P., East Orange, N. J.:

Ques. (1) Will you please tell me what the age limits are for admittance to the Marconi School and if a technical knowledge of wireless is needed before going in; also about what length of time it takes and are there any night classes?

Ans. (1) Applicants are not received at the Marconi School at an age of less than 18 years. No technical knowledge is required, but applicants must be able to receive in the Continental code at a speed of from 10 to 15 words per minute. The technical course requires three months of instruction. The length of time necessary to qualify in respect to the Continental code depends entirely upon the student.

Ques. (2) Would a knowledge of German or Spanish help one in getting in?

Ans. (2) Such knowledge is not necessary, but is a desirable asset.

C. A. B., Ocean Grove, N. J., asks:

Ques. (1) What is the difference between a sharp wave and a pure wave?

Ans. (1) According to the United States regulations, a pure wave is of such character that if the energy is radiated in two wave lengths the energy in the lesser wave shall not exceed in value by 10 per cent of that in the greatest. By the same regulations a sharp wave is one where the logarithmic decrement per complete oscillation is less than 0.2.

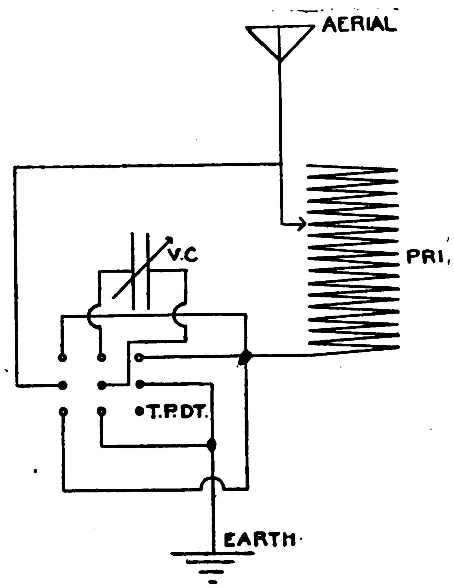

Fig. 2

Ques. (2) When by the wavemeter it is found that two waves are being radiated instead of making the coupling looser, why not vary the inductance, or capacity, or both, until but one wave is radiated?

Ans. (2) By a variation of the inductance or capacity the circuits will be put out of resonance and the radiation seriously crippled. It is possible to leave the primary and secondary of the oscillation transformer alone as regards position, and then, if the condenser capacity of the closed circuit is increased and the inductance of the closed circuit decreased, the mutual inductance will diminish in value on account of the decrease of the self-inductance of the closed circuit. Hence we may expect a decrease in coupling. But if distance is to be expected, resonance betwen the two circuits must be maintained.

* * *

C. I., B. & O. R. R., asks:

Ques. (1) Please give a drawing of a switch to cut the aerial, primary of loose coupler, variable condenser and ground in series, which, when thrown over in opposite position, will connect aerial and primary to ground, with the variable across the primary terminals, thus enabling one to tune for long or short wave lengths.

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Ans. (1) The result may be obtained by the use of a triple pole, double through switch, as per the diagram, Fig. 2.

Ques. (2) What capacity of fixed condenser would be necessary to give good results in this case?

Ans. (2) This question cannot be answered, as you have not stated in what part of the circuit you desire to use it.

Ques. (3) Would a variable condenser (rotary) built up of 16 stator and 15 rotor plates 2½ inches in diameter give enough capacity to use for tuning?

Ans. (3) We suppose you refer to the small condenser, which may be purchased in the open market. If so, it will be sufficient for wave lengths from 200 to 1,000 meters.

Ques. (4) In the rotary receiving transformer, such as the Blitzen, does this give as good results where the wire is wound in two grooves, one layer upon the other, than in the ordinary transformers where there is only one layer?

Ans. (4) Practically speaking, yes.

* * *

J. A. M., Milford, Utah, asks:

Ques. (1) What results could be expected by using an abandoned copper transmission line two miles long, consisting of two No. 8 copper wires 2 feet apart, on 25-foot poles, as an antenna?

Ans. (1) You should be able to obtain results from stations sending on longer wave lengths, but, of course, the transmission line is out of resonance with the emitted wave from any station in the universe. It is a curious phenomenon that it is possible to receive signals from 600 meters' stations on such aerials with a fair degree of efficiency, provided a variable condenser is connected in series with the earth and close coupling is employed at the receiving oscillation transformer.

Ques. (2) What results could be expected at this point, surrounded by deserts and mountains, with an aerial 80 feet high of 4 wires, 400 feet long, in connection with a triple audion set, described in your January issue, in getting signals from Kansas City, Colon and the Pacific Coast?

Ans. (2) You should be able to hear signals 2,500 miles at night time during the winter months. The day range is rather difficult to estimate.

Ques. (3) What will the Marconi Company assemble and wire a cabinet triple audion set complete, except head phones, for?

Ans. (3) These sets are not made by the Marconi Company. Communicate with the Radio Telegraph and Telephone Company, 309 Broadway, New York City.

Ques. (4) What are the names and addresses of other wireless publications besides those of the Marconi Company?

Ans. (4) The Wireless World-Marconi Press Agency, Marconi House, Strand, London, E. C., England. The proceedings of the Institute of Radio Engineers are published periodically, and copies may be secured by addressing the secretary, 8 New street, New York City.

* * *

D. O., Tieton, Wash., writes:

Please inform me where I can obtain the books named in How to Conduct a Radio Club on page 217 of the December issue of The Wireless Age.

Ans.—D. Van Nostrand & Co., 25 Park Place, New York City; the book department of The Wireless Age.

* * *

L. W. E., Columbus, O., asks:

I have constructed a wavemeter loose-coupled receiving tuner, the windings of which are made on a wood fiber coil 7 inches in diameter, for primary circuit, and 5¾ inches in diameter for secondary circuit.

The primary windings have a tap for every two turns and secondary windings have a tap for every ten turns.

With this tuner I receive signals from all the long wave length stations much louder than I did with a 2-slide tuner wound on a drum; but all stations on wave lengths below 600 meters do not come in as loud as on the 2-slide tuner; some stations that I heard before, I cannot hear at all now.

Can you explain the trouble?

Ans.—At sight it appears that possibly the switches on your inductance coils are so arranged that when the minimum number of turns are in use the inductance is of such value as not to allow wave length adjustments below 600 meters.

Again, it may be that the natural wave length of your aerial is above that of the stations from which you desire to receive, and, owing to the "loose" degree of coupling afforded by the variometer, the antenna cannot set up forced oscillations in the local detector circuit.

With the 2-slide tuner, however, owing to the closeness of coupling between the two circuits and the corresponding increase of damping, the tuner is responsive at one adjustment to a wide range of wave lengths (due to forced oscillations). This does not indicate that the 2-slide tuner is the more efficient of the two, for, if the inductively-coupled tuner were properly designed and the aerial proportioned to the wave length it is desired to receive, equal results could be expected with both tuners as far as the signals are concerned. Advantage is derived with the inductively-coupled tuner on account of the ease with which any degree of coupling desired may be obtained.

When receiving wave lengths below 600 meters, try connecting a variable condenser in series with the antennæ, thereby reducing its wave length.

* * *

L. C. G .,Mattituck, N. Y., writes:

On January 13, while listening in at my wireless outfit, I disconnected the ground wire and noticed a small spark as the wire left the binding post. Thinking in some way that it might have come from the battery of the test buzzer, I disconnected that, and still noticed the

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spark as I touched the wire to the "ground" slider of the tuner. I then wet my fingers and touched one finger to the ground wire and the other one to the ground slider, and received a light shock. This seems very strange to me, as there is only one battery on the place, and that is on the buzzer test, and was not in any way connected. There are no high-tension lines anywhere near my outfit. I told a wireless friend about what I had done and he tried it on his outfit and received a fairly good shock. This was at 12:05 P. M. and I have never noticed it since. The weather was overcast and very cold, with occasional loud bursts of static. Can you tell me what this was?

Ans.—The phenomenon indicates nothing unusual. It is simply an accumulation of static electricity on the aerial wires, which, when touched with the earth connection, discharge this current to the earth, causing a spark. Frequently at some of the larger stations having good-sized aerials sparks 6 inches in length can be drawn in from the aerial, particularly in mountainous countries. Static charges are especially prevalent previous to the arrival of a new snowstorm .

* * *

J. M. H., New York City, inquires:

Kindly let me know where I can buy an auto-transformer with a resistance of 9,000 ohms?

Ans.—We suppose you refer to the auto-transformer to be used in connection with the audion amplifier described in a previous issue of The Wireless Age. You will find it difficult to purchase such a device. Why not make it yourself? It simply consists of a single coil of wire wound about a soft iron core composed of a bundle of fine iron wires.

Please observe that it is not the amount of resistance which determines the efficiency of the coil, but the value of the inductance obtained.

As a substitute, you may use the secondary winding of a transmitting transformer, or the secondary winding of an induction coil.

* * *

O. B., Natick, Mass., writes:

Ques. (1) I have a transformer that cuts 110 volts alternating current down to 3 voltages—6, 10 and 16. I also have a 1-inch spark coil, but when used in connection with this transformer it gives only ¼-inch spark on the 6-volt tap, much less on the 10-volt tap and none at all on the 16-volt tap. How can I increase the size of the spark? Would a rectifier be of any use; where could I buy one?

Ans. (1) Induction coils are not intended to be used on alternating current. The proportionments of the primary and secondary windings and the constants of each circuit are not designed for alternating current. We are under the impression that the coil will give better results with a rectifier, which may be obtained from any amateur electrical supply house.

Ques. (2) Is the auto-transformer, shown in Fig. 2 of the article on How to Conduct a Radio Club, in the January issue of The Wireless Age, wound on an iron wire core, as indicated in the diagram, or on an air core?

And. (2) On an iron core composed of a bundle of fine iron wires.

Ques. (3) According to the dimensions given, the primaries of the receiving transformers slide inside the secondaries. Will this form be as efficient as the usual one?

Ans. (3) Certainly.

Ques. (4) Would the set shown in accompanying diagram work, and if so, would it give the same results as the one in Fig. 2, provided the crystal rectifier shown is as sensitive as the perikon? Fixed condenser FC and the local battery circuit have been dropped; otherwise the two are the same. The mineral used is, of course, one that does not require a local battery.

Ans. (4) The arrangements of circuits as shown in your diagram would make the equipment absolutely inoperative for long distance signals.

* * *

E. C., Fort Wayne, Ind., asks:

Is it possible to use iron wire instead of aluminum wire for an antenna, and what would be the difference?

Ans.—You will be able to hear signals on an aerial composed of iron wires, but iron has an enormous value of high-frequency resistance, which is productive of considerable energy losses. Aluminum is the better conductor of the two, but trouble is apt to be encountered at the joints, owing to the coating of oxide, which forms when the wire is exposed to the weather. There are special solders made for aluminum wire joints, which may be obtained from any large hardware concern.

* * *

L. H., Bennington, Kan., asks:

Ques. (1) Without antenna or "ground" connected to my receiving set, consisting of loose-coupled tuner, condensers, detector and telephone receivers, I easily get signals from a friend's wireless station 2 miles distant, the transmitting apparatus consisting merely of a small ignition spark coil, giving a ¼-inch spark, a D. P. D. T. switch and the spark gap shunted across leads from secondary of spark coil to the switch; no condenser or helix is used. I hear this station remarkably loud when having either antenna or ground alone connected, and when both ground and antenna are connected I find the incoming wave so "broad" that it covers entire gamut of tuner. Now, have we stumbled onto something worth while, or are such results common?

Ans. (1) It is very likely that the signals from your friend's transmitting station are getting to your receiving station over the telephone and power wires in the vicinity of his sending aerial. The signals are caused more by electrostatic induction than by wireless telegraph radiation.

Had you given more detailed information as to the disposition of the aerial, its relation in wave length to the transmitting station, etc., perhaps we might have answered the query more satisfactorily. The broadness of tuning,

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as noted on your receiving tuner, is probably due to the fact that the spark gap is connected in series with the aerial, thereby producing a highly damped wave, possessing practically no tuning characteristics.

Broadness of tuning is also often due to a poorly designed receiving tuner. You have stumbled on nothing new. The effect has often been noted. You will probably find that intervening wires are assisting the transmission.

Ques. (2) All other conditions being equal, is there any difference in the transmitting range of a ¼ K. W. and a 1 K. W. transmitting wireless set using a wave of 200 meters?

Ans. (2) With the limitations of wave length imposed, in order to use 1 K. W. at the transformer, even with a frequency of 500 cycles, it would be necessary to increase the secondary voltage of the transformer. At a frequency of 60 cycles the potentials would need to be so high as to become destructive to insulation. Such conditions of voltage would require a spark gap of abnormal length, resulting in increased damping.

By the above statements we mean that "all other conditions cannot be equal" at a wave length of 200 meters, with an increase of en-energy from ¼ K. W. to 1 K. W. Increased power with proper design of apparatus should be productive of increased distance. The statement, however, must be accepted with limitations.

Ques. (3) Why does the law require a rotary gap when using an oscillation transformer?

Ans. (3) We are not aware of any United States law requiring the use of the rotary gap.

Ques. (4) What is the advantage of an oscillation transformer over a sending helix?

Ans. (4) We suppose you refer to the advantages of an inductively coupled oscillation transformer over the directly connected helix. If so, the principal advantage lies in the ease with which any degree of coupling desired can be obtained. The degree of coupling is varied in the case of the inductive coupled arrangement by simply drawing the helices apart, whereas with a directly coupled set to obtain the same adjustments it is necessary to shift four connections to the helix.

Ques. (5) With two sections of condenser and three turns of wire on helix in the primary circuit and eighteen turns in secondary circuit of my transmitting set I get the same amperage in the antenna circuit as when using three sections of condenser: one turn of wire in the primary and nine turns in the secondary circuit, although the spark "crashes" more in the latter case. Which coupling gives the longest wave and which is to be recommended?

Ans. (5) Having no data at hand as to the capacity of the condenser or the inductance value of the helix, we cannot answer specifically, but the condition of the circuits having 18 turns in series with the aerial will give the longer wave length, both on account of the closeness of the coupling and the increased number of turns in the antenna circuit. The second condition, however, will probably give the better results, for on account of the "loose" degree of coupling obtained the energy radiated is more nearly confined to one wave length. The spark gives a greater "crash" with this arrangement on account of the increased condenser capacity and decreased inductance in series.

* * *

L. E. R., East Moriches, N. Y.:

Your first query is answered in the reply to another query in this department.

Ques. (2) Describe more fully the construction of the auto-transformer, as used in connection with the audion amplifier, as to the method of winding, composition of the core, etc. What is the function of the same in the circuit?

Ans. (2) The method of winding is described in another query in this department. The function of the winding is to act as a temporary storage for the energy from the high-voltage battery of the first audion, then to transfer it to the second audion.

Ques. (3) Referring to Fig. 2 in the article, How to Conduct a Radio Club, in the January issue of The Wireless Age, would the diagram be identical for a mineral detector employing no local battery?

Ans. (3) Yes, the diagram would be identical with the exception that the potentiometer and its associated battery would be completely removed from the circuits. Better results, however, will be obtained when employing a battery and a potentiometer.

Ques. (4) Is it to be understood that in a receiving circuit using the audion detector additional inductance should be included in preference to capacity in tuning to a longer wave length?

Ans. (4) Yes, additional inductance is preferable to capacity for adjustments to longer wave lengths, provided the resistance of the inductance is not too high.

* * *

E. E. H., Wilkinsburg, Pa., writes:

Ques. (1) I intend to install a receiving set in my room so that I can listen in on any wireless news which happens to be in the ether. The whole apparatus goes in a third-floor room, 10 by 11 feet. What kind of aerial (size, number of wires, etc.) could I arrange to place near the ceiling?

Ans. (2) Whom do you intend to receive from? You are rather badly situated, particularly to receive signals from the stations on the Atlantic Coast. Furthermore, an aerial strung in a room of this size, using the average amateur receiving apparatus, will not allow the reception of signals more than about 5 miles. If the house has an attic, string 4 wires the entire length of the roof.

Ques. (2) Would the gas pipe of the chandelier do for the "ground" connection?

Ans. (2) No, not in all cities. In some localities, particularly where a combination gas and electric light fixtures are used, the gas

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pipes are insulated from the earth by a fibre bushing, which is usually located near to the meter.

Ques. (3) Should an indoor aerial of the kind described be grounded while not in use?

Ans. (3) Not a bad idea.

Ques. (4) Is the audion the most sensitive detector?

Ans. (4) Yes.

Ques. (5) What would you suggest as an inexpensive but efficient receiving circuit containing the necessary apparatus?

Ans. (5) Two slide-tuning coils, 1 fixed condenser, a silicon or galena detector, 1 pair of 1,000-ohm headphones.

* * *

L. E., Lanesboro, Minn., inquires:

Ques. (1) Do you think that I could receive the time signals from the Arlington station with the following apparatus: 3-wire T-type aerial 100 feet long, 65 feet high, wires spaced 3 feet apart, ground connected to water pipe. Receiving instruments are Clapp-Eastham loose coupler, Clapp-Eastham Duplex loading coil, audion detector with all regulating switches and rheostat, filament and high voltage batteries, and a pair of Brandes 2,000-ohm Superior receivers. Connections made like Fig. 1, on page 275 of the January WIRELESS AGE. The Arlington station is about 900 miles from me.

Ans. (1) We are not familiar with the constants of the Clapp-Eastham tuners and associated apparatus, but if it has a range of wave length up to 2,500 meters you should be able to hear Arlington's time signals at night.

Ques. (2) Where can I obtain the audion bulbs described in the January issue of THE WIRELESS AGE? Have the owners of the audion patents obtained an injunction against the manufacture or sale of audion detectors, unless those persons have a license from the owners of the patents?

Ans. (2) Communicate with the Radio Telegraph and Telephone Company, 309 Broadway, New York. They cannot be manufactured or sold except under license from that company.

Ques. (3) Does it make any difference in the reception or transmission of signals whether the aerial lead in is taken from the ends, center or between the center and one end of a horizontal aerial?

Ans. (3) No great difference.

* * *

H. W., Atlantic City, N. J., inquires:

Ques. (1) Where can the audions described in the audion article in the January issue be obtained at the price of $3.50 mentioned?

Ans. (1) Answered under another query in this issue.

Ques. (2) Were the $3.50 audions the ones actually used by the author of the article referred to in his circuit, Fig. 3, where he copied distances up to 2,800 miles.

Ans. (2) The bulbs that were formerly priced at $3.50 were used. With the triple amplifier using bulbs of this type, the author has since copied signals at a distance of 3,700 miles.

Ques. (3) What is the maximum number of amperes that should be shown by a hot wire meter placed in the aerial circuit of a 2 K. W. transmitting set working on from 400 to 500 meter wave length?

Ans. (3) Using a set operated on 60 cycles, 7 amperes may be expected in the antenna circuit.

Ques. (4) Is there any rule for calculating the number of amperes that should flow in an antenna by a given amount of power on a stated wave length?

Ans. (4) You will find the following formula of use:

$$I = \frac{4.45\ W}{V} \sqrt{\frac{P \times 7}{N\ \delta\ \lambda}}$$

Where
I = Current (RMS value) at base of aerial.
W = Watts in closed circuit.
V = Voltage at spark gap.
P = Percentage of energy transferred from condenser circuit to aerial.
δ = Total antenna decrement.
λ = Wave length aerial circuit.
N = Number of spark discharges per second.

Ques. (5) Why is it that, although a battery consisting of an aluminum and lead plate immersed in sulphuric acid will change an ordinary 110 V. A. C. to a direct or pulsating current, it does not rectify or transform high frequency A. C. wireless waves so that they can be detected by such a battery in connection with a pair of headphones, notwithstanding that just such a rectification forms the explanation of the perikon detector?

Ans. (5) To date no satisfactory explanation has been offered. It is interesting to note, however, that electrolytic or other rectifying detectors possess current-voltage characteristics at variance with Ohm's law, i. e., if the voltage through them is steadily increased, the amperes flowing in the circuit will not correspond with the value to be expected from Ohm's law. If a curve of the results is plotted, it will not be a straight line.

We have no data at hand as to the volt-amperage characteristic of the aluminum rectifier. When used in connection with alternating currents of low frequency (60 cycles), the current will pass from the lead through the liquid to the aluminum, but a current in the reverse direction forms a film of oxide of aluminum which effectually prevents the flow of current.

It is a noticeable fact that when either the electrolytic or crystal rectifiers are used to rectify high frequency electrical oscillations, such as flow in radio telegraph circuits, the action of these oscillations must be confined to small area of contact, particularly so in the case of the electrolytic, where one of the electrodes is not more than a 1/10,000 of an inch in diameter.

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