THE WIRELESS AGE

NOVEMBER, 1913

IN OUR OPINION

THESE have been memorable days in the world of wireless.

Grim tragedies of the sea have stood sharply silhouetted against the saving light of man's greatest triumph over nature, and the fragile antenna of the wireless has again set the consuming flame and raging gale at naught. Truly, we are to be thankful for living in an age that has seen the conquest of the vast and lonely ocean by the hand of man!

A Man's Priceless Gift to Humanity

With the appalling disaster of the Volturno fresh in our minds, the priceless value of Marconi's gift to humanity is once more apparent. Ten ships answered the call from the immigrant vessel that was being destroyed by fire in mid-ocean, and when dawn broke after a night of horror the ships lay close about waiting for the weather to moderate. Each of the ten made rescues. Four of the Volturno's own boats were crushed like egg shells, and their human cargo lost. And the 521 survivors would have doubtless perished as miserably as the 136 who were drowned had not the wireless appeal brought timely succor. No lifeboat could have long survived in that angry sea except for the bulwark formed by the high sides of the rescuing ships.

All the expert seamanship and all the resources of courage, skill and devotion brought to bear on the work of rescue would have failed—as the wisest plans of man have miscarried since time immemorial—had not the wireless triumphed. The story of the Uranium liner is terrible enough, but the realization that the dreary wastes of the seas have been transformed, that no longer when a liner meets disaster in mid-ocean does she remain a helpless hulk looking to nothing but the slim chance of another ship's stumbling upon her in time to aid—only because wireless is the connecting link to life can we feel the thrill of gratification that is echoed in a million hearts at this moment.

Greater than all the widely heralded feats of ship builders is wireless telegraphy, for it does not fail.

There will be more about the Volturno disaster in our next issue. Readers will want to learn the part played by wireless in this great tragedy of the sea, we believe, and we are going to give them the complete story just so soon as we can get the authentic details. Some day this publication should have a historical value, even if only as a record of the chronological progress in the radio art. So we are holding over this story until we can get the particulars accurately.

This is really a very important consideration. So much guesswork attends a disaster of this magnitude that it is very easy to make ridiculous statements. For instance, at the time when the unfaltering hand of Jack Binns brought succor to the sinking Republic, it was reported in the daily press of the country that he was forced to swim under water to the galley to obtain nourishment to sustain him at his post. That this was mere supposition is conclusively revealed in the heroic operator's private statement—that he was not and never has been able to swim a stroke. A trivial point, perhaps, but we don't want this sort of a thing to appear in THE WIRELESS AGE. We make our mistakes, and they probably occur as frequently as elsewhere, but where painstaking verification is made possible we will always adopt this course.

The Men that Go Down and a Word of Appreciation

THE story of Robert Emanuel's devotion to duty in time of danger is told interestingly in this issue. Here is a man who stood by his key in a fire threatened cabin and was the means of saving every single soul aboard his doomed vessel. Yet, outside of the residents of Baltimore who read it in the local papers, the story of his bravery is known to few.

And the simple and supreme courage of Donald Perkins which caused his death when his ship, the State of California, plunged to the bottom of Gambier bay, received little of the eulogy it merited. That this fine man's unselfish act has just been officially recognized by the Government is gratifying.

William C. Redfield, Secretary of Commerce, has written a letter to the only loving member of Perkins' family, a sister, who lives in Berkeley, California. It is our great privilege to print this letter in full:

"There is due to you an expression from this department of its appreciation of the noble self-sacrifice shown by your brother, Donald Campbell Perkins, First Radio Operator on the S. S. State of California, who calmly and with deliberate courage went down to death in pursuance of his duty when the vessel on which he served was wrecked.

"The evidence taken at the inquiry into the disaster shows that Mr. Perkins was off duty when the vessel struck, and presumably in a position where he might have saved his own life. He went instead back to his post, relieved his subordinate whom he sent to help clear away the boats, and taking his place, sounded the call for help continuously during the few minutes that elapsed before the vessel sank. He went down with her, the call of distress still sounding.

"The story is brief and simple, but through it shines the light of a strong unselfish character who preferred others to himself, and faced death fearless in the line of duty.

"From such lives come inspiration; from such deaths our sons learn the value of heroism. Your brother's life was all too brief, but in the heroic act which marked its close he spoke a lesson of fine devotion that I trust may long live for the inspiration of his fellows."

THE sea has always meant peril and mystery to mankind. Its trackless waters carried the commerce of the world, but for ages its darkness was dreaded. Then with its mastery challenged at the fluttering of the curtain which revealed a new application of the forces of nature, the greater fear took wings and the dread of the sea abated.

Will Wireless Solve the Problems of Air Navigation?

With ocean voyages made safer than land travel, wireless may now turn to the conquest of the air.

Some two hundred years ago a series of Eastern tales came out of Constantinople, among which there was one about a mountain of lodestone which destroyed ships through attracting and drawing out all the iron nails.

It was a fanciful tale, and diverting. No one then knew of the existence of magnetic waves which were to be used to transmit signals—for this was before the day of manufactured electricity and electro-magnets—but the yarn contained the germ of a truth which has only begun to be appreciated.

Now that the magnetic needle serves ships as a guide for direction, and the influence of magnetism enables shore stations to send out time signals by which chronometers are checked, and correct determination of longitude made, it certainly seems possible that magnetic lines of forces may be controlled so that air routes may be established in an even more definite manner than the lanes in which ocean-going vessels are operated.

We hear a lot about contemplated transatlantic flights by airship. Is wireless going to make this feat possible?

Aviators tell us that one of the greatest difficulties of long-distance aerial journeys is in maintaining a definite course in the midst of clouds and darkness. The vibration of the aeroplane makes it difficult to take observations even in clear weather. What is needed is some positive guidance, indicating the route which should be followed.

Since magnetic waves can be directed and a number of scientists have proposed definite trains of electrical waves, it is quite within possibility that further development along these lines would result in the discovery of a method of indicating air routes. Could a definite train of waves through space from one continent to the other be set up, the airman would be able to determine through a sensitive detector whether he was in the right road or lane. Then he could give his undivided attention to the operation of his machine and know immediately when he had deviated from the right route.

With the successful transmission of energy for that purpose, it is not improbable that a greater energy, sufficient, say, for use as a propelling power, might be employed. The methods would be widely apart from each other, but who can say that the introduction of directive air channels would not lead to supplying motive power through space? Then, the greatest practical problem of continuous flight, fuel supply, would be eliminated.

Some may term us visionary. Wait and see. The magazine is here, and the period it antedates—THE WIRELESS AGE—is close behind.

THE EDITOR.

Statement of the ownership, management, circulation, etc., of THE WIRELESS AGE, *published monthly at New York, N. Y., required by the Act of August* 24, 1912. *Editor, J. Andrew White,* 456 *Fourth avenue, New York; Business Manager, John Curtiss,* 456 *Fourth avenue, New York; Publisher, Marconi Publishing Corporation,* 456 *Fourth avenue, New York.*

Stockholders holding 1 *per cent. or more of total amount of stock, Marconi Wireless Telegraph Company,* 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 2nd 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.

California's Part in the Trans-Ocean Scheme

The Cottages for the Chief and Assistant Engineers at Marshalls are Nearing Completion

THE Marconi high-power stations in California, one of the links in the wireless chain that will girdle the globe, are rapidly nearing completion. This link will be made up of the transmitting plant at Bolinas Point, eighteeen miles northwest of San Francisco, and the receiving station, near the town of Marshalls, about eighteen miles further north on Tomales Bay. Despite the difficulties attending the transportation of building material, the progress on the California sites has been satisfactory. Most of the material for erection purposes—steelwork and machinery, as well as all mast sections and the wire rope—is being made in the East. It is sent from New York by boat to the Isthmus of Panama, across the isthmus by rail and thence by water again to San Francisco. To ship material by this roundabout route requires from four to five weeks. However, the work at the receiving station is further advanced than that on the New Jersey stations.

The site at Bolinas is not advantageously located for bringing in heavy loads of material. The roads leading to it—rough and ungraded—are at least four miles distant from the highway regularly used for traffic. There is no railroad available, and it is necessary to send the material by water from San Francisco, unload it at the wharf at Bolinas Bay, and haul it to the site. Bolinas Bay is obstructed by a sand bar with a shallow opening through which the tide races. This makes it impossible for a boat of any size to get to or from the wharf except at high tide, and the coast is so dangerous to shipping that owners of vessels are reluctant to have their craft navigated in and out of the bay. As a matter of fact only one small schooner, The Jennie Griffen, enters the bay, and she makes the trip only when there is enough material to warrant it. The construction work has strained to the utmost the schooner capacity of 100 tons and overloaded the wharf. A larger derrick has been installed to unload the heavier pieces and the area of the wharf has been extended to give greater space for materials. Spurred on by the fear of winter storms and consequent impassable roads, the men in charge of the work are making every effort to transport the machinery and heavy materials as quickly as possible. A large number of motor trucks are being used to facilitate the task.

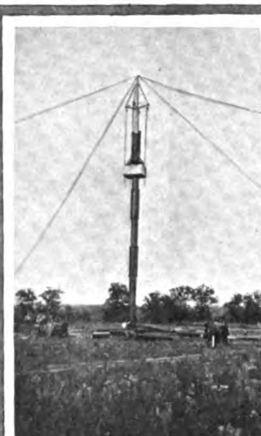
The buildings are located on a bluff about one hundred and sixty feet high and within five hundred feet from the shore. The bluff, rough and rugged, runs down sharply into the ocean with little or no beach. Although the land above the hill is somewhat furrowed from washouts, it commands a wide view of the ocean.

The stay anchorages have been put in place and the masts are being erected. The stay wire rope and insulators have for a considerable time been on the ground waiting for the steel sections. The power house foundations are complete and the piers and foundations for the motor generators, disc dischargers and other machinery are being poured. Rapid progress is being made in the construction of the hotel and the residences for the chief and assistant engineers. These buildings are constructed of steel and concrete, with tile roofs to make them fireproof. Much difficulty was experienced in obtaining a water supply because of the fact that the ground is full of cracks caused by earthquakes and that salt water seeps in from the ocean. It was finally decided to develop a supply by damming Gregorio Creek, and putting in a small pumping plant and a tank with a capacity of 10,000 gallons; the water will be carried through a two-inch pipe for a distance of about two miles to the buildings.

If one crosses in the ferry from San Francisco to Sausalito, boards a train on the North Western Pacific Railroad and travels about an hour and a half or two hours on that narrow gauge road to the little town of Marshalls, he arrives on the eastern shore of Tomales Bay, the site of the receiving station. The railroad runs up a valley, crossing stream time and again. Picturesque and densely wooded, the valley is a popular place for camping and fishing parties. Most of the big redwood timber has been cut down, but a large number of the smaller trees are still standing. At the head of the valley the railroad plunges into a tunnel and emerges into a second valley which is bounded by open, rolling country. On these hill sides the aerials will stretch back about a mile from the shore, and catch the radio messages crossing the Pacific from Honolulu.

For several months workmen have been busy in this section, with the result that a group of buildings dots the hillside. In fact the work has advanced so far that the minds of the engineers have turned

A Close View of the Hotel for Housing the Operating Staff at the High-Power Station at Marshalls, Cal.



At top: Some of the 10-foot steel sections used in mast construction. In oval: A view of the New Brunswick power house, identical with the one at Bolinas. Below: An illustration of the rapidity of mast erection, view taken after day-and-a-half's work.

to sports and grading for tennis courts and baseball grounds has been finished.

Tomales Bay, celebrated for its clams and oysters, is about twelve miles long and a mile wide. It is navigable for good sized boats and is extremely popular with fishermen. On the eastern shore, just south of the Marconi property, is located a fishing colony. Along both shores the hills rise abruptly and stretch away on the eastern side in a rolling tableland. The tongue of land between the bay and the ocean is about three miles wide. Covered with heavy woods, this promontory is a favorite summer resort for campers and hunters. It affords good duck shooting and deer are also to be found in the woods. The hills are not high enough to interfere with the proper working of the receiving aerials.

The distribution of construction material is being carried out from two points. For the buildings and the first two masts nearest these, a spur track from the railroad was put in on the southerly end of the property, where all the material for these parts is unloaded and hauled to the sites by motor trucks. The material for the remainder of the masts was unloaded at the railroad siding at Marshalls, hauled through the town and up a steep incline passing across the rear of the Marconi property.

The group of buildings, consisting of the large hotel, the residences of the two engineers and the lighting and heating plant, are about three hundred yards south of the line of the aerial; the operating building at the end of the aerial line is nearly a fifth of a mile from the other structures. These are arranged in a semicircle above the county road, looking out over the bay from an elevation of one hundred feet. The operating building is on the top of an abrupt hill on an elevation of about one hundred and thirty feet.

The construction of the buildings has advanced rapidly. The hotel, which is the largest of the structures, is one hundred and seventy feet long and the concrete work on it has been completed. The steel for the roof is in place and the conduit for electric lighting is being put in. As soon as the roof tile is laid, the interior finishing will be started. The residences of the chief and assistant engineers are also rapidly nearing completion. Satisfactory progress has been made on the mast erection. One mast has been completed and stayed, while all the others have at least four sections up. The top plate of the mast foundation can now be accurately leveled up and the last grouting concrete poured.

A 200 Meter Amateur Set

By E. E. BUTCHER

FROM the number of inquiries addressed to THE WIRELESS AGE, it is evident that amateur experimenters are meeting with many difficulties in constructing transmitting sets in accordance with the 200 meter adjustment required by law.

Careful examination and tabulation of the corresponding make it appears that a number of amateurs know nothing of the appearance, construction and usage of a wave meter. The formulæ for calculation of inductance and capacity of a radio-telegraphic circuit to determine the wave length are apparently not well known. The purpose of this article is to assist those having no knowledge of wave meters, by giving data for constructing a set with a definite wave length.

Producing a set of simple construction and having a range sufficient to enable them to establish communication with their friends and which will not involve them in an argument with the radio inspector, is somewhat of a problem. It is not so difficult to give the constants of a transmitting set that will meet with all wave length requirements if the apparatus is to be operated on a frequency of 1,000 cycles, for then the capacity in the closed oscillatory circuit of the transmitter will be less than when the usual frequencies are employed; because this increase of frequency allows more energy to be radiated on a short wave length (such as 200 meters), at the same time affording relatively increased range of communication.

But since a frequency of only 60 cycles is generally available, and as few amateurs are able to afford a rotary gap, it is presumed that they are most interested in the actual dimensions of a helix, spark gap and condenser suiting the 200 meter requirements, and, of course, the power necessary to operate a set of this character.

It must be understood, first of all, that the Government regulations will not allow an installation to be operated with the spark-gap connected directly in series with the antenna. An oscillation transformer must be used, and furthermore, neither of the emitted waves is to exceed 200 meters.

A number of tests have been made on a set constructed to meet these restrictions. A sketch of the actual length of connections to be employed is shown in Figure 1; the dimensions of the helix, spark-gap and condenser are also given.

Condensers.—The condenser consists of 25 glass plates 8" x 8", having an average thickness of 3/32". (In this particular case the glass used was supposed to be of ⅛" stock, but it had an average thickness of 3/32".) The plates are then covered with sheets of tin-foil 6" x 6". The foil is first glued to the glass (any good fish glue may be used), and when it is dry the entire plate is covered with a coating of high grade shellac. The assembly of the condenser is that employed in standard Marconi sets: alternate left and right plates, as shown in the lower portion of Figure 1. The condensers should be immersed in oil and before this done the plates may be held together by winding the entire unit with a few turns of insulating tape.

Spark Gap.—While the spark gap may be of any type ordinarily used with amateur sets, the actual dimensions of the gap employed in a particular instance are given. The discharge points should not be more than 3/16" in diameter.

Oscillation Transformer.—The form on which the oscillation transformer is wound is a paper mailing tube having an outside diameter of 5¼". These tubes may be obtained from any manufacturer of fireworks. The primary of the oscillation transformer consists of a single turn of No. 8 D.B.R.C. wire. The secondary has 35 turns of No. 10 D.B.R.C. wire. The insulation at the top 15 turns of the secondary should be cut open at intervals to permit a variable connection to be made with the antenna. The turns of the secondary are wound closely together, the insulation of D.B.R.C. wire being quite sufficient to hold the charge under ordinary conditions. As a special precaution the mailing tube may be parallel connections are not employed (the plates being all connected in parallel), the amateur should procure a grade of oil having very high insulation qualities. Swan & Finch's "Atlas Special AA," is the standard.

When a set had been constructed as

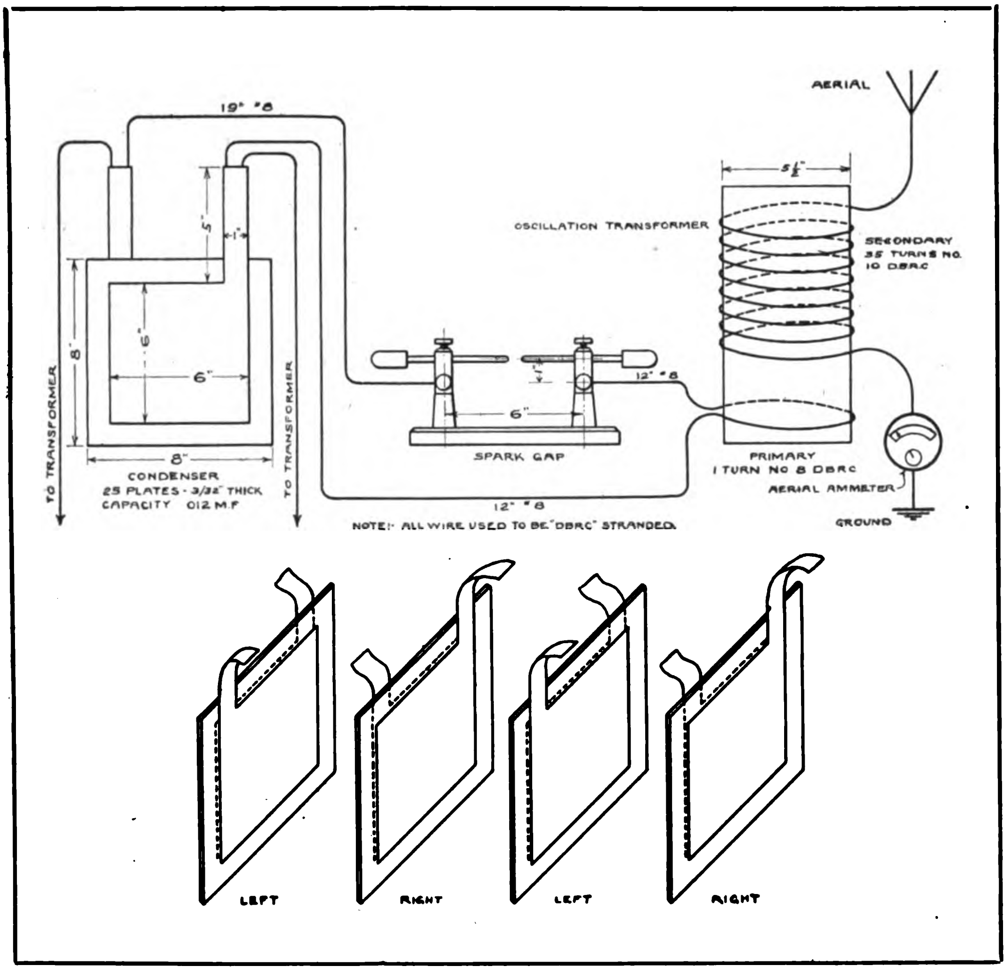


Fig. 1

immersed in hot paraffin and thus rendering it somewhat impervious to moisture.

Length of Leads.—The actual length of leads employed in the closed oscillatory circuit is given. These dimensions should be strictly duplicated when the set is constructed.

General Instructions.—The condenser is to be immersed in oil, and as series shown in Figure 1, the closed circuit (condenser, primary oscillation transformer and spark gap) gave wave length of exactly 200 meters. When the secondary of the oscillation transformer was connected to a flat top antenna having a vertical height of 42 feet and a horizontal length of 50 feet, it had a period of exactly 200 meters.

Now it is desired to radiate a single

wave length from the antenna, and of course the coupling must be loose. It is for this reason that but one turn is employed in the primary of the oscillation transformer. This turn may be placed close to the turns of the secondary of the oscillation transformer or, if a still tighter coupling is desired, may be wound closely around the turns of the secondary.

It is understood that the condenser is to be charged from a transformer. Let us see what voltage is necessary when the power consumption of the transformer at the secondary is to be ¼ K.W. Assume one spark per alternation, that is, two sparks per cycle (this is not always obtained in practice with a plain gap, but may be approximated); then the total power consumed will be;

$$W = N V^2 C$$

where N = cycle frequency
V = kilovolts
C = capacity in microfarads

The high voltage capacity of the condenser used with this set upon measurement was found to be .012 mfds.

We now desire to know the voltage required for a capacity of this order when the consumption of energy from the secondary of the transformer is to be ¼ K.W. (250 watts). We may then write equation (1) in the form,

$$V = \sqrt{\frac{W}{N \times C}}$$

substituting

$$V = \sqrt{\frac{250}{60 \times .012}} = \sqrt{347.222} =$$

18.6 kilovolts or 18,600 volts.

Therefore the required voltage will be 18,600. This value is not the root mean square (the value ordinarily specified when designating the voltages of closed core transformers), but it is the maximum value per cycle. (18,600 volts is the maximum allowable for glass of this thickness—⅛″—but if a good grade of glass is obtained and used in connection with oil having high insulating qualities, fear of puncture need not be entertained.)

The root mean square value of the voltage assuming sine curve, is .707 of the maximum value, therefore if a closed core transformer is to be ordered for this set. the amateur should specify the voltage as

$$.707 \times 18{,}600 = 13{,}150 \text{ volts.}$$

(The factor .707 does not hold good in every case and must be considerably changed, depending upon the power factor, but for convenience it may be assumed that the power factor is 100%). The amateur will find that if he should order a ¼ K.W. transformer giving an R.M.S. secondary voltage of 12,500, it will be quite sufficient. Allowing for losses between the primary and secondary of the transformer the watts input to the primary will be slightly greater than 250.

Owing to variations in the dielectric constant of various grades of glass and also because it is practically impossible to purchase glass of a constant thickness, the amateur may find after construction that the wave length of this set is slightly more or less than 200 meters, but he is assured when the Government Inspector arrives that the adjustments are only a very few meters out of the way—not more than 2 or 3 meters. Should this be the case it will only be necessary to lengthen or shorten the lead from the condenser to the spark gap (the 19″ lead) to give the required wave length.

It may be argued that a capacity of .012 mfds. will not allow sufficient inductance at a wave length of 200 meters to properly transfer energy to the secondary of the oscillation transformer. Let us see what value of inductance this capacity will allow.

$$\text{If} \quad \lambda = 59.6 \times \sqrt{LC} \qquad (1).$$

where λ = wave length in meters
L = inductance in centimeters
C = capacity in microfarads

then equation (1) may be written,

$$L = \left(\frac{\lambda}{59.6}\right)^2 \times \frac{1}{C}$$

substituting the known values,

$$L = \left(\frac{200}{59.6}\right)^2 \times \frac{1}{.012} =$$

937 centimeters approx.

Roughly figuring, we may subtract half

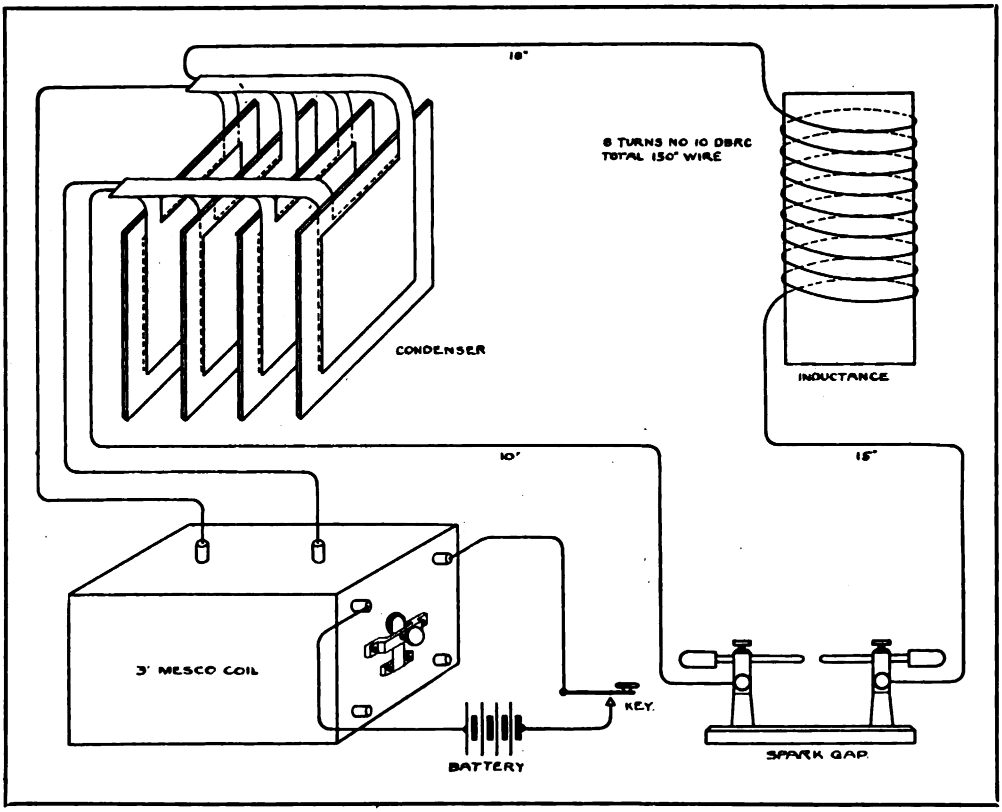


Fig. 2

of this to allow for the connecting leads, leaving about 468 centimeters of inductance for the transference of energy to the secondary of the oscillation transformer. While this value may seem small, yet for the loose degree of coupling desired it is quite sufficient to transfer all the energy that could be expected.

Tuning the Set.—For tuning, a small hot-wire ammeter (its scale reading need not be more than 4 meters) is connected directly in series with the secondary of the oscillation transformer as shown in the sketch. Since the closed circuit is already adjusted to a wave length of 200 meters the open circuit may be adjusted to the same wave length by a simple variation of the inductance in use in the secondary until the aerial ammeter shows the highest possible reading.

This may also be accomplished by inserting a small glow lamp in series with the antenna, the glow lamp being shunted by a loop of wire. This shunt must be adjusted to suit conditions and when maximum glow is obtained resonance between the primary and seconardy is assured. A four volt battery lamp with an adjustable shunt of No. 8 wire may be used.

Coil Sets

Other inquiries received request information as to the arrangement of the circuit when an oscillation transformer and condenser are to be employed in conjunction with a small induction coil. This is likewise a problem, for the voltages for which these coils are designed are of such high value that only a very small condenser capacity is allowable.

For the given wave length of 200 meters, with capacity of such minimum value the amount or inductance required is so large as to make the set practically inoperative; that is to say, inductance predominates in the circuit and its resistance is such as to materially reduce the volume of energy at the spark gap.

A number of tests were made on Mesco coils and it was found that the smallest coil which could be efficiently used in conjunction with a condenser and helix was of the 3" size.

The complete sketch of the connections and the actual linear dimensions are shown in Figure 2.

Condenser.—The condenser consists of 4 plates of the same dimensions shown in Figure 1; these of course are immersed in oil.

Oscillation Transformer.—The primary of the oscillation transformer consists of 8 turns of No. 8 D.B.R.C. wire wound on a paper mailing tube of the same size as given for the power set. The secondary may have the same number of turns as shown in Figure 1.

General Instructions.—The distance between the turns of the primary and secondary may be varied so as to give any degree of coupling desired and the amateur should thoroughly understand that if a single radiation from the antenna is desired the coupling must be very loose.

Antenna Current.—With the ¼ K.W. set just described, the current to be expected in the antenna will not exceed 2 amperes, and when using the coil set not more than 1 ampere.

OPERATING A TORPEDO FROM A LAND STATION

United States army and navy officers are deeply interested in a mechanism invented by John Hayes Hammond, Jr., for operating a torpedo by non-interfereable radio impulses from a land station. To bring about the realization of the system necessitated, it is said, the taking out of fifty patents and the expenditure of thousands of dollars and an immense amount of labor at the Hammond Radio Research Laboratory in Gloucester, Mass.

Considerable secrecy surrounds Mr. Hammond's mechanism, and he said in response to a request from THE WIRELESS AGE for information regarding his invention that "inasmuch as the U. S. army officials are co-operating with me to-day in my work you will, of course, understand that all the matters of my laboratory are confidential." He has, however, it was learned, brought his invention to such a degree of perfection, after many months of experimenting, that officers of the navy and army have agreed to witness his tests.

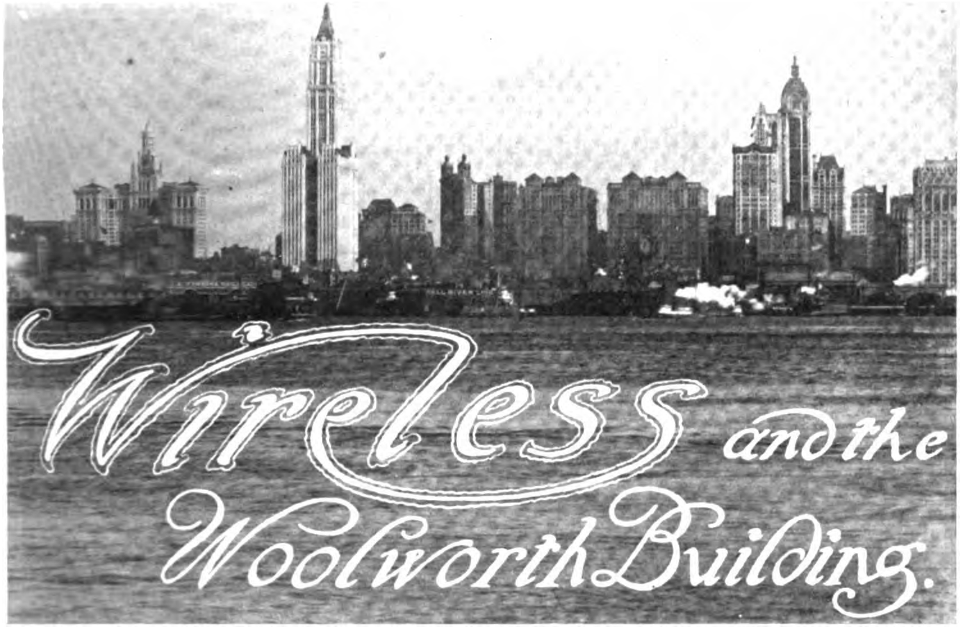
Hitherto it has been possible to operate a torpedo from shore at an eight-mile speed, but the control has always lacked the fundamental essential of immunity from interference by an enemy. That is, a hostile battleship against which a land-operated torpedo might be directed, could, with its own, wireless radio impulses, interfere and negative those of the land station.

Mr. Hammond's invention is credited with making such interference a boomerang for an enemy, for with his new device, in case interference is attempted, the radio forces impelling the projectile, instead of losing their efficiency, are strengthened, and the torpedo is drawn toward its mark at an increased rate of speed.

In the little bay near Gloucester harbor's mouth, beneath the bluffs, where tower the twin finger-like wireless masts, 360 feet high, which Mr. Hammond had built, lies a fifty-foot "house boat" recently remodeled for wireless control operations which the inventor, standing at a mysterious keyboard in his laboratory, can at will put through its paces out in the bay—two, three, four miles from there, running at a twelve-miles speed, turning, stopping, backin, starting forward again, without interference by any one on board if there happens to be any one.

The predecessor of this "house boat," the Radio, a speedier type, was operated by wireless waves at a thirty-three-knot rate. When the navy experts heard of this and satisfied themselves as to its truth, they requested Mr. Hammond to continue the experiments with a slower type, with the result that the Hammond "house boat" was refitted for the radio tests.

From the Steps of City Hall the Home of Wireless Loses Nothing by Contrast with the Handiwork of Nature



Photos. Underwood & Underwood.

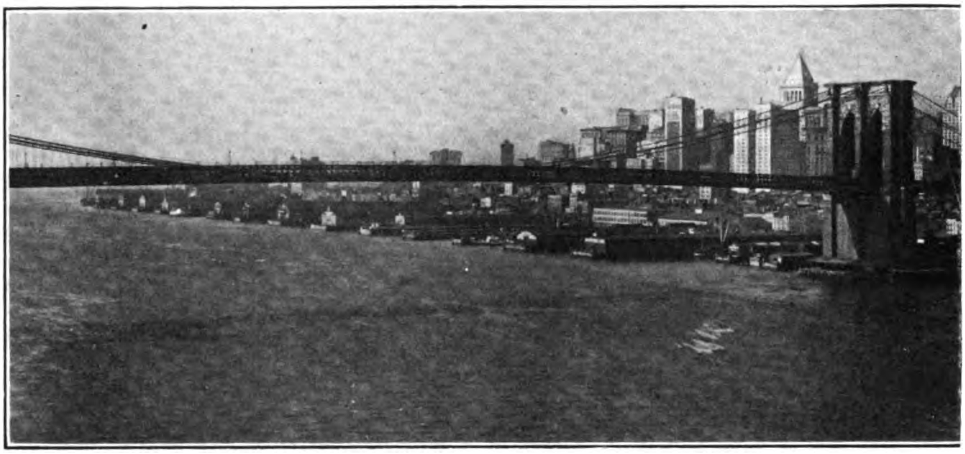
AS the Half-Moon rounded the Battery and swept toward the mouth of the river which Henry Hudson had crossed the ocean to name, he and his lieutenants discussed real estate and its possibilities.

"Right over there where you see that Indian brandishing his tomahawk," said the chief of the expedition, pointing to the future corner of Broadway and Barclay street, "there's going to be a big building. But there's got to be something big to go in it—something that will match."

Whatever discussion there may have been regarding the matter, the question was settled several hundred years afterward, or to be more exact, in May, 1913, when the Marconi Wireless Telegraph Company of America established headquarters on the eighteenth floor of the Woolworth Building. The establishment of the Marconi Company's offices in the building marked the physical union of two big institutions—one the highest business structure in the world, and the other the headquarters for an organization which transmits wireless messages to all parts of the world.

As history is being made to-day in the world of wireless by the Marconi organization, so was it made by the early settlers of Manhattan on the site of the building where the company has its home. Not by the wildest stretch of their imaginations, however, could the Dutch and English adventurers of the years gone by conceive that in the neighborhood of where they built their hastily-thrown together huts would be located the offices of an enterprise which sends messages through the air. In the early days of New York there was a recreation park on or immediately adjacent to where the Woolworth Building now stands. Nearby was the meeting place of citizens who gathered to express their indignation at the passage of the Stamp Act, and at another time an old-fashioned mansion, the haunt of cultured men of the times, covered a part of the territory occupied by the big building.

The building which the Marconi Company selected as its home has so many unique features that thousands of persons visit it daily. The mere statement that it is 780 feet in heighth and has fifty-five stories does not convey its full



From where the graceful span of the Brooklyn Bridge crosses the

significance till the visitor goes to the top of the tower and looks down upon a new world of wonders. In the streets below the pedestrians resemble dwarfs, while the big ocean liners in bay and river seem small and commonplace. Just how near the clouds one is able to get by ascending to the highest point of the structure can be better realized when the observer takes into account the fact that the Metropolitan Tower, which reaches so far skyward that it constantly attracts attention from crowds farther north, is but 700 feet in height and the Singer building a giant structure in the neighborhood of the Woolworth, measures 612 feet from the sidewalk to its roof.

The tower is the highest point of the Woolworth Building, but the main structure has twenty-nine stories and is 385 feet above the level of the street. Included in the main building are 30,200,000 cubic feet. There is no lack of rentable office space, twenty-seven acres being at the disposal of tenants. The elevators, twenty-eight in number, and the corridors take up about thirteen acres. After the builders had finished work on the structure they realized what an enormous task they had accomplished. It was estimated that there are more than 3,000 exterior windows in the building and that in furnishing the structure more than forty-three miles of plumbing pipes were used. Materials used in making the building what it is to-day included 53,000 pounds of bronze and iron hardware, 3,000 hollow steel doors, twelve miles of marble trim, twelve miles of slate base, 20,000 cubic yards of sand, 15,000 yards of broken stone, 7,500 tons of exterior architectural terra cotta, 28,000 tons of hollow tile, 28,000 tons of terra cotta partitions and 15,000 cubic yards of broken stone. One of the claims made for the building is that it is absolutely fire proof. The doors, partitions and trim are of steel, terra cotta and wire glass. No wood was used in the construction of the building. It is estimated that it houses between 7,000 and 10,000 tenants.

There are many things to interest the visitor to the building, and not least among them are the Marconi offices. Comment has been made on the fact that among the last objects passengers on outgoing steamships see are the offices of the Marconi Company and that the headquarters of the company first greets the view of long voyagers as they land from incoming vessels.

As the visitor steps into the main entrance to the Marconi offices he finds himself in a reception room. This room contains several mahogany tables on which can be found message blanks and memorandum pads. At a window opening off this room marconigrams are received for transmission to all parts of the world. On the right hand of the reception room is a telephone switchboard fitted with twenty-one lines for communication between the various departments and five trunk lines connecting with the outside.

river the Woolworth Building rises high above the city of skyscrapers

Opening off from the reception room is a large office in which may be seen a considerable number of men, all intent on the completion of some particular work. The first impression that a visitor receives when he enters this room is that he is in the midst of unusual activity. Yet the work is carried on so quietly and there is such an absence of confusion that he can hardly believe that here is the headquarters of an organization which is directing the vast business of transmitting wireless messages to various points on the globe.

On the right-hand side of the room are the men of the traffic department, where hands are on the pulse of everything that pertains to the telegraph staff both at sea and ashore. No detail is too small to escape them. It may interest you to know that if you ever feel disposed to "kick"

The Board Room where are held the meetings of the men who guide the destinies of the company.

A view of the main office, showing a portion of the traffic department.

about a marconigram, it is here your protest will be investigated and your complaint adjusted. Copies of all messages transmitted are kept on file and these enable the men to trace the reason for non-delivery, delay or overcharge, as the case may be. The charges for transmitting the message are always refunded when it is discovered that an error was made in sending or receiving it.

One of the important features of the work carried on by this department is the assignment and regulation of ship operators. Immediately after the ships on which they are employed reach port the men, in accordance with the rules of the company, make their reports. They are required to make a full statement of their traffic receipts and report any defects that they may have discovered in the wireless apparatus they have been operating. As a further safeguard, as each ship docks the apparatus is gone over by inspectors. When a defect is discovered the construction department details a man to overhaul the outfit.

The operator is also required to make a full report of any communications which he may have picked up while sitting at his apparatus throughout the entire voyage. This report is practically a diary of communication events not only aboard the ship on which the operator is detailed, but of all craft on the ocean during the voyage.

The rules of the company require each operator to report daily to the operating department while his ship is in port. This rule is enforced in order that he may be on hand if it becomes necessary to transfer him to another ship. On the day that his ship sails he must report for duty several hours before the time for the departure of the vessel. A list is made out of the supplies which he will need during the voyage, including message forms, abstract forms, official circulars, detectors, telephone headgear, and parts which it may be necessary to have for the apparatus. It is necessary for an inspector to indorse the request for a requisition before the more expen-

The office of the Vice-President and General Manager, overlooking the great shipping center of the port of New York.

The succession of piers stretching for miles along the Hudson and the buildings of the shipping district are in full view of the Marconi offices. At any hour of the day craft may be seen departing for all quarters of the globe.

sive apparatus can be obtained. To add to the efficiency of the service operators are compelled to report for duty on the vessels to which they have been assigned three hours before the time of sailing, and notify the department by telephone. With this department also lies the responsibility of ascertaining that all of the company's operators have government licenses in compliance with the law.

Opposite the men of the traffic department is the staff of the engineering department. Here are to be found some of the engineers and draughtsmen absorbed in the work of designing and constructing Marconi apparatus used both for government and commercial work. Much responsibility rests upon the shoulders of the men in this department at present, because of the detail involved in constructing the higher power stations which are to connect up two continents by wireless. Reports from engineers in charge of outside work are received each week. These tell of the progress which has been made in the various tasks to which the men have been detailed.

The auditing department is also contained in the spacious room that houses the traffic and engineering departments. To keep account of the large amount of receipts and expenditures in the maintenance of an institution like the Marconi Company involves much clerical work. The auditing department, however, has succeeded in establishing a system of accounting that effectively meets all the requirements of the company.

Windows on either side of the main office and the inner sanctums of the department heads afford an excellent view of the Hudson river, New Jersey shore and New York Bay. From these windows can be seen craft sailing to all quarters of the globe. Furnishings that are handsome and in good taste mark the appearance of the room.

At the extreme end of the room is the entrance to the office of the vice-president and general manager. The windows of this office overlook the great shipping center of the port of New York.

Opposite the office of the general manager is the director's room, where are held the meetings of the men who guide the destinies of the Marconi Company.

The heads of the contract, traffic and engineering departments are in offices which are reached just before the visitor arrives at the main entrance to the Marconi suite. These offices are connected with one another and with the main room.

Throughout all the offices may be seen pictures of the big ocean greyhounds, and here and there a portrait of the company's inspiring genius, Mr. Marconi.

At no time since its organization has the American Marconi Company been so prosperous as at the present day. The exceptional progress the company was making was reported interestingly by Mr. Bottomley at a recent meeting of the board. He mentioned that the majority of vessels were now fitted with rotary gap sets and that these and the auxiliary sets were giving extremely good service. That the Marconi system dominates throughout the merchant marine was shown in the fact that Lloyd's Register, 1913-14, gives 1,882 merchant vessels equipped with wireless, about three-quarters of that number, or 1,393, being Marconi installations.

Announcement was made of a new contract with the coastwise steamships of the Agwi Lines, under which 76 additional vessels will be wireless equipped and operated by the company. The estimated traffic receipts for the six months ending June 30 show a substantial increase over the preceding year.

Mr. Bottomley reported that "arrangements have been completed for the erection of a station at Miami, Fla. We have arranged that we shall have such accommodations as we may require, including a place to house our apparatus, also space to erect towers and a house for our operators at a nominal figure. The lease is now under consideration by the authorities at Miami, and we expect to have this signed within the next few days."

The importance of this station lies in the fact that it will break up the long stretch from Jacksonville to Key West, and will greatly facilitate the handling of messages. "In addition," observed Mr. Bottomley, "we shall be able to control a large portion of the business which has heretofore gone through the government station at Key West."

To supplement the ship to shore business it is expected that connection will be made between Nassau and Miami; negotiations are now in progress with the Nassau authorities.

The Engineering Dapartment has been busily engaged in supplying apparatus to the Navy, it was said, and the majority of business which has been offered by the government has been secured by the Marconi Company, even though in many cases its bid was not the lowest. During the last four months contracts for 13 sets of apparatus have been made and an expected award for several additional sets has just been received. A sample set for submarines has been made up and met with the approval of the Navy Department. There is an excellent chance that the company will secure an order for 35 of these sets. Two sets supplied to the Revenue Cutter Service have proved very satisfactory.

The Navy Department has also purchased two Marconi-Bellini-Tosi Direction Finder equipments and tests are soon to be made under the supervision of the company's inspector. Mr. Bottomley said that he looked upon this apparatus as one of the most important factors in wireless telegraphy and he anticipated a considerable demand for this apparatus.

It was announced that the traffic arrangements have been completed for the contract with the Norwegian Government and the message rates agreed upon were satisfactory to the traffic department and the Western Union. A location for the American station has been selected and the site will be acquired within a few days.

Further developments on the Pacific Coast were announced, notable among which is the erection of two stations in Alaska. A site has already been secured near Ketchikan and a 25-kilowatt set is being built for this station, which will probably be completed some time in the early spring.

An engineer's report on the work being done at the high power stations was read and satisfaction was expressed with the excellent progress made. Referring to the globe girdling chain of Marconi stations, Mr. Bottomley reported that "arrangements have been made whereby the stations in the Hawaiian Islands are to communicate with Japan; the erection of the station in Japan is to be proceeded with immediately."

PICTURES BY WIRELESS

Francisco de Bernocchi, a young Italian investigator, who has been working for five years in the endeavor, has at last succeeded in sending pictures by the Marconi wireless system. The inventor is but twenty-five years of age, and after getting his system in working order he subjected it to severe tests which were devised by a committee of scientific persons. Reports of the tests say that drawings, pictures and autographs were transmitted with fidelity.

It has been announced that $5,000 has been given to Columbia University by an anonymous donor for equipment for research in wireless telegraphy.

THE SHARE MARKET

NEW YORK, October 20.

Had it not been for a slight flurry near the close of to-day's session industrials in the outside security market would have shown even greater losses than at the end of the preceding week. As it was the activity came in time to permit the closing figures to reach the average level maintained during the early part of the month.

For no apparent reason the market has settled into a state of apathy. Only six industrial issues were traded on the curb to-day, in contrast to the active trading that marked the close of last month. Brokers are of the opinion that Marconi's are more than holding their own considering the state of the market, even if fractional declines are shown.

Bid and asked prices to-day:

American, 4⅜-4¾; Canadian, 2¼-2⅝; English, common, 18-19; English, preferred, 15-16.

HOW TO AVOID DOUBLE MESSAGE TOLLS

A complaint was lodged with the Marconi Wireless Telegraph Company recently by one of its customers that two fees were being collected on wireless dispatches addressed to passengers on ships approaching or leaving European ports. This case in point was cited as having occurred on the Imperator:

A passenger on that steamship received a message which had been sent from New York to Crookhaven by cable and thence by wireless to the Imperator. Notwithstanding that this dispatch was marked prepaid in New York, the addressee was called upon by the Imperator's wireless operator to pay an additional fee when delivery was made.

The Marconi Company explains how this can be avoided. All marconigrams addressed to steamers which must be reached through foreign cable points should be filed with the Marconi Wireless Telegraph Company proper. A code word is prefixed to the dispatch, and then it is returned to the telegraph companies for transmission to the station nearest the zone in which the steamer is sailing. Otherwise the addressee must pay the wireless tolls beyond the foreign cable point.

The charges assessed are based on a chart issued monthly by the Marconi Company. This chart shows the zones in which steamers equipped with wireless can be reached during voyage. The through rate would be the land line tolls, the cable tolls and then the wireless tolls to the steamer. For example, a prepaid message filed in Chicago for a steamer nearing Europe would be sent in care of the Marconi Company in New York. No additional charge is made for routing the dispatch this way. When the telegraph company handling the dispatch delivers it to the traffic department of the Marconi Company that company prefixes a code word to it and returns the dispatch to the telegraph company for transmission by cable to the station nearest the steamer. Unless this method is adopted, the addressee is required to pay the charges beyond the cable point.

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

IN the smoking room of the Ostentacia, three days westward bound across the Atlantic ferry, a tall gentleman with a notable forehead, side whiskers and an air of absorption was playing chess. One hundred and fifty nautical miles from the Ostentacia, steaming in the same direction and just about holding her own, was the Sparta. And in the smoking room of that vessel, a fat, baldheaded gentleman, his brow corrugated with lines of thought, studied another chess board and sent and received moves by way of the wireless house.

"Isn't this John Maglory, of Ragged Edge, Arizona?"

A thin, nervous man who disseminated an air of prosperity, had put the question. He addressed himself to one of the group that was watching the Ostentacia end of the long-distance chess game.

"Right you are, mister. Maglory's my handle, whereby to be known," was the answer. "Howdy do—say, wouldn't you call that plumb foolish now?" and Maglory, of Ragged Edge, nodded toward the thoughtful gentleman with the side whiskers. "He's been two days at that one game, off and on, and sometimes it's as much as two hours before he grabs a move out of the air and slips it across that dinky little board!"

A genial smile lit up the stranger's face and the searching eyes glimmered pleasantly.

"Now that the Hertzian waves have been broken to harness, Mr. Maglory," he remarked, "they're being used in all sorts of ways. My card."

"Tommy-rot!" snorted Maglory, looking at the square of pasteboard but addressing himself to the Hertzian waves. "There's a heap of flubdub about this wireless business. I'm not from Missouri, but you can gamble your spurs little old Ragged Edge is a 'show-me' town. Boys' play—that's all this telegraphing without wires amounts to. That loose-jointed cimiroon over yon," and he nodded toward the gentleman who hung so fervidly over the chess-board, "pans out about the only real color in the wireless game. It's a pastime for some people same's a tin whistle or a pewter soldier or a Noah's ark is to a kid. H'm!" as Maglory glanced at the card. "'William Sidney,' eh? Any relation to old Chet Sidney, the three-card jigger who used to skin the natives of San Simone?"

William Sidney had carefully studied Maglory at first, and then with a patient smile had borne with sentiments conceived in ignorance or prejudice; but there was a perceptible change in his manner when his connection with a sharper at monte was vaguely suggested.

"New York is my town, Mr. Maglory," he snapped, "and I've never been west of Chicago. And, so far as I know, I am the last of my own particular line of Sidneys. This person who skinned the San Simoners was nothing to me."

"Then rise up and sing praises!" said the Arizonian. "A man can't always help the crooked off-shoots of his family tree, and if yours has been pruned I allow you're playing in a heap of luck. Me, now, I've got a sister's son that's caused a pile of trouble. We ought to hitch, but his ways are such that we can't and don't. Jefferson P. Rance is the name." Maglory frowned heavily. "Sidney, if you ever run across that name or the upstart that bears it, just remember I can't help it because it represents a kin of the Maglorys'. I——"

The Arizonian broke off suddenly. The frown on his rugged face faded into a smile at once childlike and happy. A girl, lithe and graceful, was floating towards Maglory and Sidney through the smoke-laden room.

Sidney's stare was one of surprise and admiration. Her face was, indeed, calculated to arouse admiration, for her rounded cheek was purest olive in tint, and her hair, straying from under the silken shawl she had thrown over her head, was black and lustrous. Her eyes were Spanish—wide and dark.

She came straight to John Maglory, her every move marked with an airy freedom and independence which balked at convention, as a mustang balks at a wire fence.

"Uncle John," said the girl, "you go right now to your room and go to bed. I'll not come after you again."

"Shucks!" grinned Maglory. "Bonnie, don't you fret about me. I just want another hour."

"Eleven o'clock then, for this once!" A slim, white finger was lifted admonishingly and the dark eyes swerved covertly and with disapproval upon William Sidney. "If you're not in your stateroom by eleven I'll have something to say to you in the morning, that's all."

With a final look at Maglory the girl turned and vanished as quickly as she had appeared. The old man chuckled fondly.

"That's her," he remarked, "that's Bonanza. Arizona born and bred, Sidney, which shows what Arizona can do when she throws herself. Lord! But I don't reckon there are any more in the world like *her!*"

"Niece?" came tentatively from Sidney.

"Nope," was the response in a tone heavy with disappointment. "She calls me uncle just by way of being affectionate-like. We ain't any more kin', though, than what you and I are; but I couldn't think any more of Bonanza if she was my own girl."

"Queer name for a girl!"

"Don't you find any fault with that name!" bristled Maglory. "I gave it to her myself when she was too small to have a say in the matter, and more and more as she grows up I see how it fits. Know what a bonanza is?"

"It's a term applied to a gold mine that really produces gold, isn't it?"

"It's a name applied to a mine that produces so much gold it's a Class A, blue-ribbon winner! And that's what little Bonanza is. The way she holds the bit on Uncle John is right divertin', and the way Uncle John looks after her"—the square jaw snapped and the gray eyes gleamed—"is going to make her future plumb safe and happy.

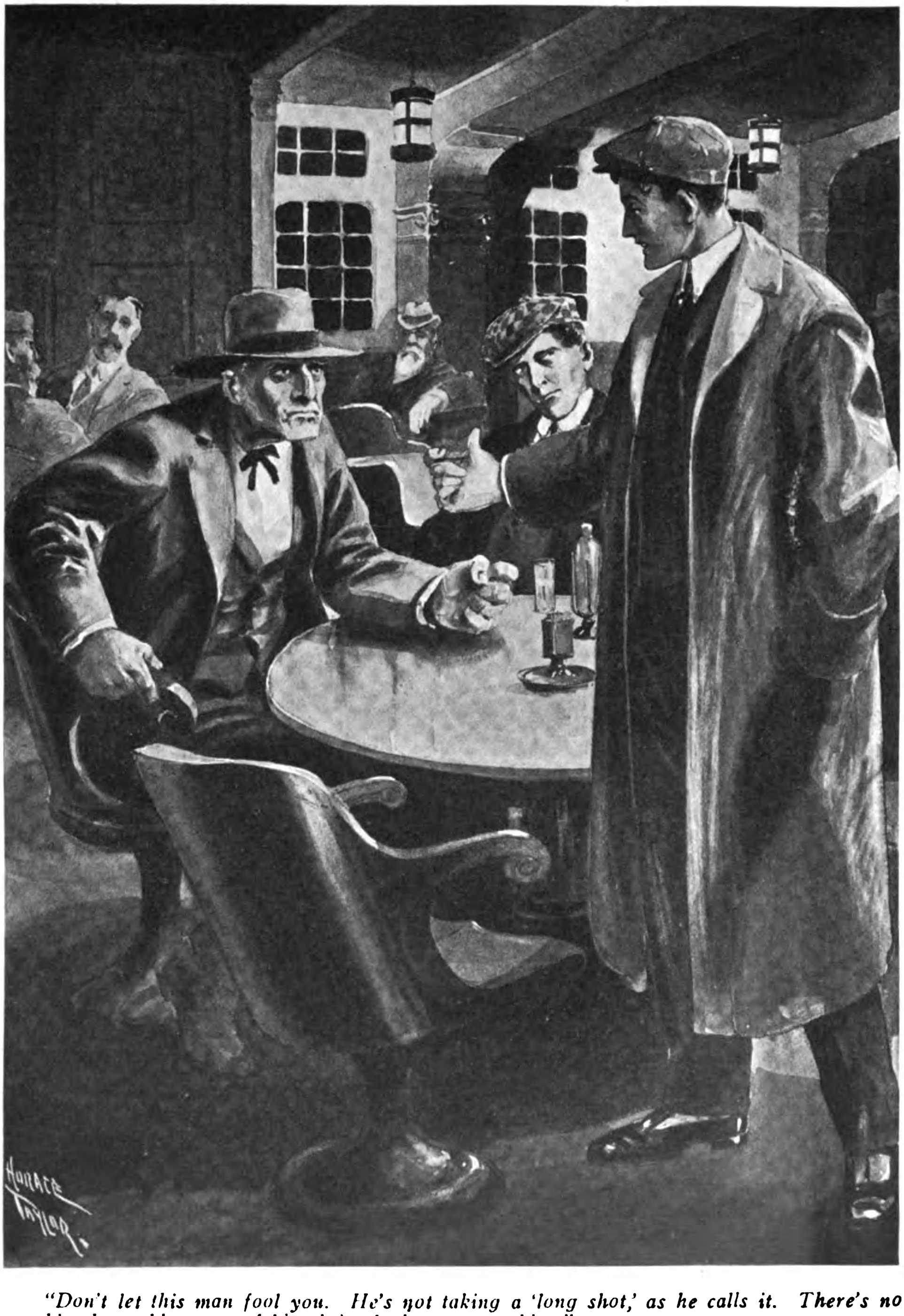
"Bonanza was two years old when she moved into Ragged Edge. Her father and mother brought her to the camp, but neither of 'em lasted long. Lungers, they were, and so poor their next meal was more or less of a gamble. I took to little Bonanza right from the start, and helped out her folks just because they were her folks, and when they hit the Long Trail I made it my business to look out for the kid.

"Hired a woman to come out from 'Frisco to start her off right, and she was brought up the best I knew how. Sent her to school, when she was old enough to go, and she was finished off in one of these high-up seminaries in Denver. I called her Bonanza because she was just about the biggest 'strike' I ever made in the Southwest.

"Father's name was Denbigh. He tuckered out in the hills, prospecting for a mine. Poor old fellow, he had hoped the climate would do big things for him and his wife, but they fell back on the climate too late. 'Most always it's that way. We hunted for Denbigh, and when we found him he was lying face down in as fine a blow-out of white quartz as you ever saw. That was all he left the girl—that claim and a tendency to the same ailment that carried him off. But the climate has taken the taint out of Bonanza's blood and she's as healthy and happy as an Injun squaw. As for that mine, I've been developing it for her, and I've got my hopes it will make her rich in her own right. I call the mine the Bonanza, but we're down a hundred feet without much of a showing—yet. Any day, though, good rock may be uncovered. I'm expecting it."

A glint had flared and faded in the eyes of Sidney. The talkative Maglory had not observed it.

"My friend," said Sidney, "my hobby in life is the long shot. I love to take a chance. Money is scarcely an object with me, and the story has its appeal.



"Don't let this man fool you. He's not taking a 'long shot,' as he calls it. There's no gamble about this move of his—he's playing a sure thing."

I am interested in Bonanza and her mine. Will you give me an option on the property for thirty days at fifty thousand dollars?"

The Arizonian stirred in his chair. Turning, he favored Willian Sidney with the whole of his attention.

"You've been in London?" he asked drily.

"Yes," the other nodded.

"Then you *sabe* I was trying to sell the mine to an English syndicate with big mineral holdings in Poco Tiempo Valley. Maybe you know that was the figure I asked them any they wouldn't have it?"

"I know that, too. And I know, furthermore, that your nephew, Jefferson P. Rance, blocked your plans. Mr. Maglory, pardon me for adverting to it, but I hear you have had reverses. You, from present indications, will have little to leave your ward, Bonanza. You are trying to make her future safe by letting some one else take the chance on that mine. Risks are my long suit. I will give you five thousand dollars for a thirty-day option on the mine at the figure named. And we can complete the deal right here."

The Arizonian seemed stunned. He aroused, however, to remark:

"Let's see your five thousand, Sidney. Only the cold cash talks between strangers, mind."

Sidney smiled and thrust a hand into his breast pocket. Before the hand could be withdrawn, a man started out of a corner of the smoking room, came forward and planted himself in front of Maglory.

"Tell him mañana, Uncle John!" he exclaimed. "He's stacking the cards on you."

CHAPTER II

John Maglory was sixty-two. He was big and square-built, and the gray in his hair matched the gray in his eyes. And there was steel in his make-up, finely tempered. Yet withal his good qualities he was strangely out of tune with the onward march of the world.

He had been among the first to pitch camp on the brink of Lost Horse Cañon, and to sluice for nuggets in the gravel banks below. His tent had given way to four adobe walls, and he had christened the settlement that grew up around him. "Ragged Edge" he had called it, which was decidedly appropriate, for it was ragged indeed, and on the edge of nowhere.

With the working out of the placerings, Ragged Edge gasped and all but expired. Then it secured a fresh lease of life with the discovery of rich lodes in the vicinity, and a modest if no more enduring prosperity came to the brink of Lost Horse Cañon.

Counting the Mexicans, there were fifty inhabitants in the town. Maglory felt crowded and moved over to San Simone. But San Simone grew, and when telephones and electric lights came into the place Maglory moved out—back to Ragged Edge again.

His primitive soul cried out against the refinements of civilization. He wanted the things he was used to, and he was headstrong and had a will of his own. The first automobile that popped and sputtered along the Lost Horse sickened his heart and sent him into the trackless hills for a week.

Now Ragged Edge was dying again, and this time for good. The fortunes of John Maglory were dying with the town. He had planned on leaving Bonanza all he had, but he could see plainly that in five years, if he lived that long, he would have nothing to leave the girl.

Blindly he had taken his ward and gone East, and even more blindly he had crossed the water to sell Bonanza's claim. He had failed. And only now, while returning to his own country, had rare good fortune thrown William Sidney across his path.

In the eleventh hour luck had blundered. Who was this that dared interfere with a business transaction which was to mean so much to Little Bonanza?

Maglory stared at the young man who had suddenly appeared before him. For a moment he seemed stupefied; then his gray eyes snapped and his red face whitened and hardened. Slowly he got to his feet. Unmindful of the place—all unsuited to the airing of domestic troubles—he shook his fist in the face of the man who confronted him.

"Jeff Rance," said he, "your being here is a surprise, but it's an eye-opener. You've been skulking around and camping on my trail. You've queered my work and double-crossed me, trying your best to beat Bonanza out of her rights. That's mean and low, and shames your Maglory blood. I told you a year ago I didn't want you around. Now you clear out and mind your own affairs or I'll forget you're my sister's son!"

Rance may have been twenty-five. He looked very little like a black sheep. In fact, if Maglory could have been set back forty years he would have borne a striking resemblance to his nephew.

In Rance were the same steady gray eyes, the same strong chin, the same finely molded lines of purpose and determination. He met the glance of the older man with firmness.

"You'd sell Bonanza's birth-right for a song," said he. "John Maglory, you're getting old and losing your grip. You're scared of shadows. You are a big-hearted, lovable old fool. Turn me down if you feel like it, kick me out, wash your hands of me, but while I live and breathe I'll stand between you and that claim of Bonanza's. You're not going to sell it!"

"Right to my face!" breathed Maglory, huskily. "You say all that right to my face! Rance, in about a minute I'll grab holt on you—I will, by cracky! You snake-in-the-grass . . . sidewinder . . . you would strike the hand that fed you. I——"

"Chop it. You talk too much," went on Rance, relentlessly. "You've been sitting here for half an hour, gabbling like an idiot to a perfect stranger—a man who's putting something over on you and——"

"Sir!" interrupted William Sidney, showing signs of temper.

"Don't try to play lame-duck with me," Rance flung in the stranger's teeth. "You received a wireless message this afternoon and that's why you're here. But I got one, too, and that's why *I'm* here. Uncle John," and Rance turned in desperate appeal to Maglory, "don't let this man fool you. He's not taking a 'long shot,' as he calls it. He knows what he's doing. There's no gamble about this move of his—he's playing a sure thing. Read that!"

Rance thrust a scrap of paper into Maglory's hands. The old man dropped his eyes mechanically and read:

> UNCOVERED FOOT VEIN HUNDRED DOLLAR ROCK. BIGGEST STRIKE THIS DISTRICT EVER HAD. BONANZA MINE REAL BONANZA. HEAD OFF YOUR UNCLE.

This was signed by Lafe Kennedy, foreman in charge of the work for Maglory. The old man stared.

"Where'd this come from?" he asked.

"From San Simone by telegraph and from South Wellfleet by wireless," answered Rance eagerly.

"Wireless!" Blistering contempt came from Maglory with the word. "I wouldn't believe wireless under oath. It's a chess and checker game, young man, and you can't phase me. Clear out of here, or I'll have one of the stewards throw you out." He turned to Sidney. "Where's that five thousand?" he demanded. "We'll do business."

An exclamation broke sharply from Rance and he advanced a step and dropped a hand on his uncle's arm. Maglory roughly threw off the hand. Rance, thoroughly enraged, started for William Sidney. A short scuffle ensued and, in answer to Sidney's frightened appeal for help, two stewards grabbed the young man and hustled him out of the cabin.

The long gentleman with the side-whiskers seemed greatly annoyed. Others in the room laughed, or looked scandalized, and presently returned to their talk or their card-playing.

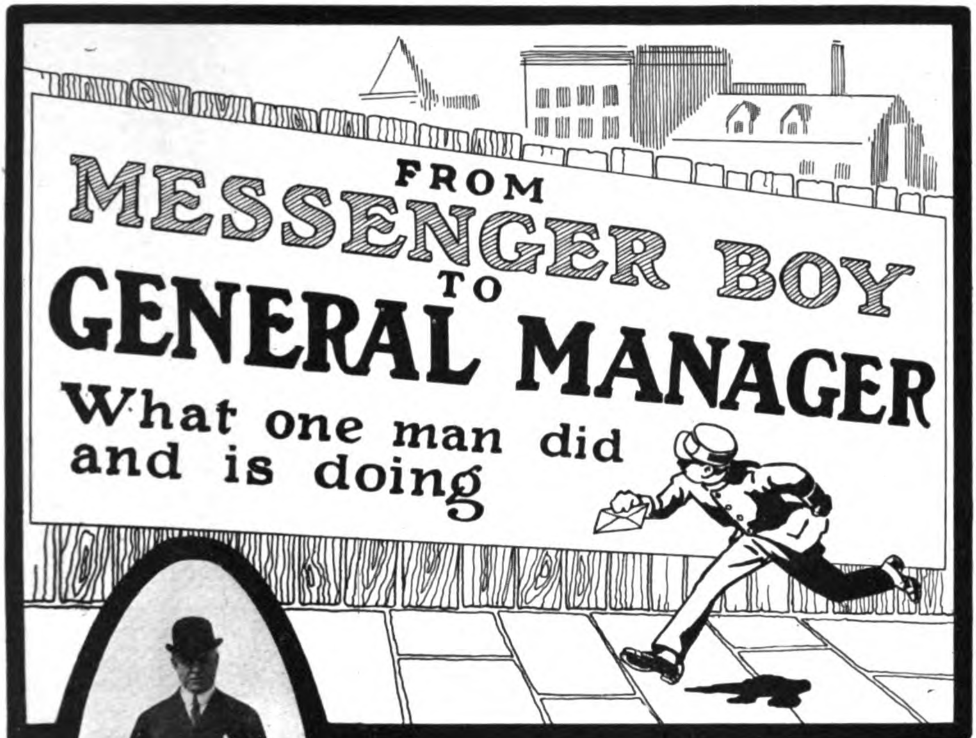
A reading room steward entered with a marconigram for the gentleman at the chess-board. The latter read it, moved a piece in front of him and smiled.

"Here's where I give checkmate," said he, and sent a message of his own to the wireless house.

(*To be continued*)

FROM MESSENGER BOY TO GENERAL MANAGER

What one man did and is doing



A Few Sidelights on the Business History and Character of Edward J. Nally, Recently Appointed Vice-President and General Manager of the Marconi Company

EDWARD J. NALLY has been appointed general manager of the Marconi Wireless Telegraph Company of America; which is an occurrence of quite enough importance to have a chapter to itself in commercial history, the only kind of history that counts in these days of Peace Palaces and grape juice diplomacy. Besides, the Nallys have been making commercial history for a considerable period.

Some seventy-six years ago America, or more accurately that portion of it directly adjacent to a certain steamship pier, suspended work for a minute or two to nod and smile a welcome to a stranger. Quite an unusual procedure, some will say, in a country always too busy to get acquainted with next-door neighbors. But in this case the aforesaid smilers and nodders had little choice in the matter. Ordinarily the arrival of a mere slip of a colleen, clinging closely to the arm of a stalwart Irish lad scarcely out of his teens, would have passed unnoticed. The passengers lined up along the rail of that particular steamer, however, took good care that this didn't happen. Hats were tossed into the air, handkerchiefs waved and cheer after cheer arose to announce the arrival on these shores of "Handsome Patrick" Nally and his bride. Whereupon staid and sober citizens smiled their sympathy and understanding and immediately forgot all about it.

But not for long. Patrick Nally, fresh from Ireland and twenty-one, made them sit up and take notice. Philadelphians soon learned that one in their midst knew a thing or two about advanced commercial methods, and not so many years later St. Louis awoke to the fact that the city was a whole lot better off when Patrick Nally came, saw—and decided to settle there permanently. Nally prospered in the new country and became a considerable factor in the business world. He did many things of vital import in his day and generation; but what interests us most, he had the foresight to provide for the acceleration of the country's—and incidentally the world's—business after his time. For on April, 1859 he announced to his friends the entrance into the world of Edward J. Nally—destined to become the maker of men and builder of colossal business enterprises.

So, interesting and vital as were the early activities of the elder Nally, they must be left to some other biographer. For even in these days of big men and bigger deeds the announcement that Edward Julian Nally has come out of his brief retirement to prove what he can do in the way of making wireless telegraphy the most important and powerful adjunct to the transaction of the business of both hemispheres, overshadows a whole lot of things that might otherwise be occupying these pages. Practically every one in the world of wireless will want to know something about the man whom they have made general manager of the American Marconi Company, and incidentally vice-president, director and member of the Executive Board.

First of all, he is the man who put the Postal Telegraph Company on the map; that fact alone makes it a pretty safe prediction that the Marconi Company in America is going to make things hum.

What Mr. Nally doesn't know about the telegraph business hasn't yet been discovered. He has been connected with the wire telegraph service for thirty-eight years, starting as a messenger boy and working up to the vice-presidency and general managership of his company.

From messenger boy to general manager!

What a wonderful story lies behind that phrase! Thousands of young men and boys throughout the country have heard it, and thousands of backs have straightened as the sparkle of awakened ambition has come to the eyes of the respective owners. If for no other reason than this, the story of his struggles against disheartening odds and his rise to the very top notch of his chosen vocation is worth re-telling.

It has already been related that Mr. Nally's father had become a successful and influential citizen when the subject of our sketch was born. Yet through the vagaries of Fate, the qualities that had won him his place in the new world, the intangible somethings that prompted ship acquaintances of but a few days' standing to cheer him to the echo as he landed, were to be his son's only heritage. For shortly after the young man's arrival the elder Nally's health failed and a long succession of business reverses set in. Within a few years the fine structure of achievement so patiently builded was tottering on its foundations, and by the time the son he had hoped and planned so much for was able to run about, the absorbing problem of each day was to earn enough to feed the little family and to keep a roof over their heads.

Nothing but the bare necessities of life entered into young Nally's first impressions of the world; none of the advantages given to other boys came his way. Somehow his parents managed to give the boy one year's schooling. That was the only time he ever attended school for a full term. There were intermittent periods of attendance later, a total reaching perhaps two years.

At an almost incredible age the youngster's character manifested itself. Instinctively he realized that things weren't quite as they should be at home and he racked his little brain to find ways of getting a few pennies; for these very desirable and shiny objects seemed to have something to do with the situation. One of the means employed to this end by the resourceful little chap was to linger about the coal yards after school hours and wait for a wagon to start out with a load to deliver. He would trudge along after it, sometimes along miles of dusty roads, until it drew up before the house of the customer. Then he would make his presence known and volunteer his assistance in carrying in the load of coal. The few pennies given for his services were invariably turned over intact to the common household fund.

When he was eight years old his father's eyesight failed and young Nally went to work in a department store. He was employed as a cash boy at a salary of $13 a month. From this time until many years later his entire earnings, with the exception of his daily carfare, were cheerfully given toward maintaining the little home and family. When he reached his sixteenth year he became a Western Union messenger boy in St. Louis, and remained in the telegraph service continually from that time up until a few months ago.

Colonel Robert C. Clowry was then assistant superintendent of the Western Union in St. Louis. One day, shortly after Nally had donned his uniform, he drove up to the offices and seeing the boy just about to enter, called to him:

Both during and after business hours Mr. Nally is decidedly human, always approachable, affable and courteous.

"Here, young man, hold this horse for me!"

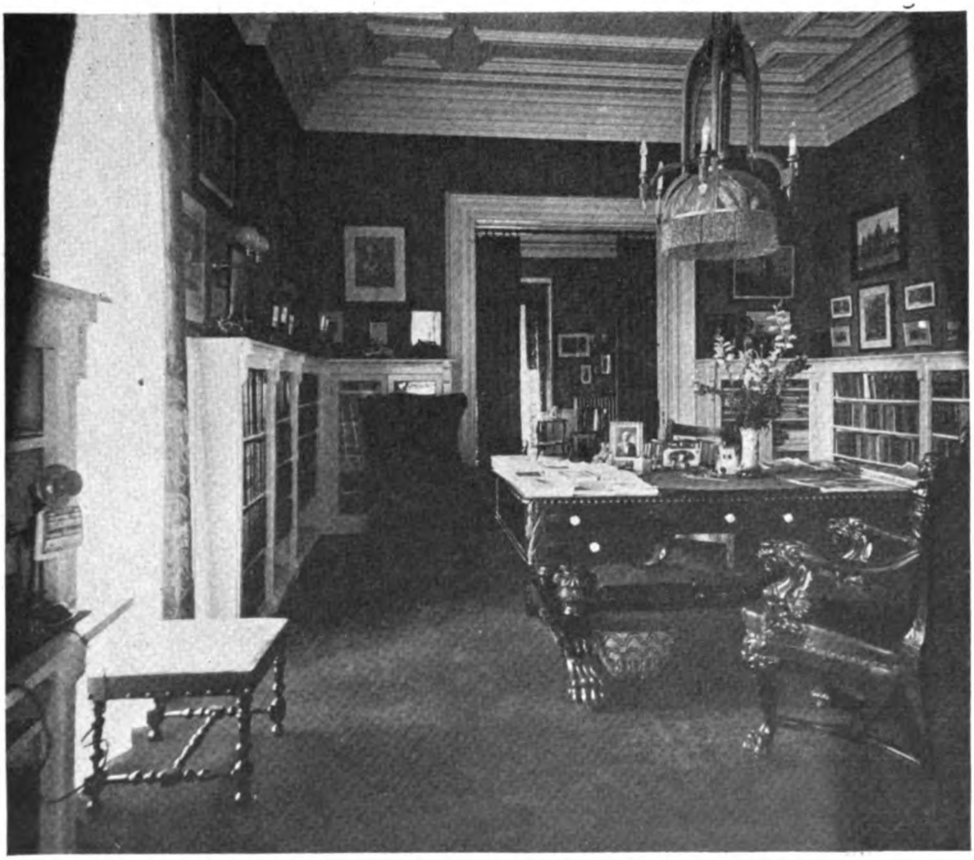
"Sorry, sir, can't do it," came the reply. "I am working for the Western Union, and all of my time must be given to my job." He of course didn't know who Colonel Clowry was then, and it is likely that the assistant superintendent dismissed the matter from his mind with but a momentary impression of the loyalty of one among many employees. It is interesting to note, however, that years afterward the boy who refused to hold his horse became the man's strongest business rival, respective heads of the two great corporations in the telegraph field.

During the three years he spent in the messenger service young Nally was the direct antithesis of the sleepy-eyed, slow-moving boy that cartoonists have pictured with more or less fidelity to type. Whenever any one wanted something done in a hurry, little "Ed" Nally was always called. In those days there were few elevators in buildings and telephones were just coming into use. Pneumatic tubes for sending press messages had not been introduced, and because of his fleet-footedness Nally was given the press route, carrying the Associated Press reports to the newspaper offices. Thus he became the only "all-night" messenger boy in St. Louis and had many exciting experiences.

One night he was given a message to deliver at the county insane asylum, away out on Rock Road, a lonely thoroughfare that ran through the suburbs of St. Louis. The locality was a dangerous one and was frequented by highwaymen, so the asylum clerk armed him with a lantern and a revolver for the return. Mr. Nally's own words best tell the story:

"With the lantern held in one of my trembling little hands and the revolver at full-cock where it rested in my pocket, I crept cautiously along in the direction of the city. After a time I began to feel a sense of security, for nothing had happened, and it struck me it would not be so very bad an episode if I should have a brush with one lone robber. The brush came, sure enough; but I regret to say that I did not rise to the full stature of the heroic role I had mapped out for myself. When I was called on suddenly to hold up my hands, I dropped on my knees, I believe. The two highwaymen took from me the revolver which had been forced upon me by the night clerk, together with all the change in my pockets. In my terror the weapon was wholly forgotten until the robber drew it from my coat!"

It has been said that young Nally's spirit of adventure came from reading stirring Indian and outlaw tales in dime novels. Nothing could be further from the truth. For it was about this time that Nally realized the handicap of his lack of early education and introduced a system of his own for acquiring knowledge. Whenever he felt puzzled he made a mental note of the matter and at the first opportunity he sought enlightenment from wiser persons or in books. There was an old book and print shop on Ninth avenue in St. Louis, and while the other boys were idling Nally could be found at odd moments drinking in the contents of the bookshelves. The quaint old proprietor, T. F. Townsend, took an interest in the boy and allowed him full run of the place; it was here that the fine efficient executive of to-day gained his first love of books and etchings and paved the way toward an education far beyond that of the average American business man. Out of this shop, too, came the first volumes of what to-day is a remarkable and intensely interesting private library,



The library in the Nally home at Ossining-on-the-Hudson; a room that reflects the many-sided personality of the owner. Here are gathered his choicest possessions, the books and prints of his early days, the later and rarer volumes and etchings, and innumerable souvenirs of his triumphs and discouragements throughout his business career.

books which for the most part were bought with the ten cents saved each day by walking to and from work.

In 1878 Nally was given a junior clerkship in Colonel Clowry's office, and later he held several other higher positions in the Western Union.

Then he went to Minneapolis, where he became superintendent for the Great Northwestern Telegraph Company. About this time the Western Union, under the leadership of Jay Gould, had what amounted to a telegraph monopoly. Business and brokerage houses began to need broader and better service and wildcat telegraph companies sprung up all over the country. At this juncture John W. Mackay, the world's most famous miner, invested his millions in the telegraph business and the new Postal Company, the only formidable rival of the Western Union, came into existence. That was in 1886; four years later Mr. Nally resigned his position in Minneapolis to become assistant general superintendent of the Postal in Chicago. Right from the beginning the new company became involved in a stormy rate war and it was left for the few men of experience, industry and integrity who had been gathered into the new company to create order from chaos. What was done is now commercial history and does not need repetition. The important tasks assigned to Edward J. Nally and his successful handling of them is clearly shown in his rapid rise in the service. Within a year he was made general superintendent; five years later he became vice-president, director and member of the executive committee with headquarters in New York. On April 11, 1907, his forty-eighth birthday, he became vice-president and general manager; which position he held up to his retirement four months ago. In thirty years he had progressed from a $13 a month job to one of the highest positions industry has to offer.

It was not to be expected that a big, broad, capable executive, still in the prime of life, would be allowed to remain out of the business world for long.

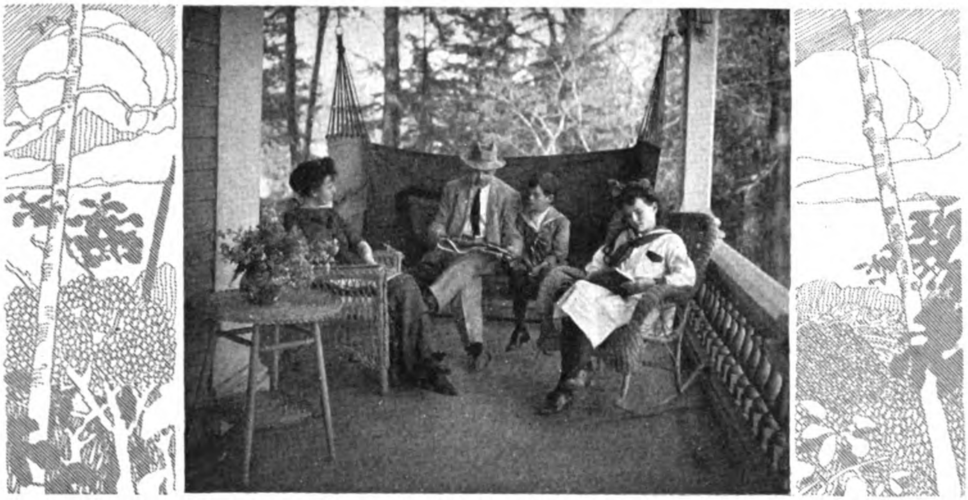
The enormous possibilities in wireless telegraphy appealed to him, and on October first, Mr. Nally heeded the call of the American Marconi Company and became its vice-president and general manager.

Mr. Nally's views on wireless give some hint of what may be expected in the way of its development under his direction. "I consider that the opportunities for constructive work are ideal, with wireless just on the threshold of its development," he said. "If there is one thing I prefer above others, it is creative work, and it seems to me that with the freedom of expression always associated with the building up of new enterprises, limitless fields of activity can be created. Wireless communication appeals strongly to my imagination and I feel the greatest enthusiasm in becoming associated with man's greatest achievement. Marconi's marvelous invention is making history. What more could a man desire than the opportunity to participate in, and perhaps influence to a degree, the epoch-making incidents of his day and generation?"

Concentration, monumental energy and squareness in dealing with employees are the keynotes of this man's character. He is a firm believer in rewarding conscientious effort and each individual working under him is constantly under his observation. "Lack of concentration of purpose and energy," says Mr. Nally, "appears to me the main obstacle which prevents the young men of to-day from 'carrying the message to Garcia.' The man who is paid fifty dollars a month and earns what he gets and no more, is the man who sticks in a fifty-dollar position and is not advanced on the pay-roll. On the other hand, the employee who draws only fifty dollars but works as if he were being paid eighty dollars is invariably the one to be chosen for promotion to the eighty-dollar place.

"Jealousy of holidays and off-hours indicates in an employee the presence of the microbe of failure. The men who are given to signing petitions and round robins also betray the same defect. They petition for opportunities instead of making them."

And Mr. Nally is the living embodiment of the advice he gives. To his determination early in life to take the world as it came, without shrinking or flinching, to face the hardships of a commercial career, incidental fatigue and discourage-



Essentially a home-loving man, the Marconi executive takes the greatest interest in making it a most attractive recreation spot for himself and his family.

ment with fortitude and indifference, he gives the credit for his rise to the top of the heap.

Both during and after business hours he is essentially a human being. Always approachable, affable and courteous to those who have something to say, he is ever in close touch with the pulse of the organization he dominates. Mr. Nally has none of the aloofness of the average corporation official; his staff is to him a great big family, all working toward a common end, and he sees that full credit and assistance are given where deserved.

A demonstration of how universally he is beloved of employees was given on the occasion of his marriage to Miss Lee Warren Redd, of Lexington, Ky., in 1897. Hundreds of congratulatory telegrams poured in from all parts of the country and scores of gifts, of all descriptions, each one pulsating with the sincerest well wishes of the giver, were showered upon the assistant general superintendent and his bride. And each advancing step in his career has been marked by tangible evidences, collective and individual, of the high estem in which his co-workers hold him.

Like all men of inordinate capacity and dynamic personality in business, his home reflects an atmosphere of orderliness in relaxation. Located on one of the highest points about Ossining-on-the-Hudson, the house commands a sweeping view of the river and the Palisades beyond, an ideal spot for the idling hours of the man of many interests. Here he has gathered about him his choicest possessions, the books and prints of the early days, the later and rarer volumes and etchings, and innumerable souvenirs of his triumphs and discouragements throughout his business career. Essentially a home-loving man, Mr. Nally takes the greatest interest in making it a most attractive recreation spot for himself and his two children, devoting many hours of consultation with Mrs. Nally, whose love of Nature and keen appreciation of decorative values finds a responsive chord in his many-sided personality. Yet with his numberless activities, Mr. Nally finds time to assist in important civic betterment work and to further the interests of a few carefully selected clubs.

Edward Julian Nally is a distinct acquisition to the ranks of wireless workers, and the Marconi Company is particularly fortunate in securing the services of one of the ablest men in the telegraph field. He looks upon the annihilation of space by wireless as the greatest of modern triumphs; and if the spirit and verve with which he entered into his new field of activity is any indication, commercial wireless is going to take some mighty big steps forward during the coming year.

LIQUIDATING COMPANY READY TO COMPLETE STOCK TRANSFERS

Early in October, the Wireless Liquidating Company sent out a notice to stockholders, requesting that proxies be signed and returned before November 17, when a meeting will be held to pass resolutions for the distribution of the stock of the American Marconi Company among holders of Liquidating stock.

The letter, which is over the signatures of Arthur P. West, George L. Fox, Alfred A. DuBan, George W. Whiteside and R. M. Owen, states: We are now about ready to distribute the Marconi stock, and we hope to be able to pay a small cash dividend in addition thereto. But such a distribution cannot be made without the approval of two-thirds of the stockholders of the Liquidating Company given at a regular meeting of stockholders. A meeting to pass on that question has been called." The circular adds: "If we can distribute the stock of the Marconi Company in the shape of stock (instead of selling it and distributing the proceeds), a course which we believe is earnestly desired by our stockholders, each holder of five shares of Liquidating stock will receive at least two shares of the Marconi Stock. Reference is made to the suits pending against the heirs of Christopher C. Wilson, and it is intimated that if certain claims which have been filed with the receivers appointed are expunged the distribution may be on a two-to-one basis instead of including a cash dividend.

It is purposed at the meeting of stockholders on November 17, that holders of the Wireless Liquidating shares shall also pass upon a resolution authorizing the directors of the Liquidating Company to appoint a trustee who will issue scrip for fractional Marconi shares. The directors assert: "One of the most difficult problems with which we have to contend in winding up the affairs of the Liquidating Company, is the question of distributing fractions of shares. That is to say, some stockholders of the Liquidating Company may be entitled, for instance, to two and one-fifth Marconi shares. The Marconi Company does not issue fractional shares; and it is our purpose to distribute to such stockholders two shares of Marconi stock, and, if the stockholders approve, to deposit the remaining shares representing such and similar fractional interests with a trustee who will issue scrip to our stockholders for their various fractions of the stock of the Marconi Wireless Telegraph Company of America, such scrip to be exchangeable for regular stock certificates in the Marconi Wireless Telegraph Company of America, whenever it is presented to the trustee, in amounts equal to a full share or shares of the Marconi Wireless Telegraph Company of America. This will enable stockholders to sell or buy fractions of shares so as to make their respective holdings even shares."

The Wireless Liquidating Company announces that "after the payment of the debts of the Marconi Company and the expenses of administration, there remains on hand sufficient money to enable the Liquidating Company to acquire the 140,000 Marconi shares free and clear of all indebtedness." Also, that "none of the members of the Reorganization Committee received compensation for their services out of the funds of the stockholders, some of them even refusing reimbursement of their out-of pocket expenses." The same applies to the officers or directors of the Liquidating Company, excepting the secretary, who receives a nominal salary.

The circular asked holders of Liquidating shares who favor the prompt distribution of Marconi Stock to attend the meeting or send in their proxies promptly. Those who do not comply with this request will be practically voting against the proposed distribution. Attention was called to the fact that under the New York Law the Company cannot proceed to distribute its assets until two-thirds of all the outstanding stock has voted to do so.

Mention was also made of the action brought by Joseph B. Witherbee and the Court's decision in favor of the Liquiding Company.

Shareholders Indorse Goldschmidt Purchase

FOLLOWING a speech made by Godfrey Isaacs at a meeting of the English Marconi Company, held in London on October 3, the shareholders approved the action of the directors in authorizing an increase in capital of £500,000 (about $2,500,000) in ordinary shares for the purpose of obtaining an interest in the Cie. Universelle de Telegraphie et Telephonie sans Fil of France. The French company controls the rights to the Goldschmidt wireless inventions throughout the world except in the interior of Germany. Mr. Isaacs, who is managing director of the Marconi Company, said that it was not yet known whether Goldschmidt's continuous wave system was capable of sustained long distance service, or whether it was superior to the non-continuous wave system. He declared that the Marconi Company would work the two systems together in various kinds of weather and adopt for use whichever one showed up to the greater advantage.

The Purpose of the Meeting

Mr. Isaacs' speech follows:

"This meeting has been convened, as the circular which you have received has informed you, for the purpose of submitting to you a resolution authorizing the increase of the company's capital by the creation of a further 500,000 ordinary shares of £1 each to rank pari passu with the existing 750,000 ordinary shares, except as regards dividends declared for the period of the current year.

"If this resolution be passed, as I have no doubt it will, and subsequently confirmed at the further meeting to be held for that purpose on the 20th instant, it is the intention, as you have been informed by the circular, to make an immediate issue of 250,000 of the shares and offer them to the shareholders at the price of £3-5-0 per share. Of the remaining 250,000 shares, part will be issued for cash in connection with the arrangements which have been made with respect to the shares to be acquired in the Cie. Universelle de Telegraphie et Telephonie sans Fil of France, and the balance for the present will remain unissued.

Revenue Continually Increasing

"I do not suppose for one moment that the recommendation to increase the company's capital will have come as any surprise to the shareholders, for it is very general knowledge that wireless telegraphy has become a very important industry not only in this country and in Europe, but in very nearly every country in the world. It is, in our opinion, destined to play a very important part indeed in the future telegraphic business of the world, and shareholders are aware that the policy of this company aims at conducting that telegraphic business for its own account wherever it may be possible.

"Considerable progress has been made in that direction in recent times and a number of important concessions have been secured, which will provide to the company the means of organizing telegraphic services with some of the busiest commercial centers of the world. Negotiations are pending with other countries and we have every reason to believe that they will be brought to a satisfactory conclusion in the very near future.

"To fulfil the terms of the concessions and create such telegraph services a number of stations have to be built, requiring a substantial expenditure. As each station is opened and a satisfactory telegraphic service conducted, for which I think we can safely rely upon our scientific advisers and engineers, an additional important, regular, and I think there is every reason to expect, a continuously increasing revenue, will accrue to the company.

"Additional and cheaper means of communication between all the busy centers of the world, together with the ever increasing commerce, should add very considerably to the sum which is today expended upon the world's telegraph messages. I think I am right in saying that the money expended yearly for telegraphic communications across the seas is already sufficient to pay satisfactory dividends upon a capitalization which I believe exceeds £100,000,000 sterling, independently of the increase which may be reasonably expected through the advent of wireless telegraphy and the general development of the world's trade; and when we shall have completed the work which lies before us, and secured, if only a small share, of the telegraph business, it should prove sufficient to enable us to earn substantial dividends upon which I think we shall be able then to regard with our million and a half sterling as a very moderate capitalization considerating the extensive telegraph routes which we shall control.

"Given efficient management of our company's affairs during the next two or three years, I am confident we shall then find that we own one of the biggest and most important industries in the world, capable of holding its own against any competition and furnishing remunerative return to those who have supplied the capital and aided in the creation of an enterprise carrying the name of one with whom we are all proud to be associated.

"You will have learned also from the circular sent to you that we are acquiring a large number of shares in the Cie. Universelle de Telegraphie et Telephonie sans Fil, which company owns the rights throughout the world, with the exception of the interior of Germany, of Dr. Goldschmidt's high frequency alternator, and his other wireless patents. I wish to say a word or two to you with reference to these arrangements in order that there may be no misunderstanding.

Did Not Fear Goldschmidt Competition

"The Cie. Universelle de Telegraphie et Telephonie sans Fil is a company registered in France with a subscribed capital of 10,000,000 francs in 100,000 shares of 100 francs each, and 100,000 parts beneficiaries or founder shares which participate in the profits to the extent of 45 per cent, thus making the capital equal to nearly 20,000,000 francs or £800,000. This capital was subscribed by a few important and very influential persons, who wield considerable power in certain countries abroad. Their board is composed of men of eminence and ability in France, Germany and this country, and their support of the Goldschmidt system, no matter what might be its merits, and upon this subject I shall have a word or two to say later, represented a serious menace to our programme in certain countries; we did not fear their competition, but we were anxious that they should not prevent or delay our obtaining certain concessions to which we attached importance. The company is in possession of some 7,500,000 francs or £300,000 in liquid capital and therefore in this respect also carried no small weight in the foreign countries to which I have referred.

Should Secure All French Business

"From every point of view, and in using these words I mean to cover something more than the interests of our company, it appeared to your directors to be of the utmost importance that we should assure the telegraph services which are embraced in our programme becoming an English enterprise under the control and direction of an English company. These are some of the considerations which induced us to make the arrangements we have made with the Compagnie Universelle de Telegraphie et Telephonie sans Fil.

"We are satisfied with the conditions we have obtained and believe we have entered into transactions which will prove beneficial to the company.

"All the shares in the Cie. Universelle et Telegraphie et Telephonie sans Fil which were previously held in Germany pass into our hands and all the German directors retire from the board—a consideration of no small importance in France and one which we hope will enable the Cie. Universelle, which will also probably hold the Marconi long-distance license for France and the French Colonies, to secure the whole of the important business in wireless telegraphy which is comprised in the programme of the French Government.

"It is probable that the Goldschmidt patents for the rest of the world will become the property of the Marconi Company. Now with regard to the Goldschmidt high frequency alternator, this is an extremely clever machine for the generation of continuous waves; it has been erected in a station near Hanover which Mr. Marconi, one of his ablest engineers and I visited a few weeks back. There is great merit in the invention, and Professor Goldschmidt is no doubt a very able engineer. But it should be understood that he has not invented and does not claim to have invented a system of wireless telegraphy, but a machine for the generation and utilization of continuous waves.

"The station in Hanover is well designed and of great promise; it has succeeded in sending across the Atlantic signals and even messages—but as we have told you on frequent occasions there is a great difference between sending signals and messages and conducting a continuous telegraphic commercial service—and the Hanoverian station, in our opinion, without the assistance, experience and patents of the Marconi Company, is still a long way from being able to conduct such a service.

Credit for Goldschmidt

"In saying this I do not want to be understood to be taking from Professor Goldschmidt one whit of the merit to which he is entitled; on the contrary, his are are the only methods other than those of the Marconi Company, of which we have any knowledge, which, in our opinion, have any prospect of success. But it is natural that a long period of tests, experiments and further inventions would be as necessary with Professor Goldschmidt as they were with Commendatore Marconi.

"However, there were many considerations which caused us to make the arrangements we have, some of which I have already referred to. There is one about which I must say a few words.

"We have had, as you know, a Select Committee of the House Commons and an Advisory Committee composed of scientific men. That committee reported that the Marconi Company alone was able to carry out the Government work at the present moment, but it nevertheless spoke of Professor Goldschmidt's machine in words which would have served the Cie. Universelle as a certificate with any foreign Government and consequently provide the means of seriously impeding, if not damaging, this company's programme.

Messages Not Received at Tuckerton

"It would have been little or no satisfaction to us to see the Cie. Universelle obtain a contract or a concession abroad, and fail two or three years later to fulfill it; for even though it fell subsequently to us to carry out it would not have compensated us for the delay or the prejudice we should have suffered meantime.

"These are considerations of importance which obtain to-day, but in a very short time, we hope, they will no longer exist; the important foundations of our business will have been securely laid and no interference with our programme can then arise.

"It has been sated that one of the reasons which induced us to enter into this transaction was that the station at Hanover had succeeded in transmitting wireless messages to Tuckerton, U. S. A., at a regular rate of 100 words per minute for hours at a stretch. There is not an atom of foundation for that statement, for no better reason than that the Hanoverian station has not done anything of the kind, nor anything approaching it. It has also been said by a paper, which is usually more accurate in its statements, that Lord Parker's committee reported that the future is likely to belong to continuous waves, which is the Goldschmidt and not the Marconi system; whereas what in fact the committee reported was that the only continuous wave machine which they had seen tried with success over the long distances was the Marconi continuous wave machine.

"A good deal more has been written upon this subject, mainly with the object of attacking the Government in connection with the contract for the Imperial stations, but these are matters which do not concern us; they are political and the Marconi Company has no politics. But when the public is told, as one paper has told them, that the nation's interests have been sacrificed, I for one protest, for it would seem to me that the course we have taken will prove to be of very marked advantage to the nation, and that for the following reasons:

"We do not know, and nobody yet knows, whether continuous waves will be able to do a continuous long-distance commercial service. If they can, will they prove superior in any way to the non-continuous waves? Those who have had no experience with long-distance wireless telegraphy may be willing to express their opinions, but Mr. Marconi and his engineers who have had such experience decline to express themselves. Before doing so they wish to see what we are about to do, viz.: work the continuous and non-continuous waves side by side across the Atlantic and compare them at all times and in all weathers. Similarly we shall be able to test the Goldschmidt continuous wave machine and compare it in every respect with the Marconi continuous wave machine.

Has Choice of Methods Now

"If the continuous wave proves to be superior to the non-continuous, we shall be in a position to decide which of the two machines is the better; we shall preserve an absolutely open mind and adopt whichever offers the greater advantage and Mr. Marconi will be the first to insist upon that. Should the Goldschmidt machine prove the better, the nation will have the benefit of it under the contract with our company without any extra cost and without having run any risk. Had the arrangement which we have entered into not been made the government would not have had the opportunity of such a comparative test; but if it had, does anybody suppose that if the superiority proved to be with the Goldschmidt machine, that the German and French interests would have been willing to furnish it on any better terms, if as good, as those entered into with this company? The Government has dealt with an English company; if the foreign machine proves of advantage, the government still gets the benefit of it through an English company. Is that how the nation's interests have been sacrificed?

"And again, if the Goldschmidt machine proves to be of the value that some contend and markedly superior, as it pleases others to say, to the Marconi machine, the commercial wireless telegraph business of the world would have been in the hands of foreign companies, whereas by our arrangements they will be in the control of an English company. Is that a sacrifice of the nation?

"I will say no more upon that subject—I hope I have said enough to convince you that whether the Marconi continuous wave machine, or the Goldschmidt continuous wave machine, or the combination of the two, proves the best in wireless telegraphy, the Marconi Company will possess them and under the contract the nation will have the benefit of them.

"Ladies and gentlemen, I trust you will approve the course we have taken and pass the resolution which the chairman will submit to you. It may interest shareholders to know that 2,303 shareholders, representing 275,657 shares, have signified their approval and sent us their proxies."

Subscriptions to the new issue of stock will be received by the Marconi Wireless Telegraph Company of America. Full particulars will be found in an announcement published in our advertising columns

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AN HONOR POSTPONED

A Rome correspondent writes: "Recently it was announced that Mr. Marconi was to receive the honor of elevation to the position of Senator. The king himself expressed approval of the step to show appeciation of Mr. Marconi's achievements. When the distinguished inventor was visiting His Majesty at San Rossore a few days ago the King congratulated him on the approaching event.

"'But,' said Mr. Marconi, 'I am not yet forty years of age, and therefore am not qualified.'

"Alas, he was right. Under the Italian Constitutional law no one is eligible for a senatorship until he has reached that age. The King is said to have expressed some surprise that his Ministers had not made the necessary simple inquiry before putting Mr. Marconi's name forward for the coveted honor. The inventor will now have to wait until next year. He was born on April 25, 1874. The plan to honor Mr. Marconi was proposed on the initiative of Premier Giolitti."

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D., R.E.
Instructor in Radio Engineering, the College of the City of New York

ARTICLE II

Dealing with the conditions encountered in radio telegraph transmitters, the author describes a high-voltage Wheatstone bridge for the measurement of capacity at high voltages and radio frequencies. The principle is shown and a detailed description of the complete apparatus is given.

A substitution method for the measurement of the capacity of condensers such as are used in radio telegraph receiving apparatus is fully described.

THE capacity of a condenser, as measured by the method outlined in the first article of this series, is strictly applicable only when the condenser is used at low voltages and audio frequencies. But, as is well known, condensers are very frequently employed in circuits where both the voltage and frequency attain very high values, and it therefore is desirable to measure their capacity under such conditions also.

8.—MEASUREMENT OF CAPACITY AT HIGH VOLTAGES AND RADIO FREQUENCIES, USING THE WHEATSTONE BRIDGE METHOD.

(a) *Arrangement of the Apparatus.*—The method involves the use of high voltages and radio frequencies in a Wheatstone Bridge. The simplest form of generator is therefore a spark gap coupled to an oscillatory circuit. In Figures 5 and 6, E is the spark gap. Connected across this gap are two circuits, L_1 C'_n and L_2 C_x. Each of these consists of an inductance and a capacity; and therefore each time there is a breakdown of the spark gap, free alternating currents (usually called, "damped oscillations") pass through each of these circuits. If the Geissler tube F be connected across the terminals C and D of the condensers, it will be found that (under certain conditions which will be given below), it is possible to keep the tube dark by adjusting one of the capacities, C'_n to a particular value. For all other values of C_n the tube glows brightly. The inductances L_1 and L_2 may now be reversed in position relative to their respective capacities, and by altering C'_n (the original value of C_n for which the tube did not glow), a new value, C''_n, can be found for which no discharge passes through the tube. From the quantities C'_n and C''_n it is easily possible to calculate the unknown capacity C_x. The second arrangement of L_1 and L_2 is shown in the right-hand portion of Figure 5.

Fig. 5

The actual arrangement of the apparatus (together with certain convenient additional measuring instruments and protective appliances) is shown in Figure 6. This diagram is of further interest, because it shows a method of arranging alternator, transformer, and spark gap which will be frequently used hereafter. G is an alternator, current from which flows in turn through the regulating reactance ("choke coil") S, the primary of the transformer K, the switch or transmitting key J, and the fuse I. Since the voltages in the secondary of the transformer K rise to high values, and since (because of the presence of the spark gap E and the oscillatory circuits) radio frequency alternating voltages will be present between the terminals of its secondary winding, it is necessary to protect the alternator G against the effect of these radio frequency high voltages, in case of a breakdown of the winding insulation of the transformer. This is satisfactorily done by connecting the large condensers H across the terminals of the primary winding. The condenser are in series and their middle point is connected directly to the frame of the transformer. To protect the secondary winding against excessive voltages, the protective spark gap R is directly connected across the terminals of the secondary. R is set to such separation of the sparking surfaces, that, before the secondary winding insulation breaks down, there is a discharge across the gap. It will be found that most transformers are already provided with such a protective gap. However, if this is not the case, the proper separation of the 1 cm. diameter brass balls of the gap for a 5,000 volt transformer is about 1.0 mm., for a 10,000 volt transformer about 2.5 mm., for a 15,000 volt transformer 4.2 mm., and for a 20,000 volt transformer 6.0 mm.

An electrostatic voltmeter V was a non-essential portion of the equipment, but served as a convenient means of rapidly determining the voltage at which the condenser capacities were measured. E is the main discharge gap, N a normal or standard variable condenser arranged for high voltages. P is the unknown condenser, F the Geissler tube, L and M are copper helix, high voltage inductances, and Q is a double pole double throw switch permitting a rapid reversal of the inductance bridge arms.

In the experiment as performed, G was a source of 110 volt 60 cycle current, the reactance S consisted of 80 turns of No. 14 wire about 25 cm. to the turn, wound on a rectangular cross-section iron core and with taps every four turns. Its inductance was 0.036 henry (measured at 500 cycles and 1 ampere). The condensers H were each 2.0 μf Western Electric 21-D condensers and the circuit was fused for 10 amperes. The transformer was a 1.5 K.W. 60 cycle, 20,000 volt, closed core transformer with adjustable magnetic leak-

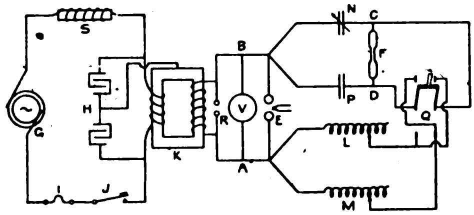


Fig. 6

age. An extra protective gap, R, was of the usual micrometer-screw-adjustment type. The electrostatic voltmeter was a 0-10,000 volt Kohl instrument. The standard condenser was a parallel plate condenser in oil. It had 8 fixed sections which could be connected in parallel readily, and one variable section for fine adjustment. Its total capacity was 0.00491 μf. The unknown capacity was a copper on glass Leyden jar, P. The Geissler tube employed should contain one of the following gases: neon, helium, carbon dioxid, or hydrogen; these gases being distinguished by their low dielectric strength and a consequent high sensitiveness of the tube as an indicator. The inductances consisted of 31 turns of 0.5″ x 0.0625″ flat copper strip wound edgewise on a series of slotted rubber rods. Outside diameter was 8.75″ and the space between turns (clear) was 0.1875″. The total inductance of each helix was 128 μh (microhenrys). The switch Q was for moderately high voltages, and mounted on a marble base, but high insulation is not particularly necessary at this point because, when the bridge is balanced there is no potential difference across the terminals of N and P.

The entire apparatus is shown in Figure 7. To the left can be seen a hot wire ammeter for measuring the transformer primary current, if desired; a control switch, the reactance S, the transformer, and the spark gap. The gap is air-cooled, one of the electrodes (of

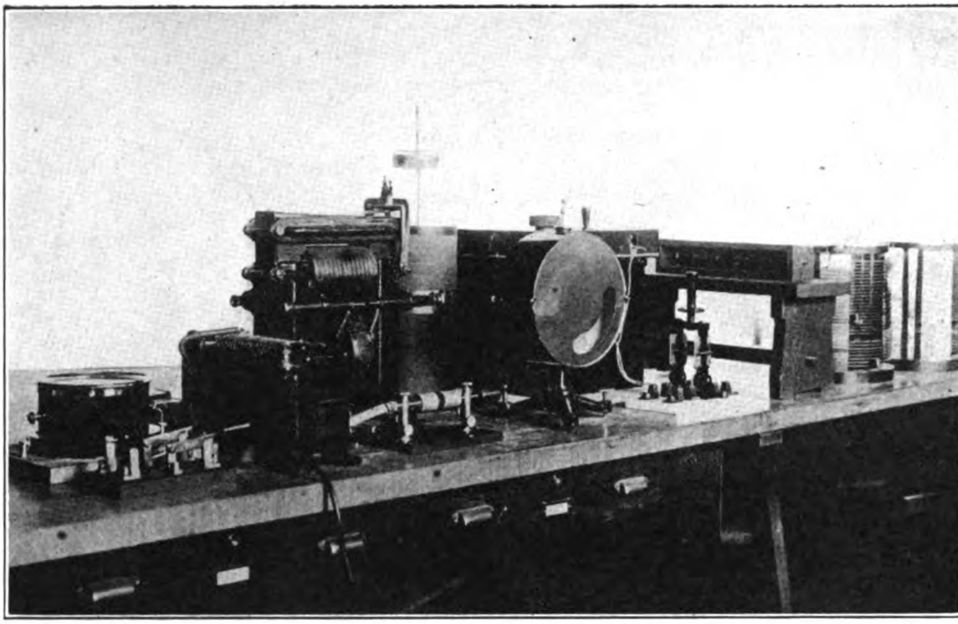


Fig. 7

zinc) being perforated, the other solid. Compressed air is supplied to the gap, and passes out radially between the sparking surfaces. Such cooling adds to the regularity of operation. Passing to the right in the illustration, the electrostaic voltmeter and the reversing switch are seen standing before the standard oil condenser. The Geissler tube is mounted in a recessed blackened box, which acts as a shadow frame. At the extreme right are the two bridge arm inductances.

(b) *Theory of the Method.*—Suppose that the breakdown voltage of the gap is E_m. The discharge phenomena are then somewhat as follows:

(1) Both condensers C_x and C_n are charged to the same voltage, E_m.

(2) The gap becomes conductive, and of fairlv low resistance.

(3) The terminal voltages across the condensers diminishes similarly to a free alternating current ("damped oscillation"), being represented by an expression of the form

$$e = E_m \epsilon^{-at} \sin \omega t \qquad (24)$$

where e is the potential difference at the terminals of the condenser at the end of the time t, E_m is (very nearly) the maximum and initial potential difference, ϵ is the base of the system of natural logarithms, and ω is the angular velocity (2π times the frequency of alternation).

It is well known that the damping factor, a, is given by

$$a = \frac{R}{2L} \qquad (25)$$

where R is the radio frequency resistance of either of the oscillatory circuits, and L is its inductance. Furthermore,

$$\omega = \frac{1}{\sqrt{LC}} \qquad (26)$$

where L and C are the inductance and capacity of the same circuit.

If the alternations of voltage across the terminals of each of the condensers are to keep in step (which is the necessary condition that the Geissler tube shall not light up), it is evident that the damping factors and angular velocities of each of the circuits $C'_n L_1$ and $C_x L_2$ shall be equal. The first condition is not as important as the second, and will be appreciably fulfilled if the inductances used are of proper dimensions and do not differ markedly in value.

The second condition leads to the following equation:

$$L_1 C'_n = L_2 C_x.$$

If, after reversing the connections of L_1 and L_2, the Geissler tube is again darkened when the value of C_n is C_n'', we have similarly

$$L_2 C''_n = L_1 C_x.$$

From the last two equations L_1 and L_2 can be eliminated, and the value of C_x is found to be

$$C_x = \sqrt{C'_n C''_n} \quad (27)$$

So that C_x can be directly calculated. The method here outlined is similar to that used in weighing on a false-arm scales.

(c) *Procedure.*—From 0.2 to 1.0 K.W. transformer input are employed, and the voltage at which the measurement is to be made is regulated by adjusting the separation of the spark gap surfaces. If the capacities to be measured are fairly large, it will be necessary to increase the transformer input for a given voltage. The inductances are arranged so that they vary by 10 or 20%, and the glow in the tube disappears at a certain adjustment of C_n. The room should not be very brilliantly illuminated for accurate measurement. The key, J, is best a heavy sending key, because, if the current is kept on very long when the bridge is not balanced, the vacuum tube may be overheated. The true balance point must be found by taking the mean of the two positions above and below it at which the tube just begins to glow. The reason for this is that it takes a certain voltage to cause *any* glow in the tube.

(d) *Errors of the Experiment, their Elimination; and Probable Accuracy.*—The inductance and capacity of the connections in the bridge arms should be small, which can be attained to a satisfactory extent by having such leads short and widely separated. Brush loss in the unknown condenser will cause an apparent increase of capacity, which should not be allowed for, because it will also be present when such a condenser is in actual use.

The results of a typical experiment are as follows:

Connection I. Tube begins to glow for following values of C_n: 2 fixed sections + (170° ± 5°) on variable section = 0.00238 ± 0.00001 μf., and at 2 fixed sections + (90° ± 5°) on variable section = 0.00219 ± 0.00001 μf.

The mean value = C'_n = 0.00228 ± 0.00002 μf.

Connection II. Tube begins to glow for following values of C_n: 3 fixed sections + (130° ± 5°) on variable section = 0.00272 ± 0.00001 μf., and at 3 fixed sections + (50° ± 5°) on variable section = 0.00250 ± 0.00001 μf.

The mean value = C''_n = 0.00261 ± 0.00002 μf.

Unknown capacity = $C_x = \sqrt{C'_n C''_n}$ = 0.00244 ± 0.00001 μf.

Accuracy = 0.5%.

We frequently desire to use condensers in receiving circuits and in wave meters. The capacity of such condensers should be measured by the next method.

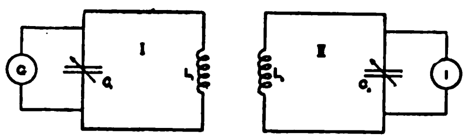


Fig. 8

9. — MEASUREMENT OF CAPACITY AT RADIO FREQUENCIES AND LOW VOLTAGE BY THE RESONANCE METHOD.

(a) *Theory of the Method.*—In Figure 8, consider the circuits I and II. Circuit I consists of the inductance L_1, the capacity C_1, and some form of gap discharger (such as a spark gap or buzzer break) G. By means of G, the condenser C_1 is charged, and during its period of discharge, free alternating currents ("damped oscillations") are present in the circuit I. The circuit II is inductively coupled to I by means of the inductance L_2. Connected across its capacity, C_2, is the indicator I. This indicator may be, for example, a detector and telephone, or a detector and galvanometer. We wish to know under what conditions of adjustment of secondary and primary circuits the response of the indicator in the secondary circuit shall be a maximum. Such a condition is called resonance. Bjerknes has shown that, if the two circuits are *very loosely* coupled, the condition for maximum response of the secondary indicator is equality of the natural periods of the circuits. We shall consider this matter at considerable length under Measurements of Wave Length.

Suppose that the condenser C_2 is unknown. We may adjust the primary condenser and inductance, and the secondary inductance, until finally the maximum indication is obtained in the secondary. We then replace the unknown condenser by a variable standard condenser C_n, and by varying C_n again obtain the greatest indication. Obviously, the last value of the standard condenser is that of the unknown capacity, since each brings the secondary resonance with the primary. (Except for the rare case of strong overtones in the exciting circuit.)

(b) *Arrangement and Description of the Apparatus.*—In Figure 9 is shown a complete wiring diagram of the apparatus. The primary circuit, I, consists of a fixed coupling inductance L_1, and extra tuning variable inductance L'_1, and the capacity C_1, also variable. The circuit is excited from the buzzer E, G which is fed by current which passes through the regulating resistance D, and the two inductance L_1 and L'_1. An appropriate resistance F is shunted across the break point of the buzzer. It contributes to the regularity of action of the buzzer, and, by partly preventing the break, causes wave trains of small damping in the primary circuit. The secondary circuit, II, consists of the fixed coupling inductance L_2, the variable tuning inductance L'_2, and either the standard variable condenser C_n or the unknown condenser C_x. Across the terminals of the condenser are connected the detector H and the telephone J. For the telephone an appropriate galvanometer may be substituted. If it is desired to heighten the sensitiveness of the indicator circuit, a small auxiliary voltage obtained from a potentiometer circuit and applied at the terminals of most crystal detectors will increase the response. And a small "telephone condenser" (of about 0.02 μf) connected across the telephone will also be found of advantage. Usually neither of these devices is necessary.

The actual apparatus employed for the experiment was as follows: B was a 10 volt storage battery, D a slider resistance of maximum 11 ohms. The buzzer was the smallest size "Eco" buzzer. F was a 4-ohm non-inductive resistance, being part of a usual resistance box. The capacity C_1 was an aluminum plate, variable, air condenser. L_1 was a standard inductance of value 190 μh. (microhenrys). It was not

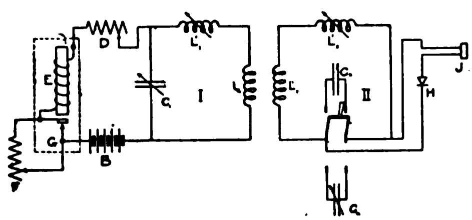


Fig. 9

found necessary to use L_2. The maximum value of C_1 was 0.00199 μf. In the secondary circuit, L'_2 was not found necessary (for the particular capacity measured), and L_2 was 192 μh. (The calculation of these inductances can be most easily accomplished by Nagaoka's formula and tables as given in the Bulletin of the Bureau of Standards, Vol. 8, No. 1, entitled, "Formulas and Tables for the Calculation of Mutual and Self-Induction" (Revised). The standard condenser was a variable 0.00497 μf. rotary plate air condenser, and the unknown capacity was a smaller variable air condenser. The detector H was a crystal detector of the "Pyron type, and the telephone receiver was a 2,000-ohm double head-band one. When it was desired to replace the telephone by a galvanometer, a Hartmann & Braun galvanometer of 325 ohms resistance and having a figure of merit of 9 $(10)^{-7}$ amperes per degree deflection was used. This galvanometer was robust and easily portable. Not all buzzers were found to be equally satisfactory. They can best be chosen by trial. If it is desired to use a slightly more powerful source instead of the buzzer, a small induction coil and spark gap of the usual type may be employed.

The actual appearance of the apparatus is shown in Figure 10. At the left of the photograph are seen the en-

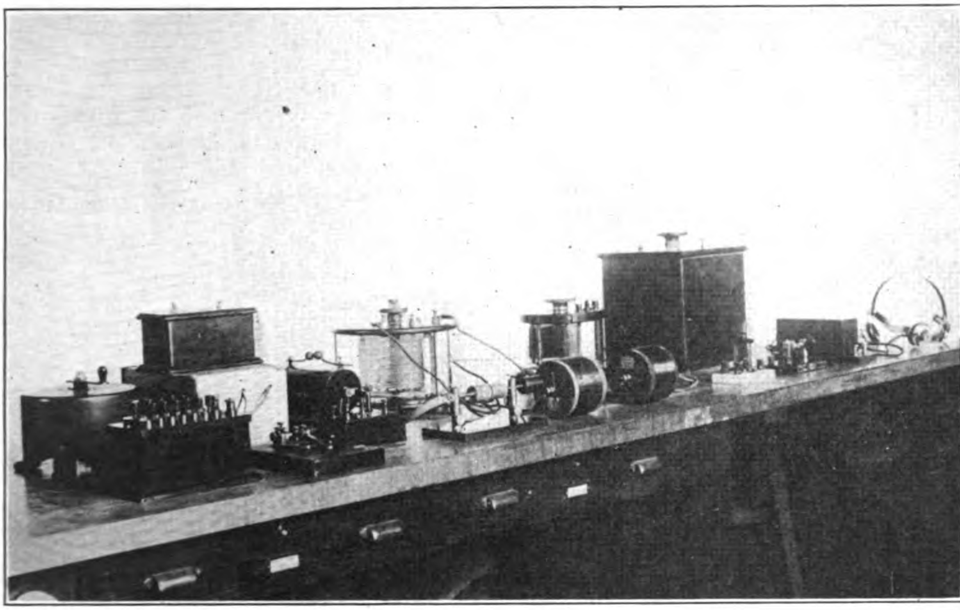


Fig. 10

closed buzzer with a small induction coil standing on it and a second induction coil beside it. Surrounding it are the regulating resistances D and F and a control key. The three condensers are shown in the background, and in front of them a spark gap (which may be used with the induction coils, if desired), the coupling inductances L_1 and L_2, the reversing switch for known and unknown condensers, the crystal detector, the portable galvanometer, and the telephone receivers.

(c) *Procedure.*—Adjust the buzzer so that it operates steadily with a clear tone. The resistance across the contact G should be *small,* say a few ohms. Of course, the smaller this resistance, the greater will be the current required to operate the buzzer. Each time the buzzer contact opens, the current through the inductances of circuit I will be rapidly changed and a free alternating current will be present in this circuit. Couple L_1 and L_2 closely, and, with the unknown condenser in circuit II, tune circuit I by varying L_1, C_1, and (if necessary) L'_1 until a loud note is heard in the receivers. It may be necessary to adjust the detector a number of times before trying a new setting. If the values of the various inductances and capacities are roughly known, time can be saved by bringing them to an adjustment such that

$$(L_1 + L'_1)\, C_1 = (L_2 + L'_2)\, C_2.$$

This is the condition for equality of natural periods (approximately); without considering the influence of buzzer and detector circuits).

Coils L_1 and L_2 are then to be separated until the coupling is so loose that a sound is heard in the telephone *practically only at one setting* of C_1. The coupling is not sufficiently loose unless further separation of L_1 and L_2 makes no difference in the resonance setting of C_1. Leaving C_1 at its final adjustment, replace C_x by C_n, and vary C_n until resonance is again obtained. When C_n is finally adjusted, its value is that of C_x. For accurate work, the whole process should be repeated several times. When the galvanometer is used instead of the telephone, more accurate work is generally possible. For extremely accurate measurements using the galvanometer a series of galvanometer readings for various values of C_1 should be made, and these readings must be duplicated when C_x is replaced by C_n. For more rapid work, only the maximum readings in the two cases need be duplicated.

(d) *Errors of the Measurement, their Elimination; and Probable Accuracy.*—Unless the detector and telephone are sufficiently sensitive, and the currents in the primary sufficiently powerful, it may happen that the coupling of the circuits necessary for easy observation is too close. The remedy for this condition is obviously to increase primary power and detector sensitiveness. When using the galvanometer, it must be remembered that the constancy of the alternating current produced by that device is not greater than about 5%. For greater constancy, special vibrating wire interrupters or a combination of transformers and small quenched spark gaps must be employed.

With the apparatus described above the following results were obtained:

Using the telephone as indicator: Setting of C_n for resonance

$$= 105° \pm 1°.$$

Accuracy = 1%.

Using the galvanometer and taking complete sets of readings, setting for resonance was 120.7° ± 0.5°. (Mean of 20 readings.)

Accuracy = 0.5%.

(For reference, it may be stated that at the same time the wave length was 865 meters, and the sum of decrements of primary and secondary circuits was 0.205. The methods of measuring these will be given hereafter.)

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

NAVAL "FANS" RECEIVE SCORES

The United States aerial "news service," whereby officers and men on United States warships far out at sea are kept informed each night of the baseball scores and other items of interest, has proved a great success.

Reports to the Navy Department from the battleship Illinois, which has returned to home waters with a big party of midshipmen, declare that the reports were picked up readily by the vessel when it was 2,175 nautical miles out at sea from the navy's powerful station at Arlington, Va., and 2,610 miles distant from the station at Key West. The battleship also reported intercepting wireless messages from European stations.

KOLSTER ADDRESSES RADIO MEN

In an interesting paper, entitled "The Effects of Distributed Capacity of Coils Used in Radio Telegraphic Circuits," read before a recent meeting of the Institute of Radio Engineers by Frederick Kolster, of the United States Bureau of Standards, important phenomena taking place in radiotelegraphic circuits is discussed. The results had been experimentally proven. It was clearly observed:

1—A single layer coil such as used in wavemeters and receiving tuners may have considerable effective distributed capacity. Two methods were described for determining the capacity.

2—This effective distributed capacity has the properties of a condenser in shunt to a tuning inductance. It may therefore be represented by an imaginary condenser (Fig. 1).

Or may be expressed by an equivalent loop circuit.

3—Under experiment a coil with a natural period of 260 meters, an inductance of 1.5 milli-henrys, the effective capacity (due to the imaginary condenser in shunt) totaled .000013 microfarad.

4—The inductance of such a coil apparently changes with the frequency or wave lengths, as was proven by curves.

5—Unused turns of the loading coil in the receiving tuner (Fig. 2), or any tuning coil having distributed capacity, may act as a coupled oscillatory circuit to the used portions of the coil. The coil will therefore respond to two frequencies.

6—The radio frequency resistance of coils with appreciable distributed capacity is found in practice to be higher for some frequencies than that calculated from the well-known formulæ. This may be particularly explained by the distributed capacity of the circuit if the circuit can be considered as an equivalent loop circuit.

The apparent resistance of such a coil may be expressed by the following equation:

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

where,

R = the calculated radio frequency resistance.
L = the inductance.
C = the condenser in parallel.

The results of experimental observations were shown, there being considerable difference between the apparent and the actual resistance.

7—The so-called untuned or aperiodic circuit (Fig. 3) may in reality not be so at all, due to the imaginary condenser (effective capacity) in shunt. This coil may have a distinct natural time period and respond more readily to that frequency. This was experimentally proven. A co-ordination of results indicates:

A—The importance of taking into consideration the capacity effects in coils or circuits designed for calibration purposes, and in particular in circuits of large inductance and small capacity.

B—Inductance coils for radio frequency circuits should be designed to have minimum capacity as well as minimum resistance. It is unfortunate that the best design for one of these requirements is not the best design for the other.

C—Coils with "deadended" turns should not be used even though the turns not in use are metallically disconnected from the circuit. They should be entirely out of the fields of the active turns.

D—Coils in so-called untuned detector circuits should be particularly designed to have minimum capacity, or else for each short range of wave-lengths a separate coil should be used having a natural period best adapted to this range.

E—In wavemeter circuits coils having distributed capacity should not be partly inside and outside the instrument. They should be connected directly to the variable condenser, for then the main effect of the distributed capacity will be merely a small addition to the capacity of the variable condenser.

Without doubt, much of the peculiar phenomena sometimes observed in receiving tuners has been accounted for. In a discussion following the reading of the paper, Dr. Goldsmith, of the agreed that the effects observed were undoubtedly true when the inductance is reasonably localized and the capacity not extremely great, but it could not hold good for radiative antennæ. Valid reasons were given.

Several methods for the elimination of the effects of distributed capacity

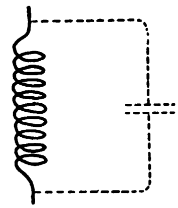


FIG 1

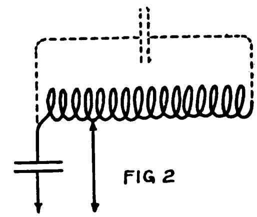


FIG 2

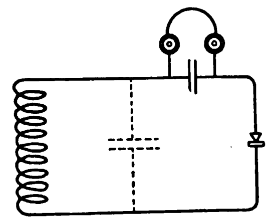


FIG 3

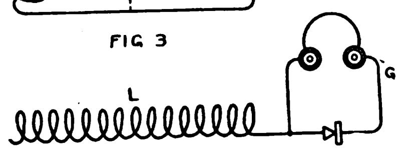


FIG 4

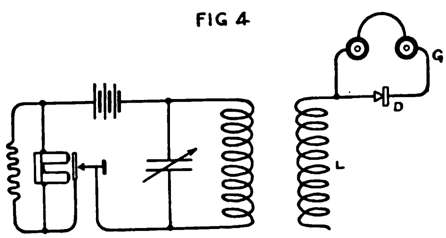


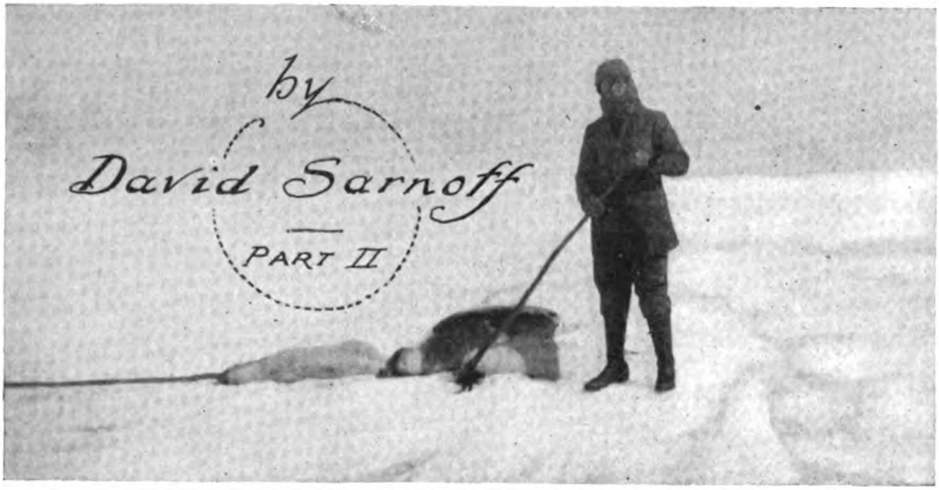
FIG 5

were suggested by members, but none might be reasonably applied to commercial practice.

An interesting feature of the discussion was a method for determining the natural period of a coil as per Fig. 4, in which D is a rectifying detector, G a galvanometer or head phones. L the coil under test.

L may be excited either by very loose coupling to a quenched spark circuit or, as was promulgated by an engineer of the Marconi Company, may be excited by a wavemeter in turn excited by an aperiodic buzzer (Fig. 5).

My Trip to the Icefields



The Captain's Story

THE doctor and I were unmercifully joked regarding our trip across ice and our ducking. In fact I felt like a young "tenderfoot" who had tried and failed to give an exhibition of bareback riding before a crowd of cowboys in the West. The jocular remarks uttered at our expense, however, were good-natured, and I consoled myself with the reflection that I was obtaining real Arctic experience.

I had intended to relate in this article something about the dramatic part the ethereal waves played in a series of incidents that came to my attention while I was on my trip up North. But recently I found my fingers fairly itching to set down on paper a story of the ice fields that is quite as graphic a portrayal of life as something on a motion picture screen. So I am going to ask you to transport yourself from your cushioned chair beside the fire in your library and take a seat beside me in the captain's cabin of the sealing vessel Beothic, wedged in among the ice floes of the North. It will be necessary for you to do so, figuratively speaking, in order to appreciate the story which I am about to relate.

Opposite me sat the commander of the steamship—a big, burly figure of a man who stolidly smoked his pipe and replied to my remarks for the most part in monosyllables and grunts. For days I had been trying on various occasions in a small way to persuade him to tell me something of himself and his life. In supplying me with information about routine matters he was courteous enough, but when the conversation touched on topics foreign to these he shut his mouth as tight as the proverbial clam.

We were alone in the cabin after the evening meal. Outside the wind moaned dismally and the thousand and one sounds that fill a ship broke the silence. A friend of mine who scribbles for a living had told me that every man has at least one good story to tell. It seemed to me that my companion ought to be able to gratify my desire for a yarn. I was formulating in my mind a speech designed to set spinning the wheels which would fabric a tale when——

"You want me to tell somethin'?" he asked.

I nodded, wondering what had prompted him to make the offer. It must have been that he was in a mood for story-telling and wanted to unburden his mind. This, then, is the captain's yarn, told as best I can remember it, in his own crude English:

"Five years ago I came up here in a big ship with a big crew—maybe ninety or a hundred men. I was going to make the big kill and get many sealskins. We started just like we came on this trip—with many folks on the shore waving hands and tellin' good-bye. I felt very happy. But I didn't know what would happen. You never know what happens up here."

He paused a few minutes and seemed deep in thought. I was impatient for the story. After he had puffed at his pipe till it was going to his satisfaction, he continued.

"That's one reason I didn't want 'Gene—that's my brother—to go along. It was the first trip he made to the ice fields. But he was a boy who liked to travel 'round. He was 'bout eighteen—a big boy, 'most as big as me. Every time I came back from my seal trips he teased me to take him along next time. His mother said no and I said no, but after a time she gave up and let him come. The day we left she stayed on the shore and waved her hands and cried. Before the boy came aboard she said to me, 'Take care of him,' and I promised.

"We had a good trip and good weather as we steamed on up North. When we got where I knew there are many seals, I sent men out from the ship, one crowd in one place and some another, to kill the seals. Then the ships sailed on, expectin' to pick up the men when it had left others on the ice.

"My brother, he went in the first crowd. I told him to be careful, not to fall through the holes in the ice an' to work hard. He left the ship, singin' and laughin', and all I said to him didn't count, as near as I could figure out.

"This was early in the mornin'. As we went on up North the ice got thicker and we couldn't go so fast. After a while the ship got wedged in between the floes so tight that she couldn't move and I wouldn't go no farther. I wanted to go back and get ready to pick up my men. Then I saw somethin' away off in the sky that made me shiver—no, not with cold, but because I am scared. I saw once before that thing in the sky and knew it meant a big storm. You don't know what a big storm is up here, Coni man, till you get in one.

"Well, there we was wedged in so tight in the ice that we couldn't budge, though I tried everything I could think of to get away. An' while I was realizin' that the storm was comin' it broke and the snow began to fall. Pretty soon it was like a great blanket that shut out everythin' in sight—you couldn't see nothin' but a mass of white flakes. Knowin' how desperate the plight of my men on the ice was, I set a charge of dynamite under the floes that was holdin' the ship, and for five minutes we was free and movin'. Then we got wedged in again.

"All the time I kept the foghorn blowin' and sent up rockets to tell the poor fellows on the ice where we was. Finally, along late in the afternoon, some of 'em reached the ship. They had heard the horn and felt their way through the snow till they found us. But forty-eight of my crew was still missin' and with 'em was my brother.

"Night came on and we was still jammed hard and fast in the ice. Again we tried dynamite, but no sooner would we get free from the floes than we'd get caught again. Now, danger don't mean a whole lot to me, but I couldn't help thinkin' of that boy. It sorta took away my nerve. I thought of gettin' the men to form a searchin' party and lookin' for the missing ones, but I knew that would be throwin' away more lives. All I could do was to keep the horn blowin' and hope that the snow would stop."

The captain halted in his narrative to get up from his chair and walk across the cabin. The memory of what he had passed through was apparently still with him. Finally he resumed his story.

"There wasn't no sleep for me that night. In the mornin' the snow was still fallin' and it was colder than ever. Some of the men volunteered to go in search of the others on the ice, and four of 'em started out. They was only gone half an hour. Then they come back, tired and discouraged after bein' buffeted about by the wind. They saw it was no use tryin' to get anywhere in the storm and was thankful to get back to the ship alive.

"The end of another day and night saw us still locked in the ice. Again a rescue party started across the ice, but turned back after goin' a short distance. And for what seemed like a month to me, but was only another night and a day, the snow continued to come down.

"On the mornin' of the fourth day that we had been locked in, the storm stopped and I set to work in earnest to get the ship free.

"It took us many long hours, dynamitin' and choppin', before we could move. Then, as fast as we could get through the floes, we steamed toward the place where my brother and the others had been left. Pretty soon we came to a place where from the deck we could see a row of figures stretched out on the ice. They were our men—all of 'em dead. Some had died of starvation and others of cold. But my brother 'Gene wasn't among 'em.

"What had become of him I didn't know. He had, I reckoned, wandered off from the others and had gone through a hole in the ice into the water, or was buried under the snow. While I was walkin' the deck with gloomy thoughts in my head, the lookout in the crow's nest shouted that he saw an object movin' slowly along the ice ahead of us. My heart began beatin' quick-like, and one of the mates turned to me with some words of encouragement and hope. But I wouldn't listen to him. I was too fearful of bein' disappointed. Over the side of the vessel and onto the ice I went with my men at my heels.

Ice figures largely in the Newfoundland sealers' scheme of living, and is used in much the same manner as we employ highways. In this picture the crew for the expedition are seen coming right up to the vessel's side, carrying their raiment and equipment on sleds.

"Sure enough there was somethin' crawlin' along, but whether it was man or animal I couldn't be sure of. We quickened our speed and finally came to the figure which, sure enough, was my brother. But I thought at first I had found him only to have him die. He was half dead from cold and hunger, an' it took days of careful nursin' before he could tell us how he had escaped the death of the others.

"Did you ever get so hungry, mister, that you felt as if you'd like to eat the skin your boots are made of? Did you ever get so cold that you didn't have no feelin' left and just wanted to walk away and find a place alone to die in? That's the way it was with those men who were stranded on the ice. Some of 'em was brave enough, too. At first they took an encouragin' look at things because they thought the ship was comin' along every minute. But when it didn't come and they looked things in the face and thought of the long night and the sufferin' they would have to go through, a lot of 'em lost heart.

"But that first night, while the men had a hard time keepin' warm enough to be kept alive, wasn't much to talk about compared to what came later. All through that night they kept warm by huddlin' close together and burrowin' into the snow. There wasn't much talkin'. All of 'em was savin' their strength. A few of 'em prayed, my brother said.

"In the mornin' the sufferin' from hunger began. They had killed a few seals, and one of the old men in the crowd made his breakfast off the meat from one of the animals. It wasn't easy to force the food down, but the others ate seal meat, too. Some of 'em couldn't do it and they was the ones that got to feelin' weak before the others. And all the time they kept a lookout for the ship. We was too far off for 'em to hear our horn, and so they kept on waitin' and waitin'.

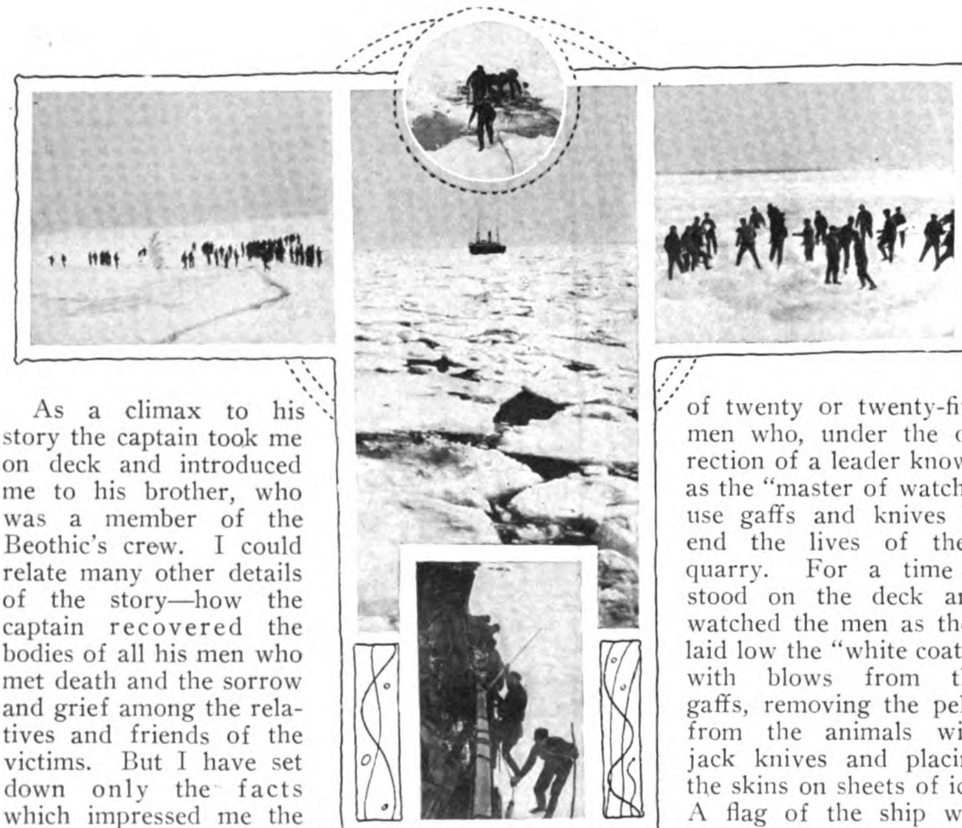
"Toward night some of the men got to actin' strange. One big feller, who couldn't stomach the seal meat, suddenly broke out into crazy talk and ran away into the storm before any one could stop him. A few of the others started mutterin', about tryin' to reach the ship; but they didn't have the nerve to leave the others just then. As darkness came on, my brother and some of the men got together all the seal pelts they could find and used 'em as coverings. But these wasn't enough protection from the cold, and when daylight got around again two of the men was found frozen to death.

"All of 'em was sufferin' so by them that they didn't know quite what they was doin'. 'Gene and another man was desperate and made up their minds to reach the ship, no matter what happened to 'em. So, not payin' any attention to the others, who didn't want 'em to go, they started off together. On and on they plodded for hours. My brother, bein' young and strong, stood things better than his companion, who, after he had tramped till late in the afternoon, fell down in the snow and couldn't get strength enough to go any further. For a long time my brother worked over him, tryin' to get him on his feet. But it wasn't no use and he had had to leave him there to die.

"All that night 'Gene walked and walked. Once he fell down in the snow and felt that sleepy feelin' comin' over him. But he knew that meant freezin' to death, so he 'roused himself up and kept goin'. I don't know how far he walked, but part of the time he musta been goin' around in a circle. Toward the end, he said, his mind probably went back on him pretty bad, because he'd think he saw the lights of the ship in front of him. Then he'd run forward and look and look, but he wouldn't see nothin' but the snow. Once he thought he heard some one shouting', too, and he spent a lot o' time, runnin' here and there. After a while he found out he had been fooled by the cryin' of a seal.

After a long and arduous day's work the sealers return, dragging the pelts across broken ice and gaping holes, impassable to the average man.

"He didn't know when the night ended nor when the daylight came. The last thing he remembered anythin' about at all was fightin' off that sleepy feelin' that was comin' over him all the time. But when we reached him he was crawlin' along on his hands and knees, so I reckon we got there just about in time to save his life."



In the small picture on the upper left hand the men are alternately dynamiting the heavy floes and pulling the vessel through the ice. At the extreme right they are bringing in chunks of ice for drinking water supply. The salt is extracted in an evaporator. At the bottom, sealers are seen boarding the moving vessel as tons of ice break up right under their feet.

As a climax to his story the captain took me on deck and introduced me to his brother, who was a member of the Beothic's crew. I could relate many other details of the story—how the captain recovered the bodies of all his men who met death and the sorrow and grief among the relatives and friends of the victims. But I have set down only the facts which impressed me the most.

I went to sleep late that night, dreaming of hair-breadth escapes from death on the ice. The steady bump, bump, of the ice cakes against the sides of the vessel added a touch of realism to my dream. Early in the morning I was awakened by the heavy trampling of many feet on the deck, and hurriedly dressed to find that we were in the habitation of a number of young seals, or "white coats" as they are called by the hunters.

When I arrived on deck I found that many of the ship's company had scattered over the ice, where they were rapidly increasing the death rate among the "white coats." It may be of interest to the readers of THE WIRELESS AGE to know that a seal hunting expedition is generally divided into groups of twenty or twenty-five men who, under the direction of a leader known as the "master of watch," use gaffs and knives to end the lives of their quarry. For a time I stood on the deck and watched the men as they laid low the "white coats" with blows from the gaffs, removing the pelts from the animals with jack knives and placing the skins on sheets of ice. A flag of the ship was placed on top of each pile of pelts to indicate ownership.

So interested did I become in the work of the seal hunters that I resolved to take part in it. Once on the ice it took me only a short time to discover a "white coat" that was by its mother's side. Always on the alert for danger, the mother attempted to draw her offspring into a hole in the ice—a "bobbin' hole," as it is called—when the saw me approach. Failing in this, she re-treated to a place of safety and left the "white coat" at my mercy. The little animal appeared so helpless that I hesitated for several minutes before striking it with my gaff. Then the shouts and cries of the seal hunters, who yelled, "Hit 'em, Coni-man, dem don't bite," spurred me to raise my gaff and strike. One blow killed the creature, and I removed its pelt with my knife. Emboldened by my first success in sealing, I selected other victims among the animals and in a short time I had killed a dozen of the creatures.

In two days the crew of the Beothic succeeded in obtaining 2,400 seal skins. I sent this news by wireless by way of Belle Isle to the owners of the vessel, and received in reply by the same means a message of congratulation which seemed to gratify the captain considerably. While I was communicating with other vessels and giving them information regarding our luck in sealing and the conditions of the weather, the captain's son, a man about thirty years old, came into the wireless cabin. At that moment Belle Isle began calling "MXB-MXB-S" which, translated, meant that a message had been received at that station for transmission to the Beothic. The wireless contained the news that a boy had been born to the wife of the man who was standing at my side.

He had been somewhat skeptical regarding messages of the air heretofore, but when he received the marconigram from his home he changed his opinion. In the captain's cabin that evening a supper was given to celebrate the arrival of the baby, and wireless came in for much favorable mention.

The wonders of radio communication were again demonstrated a few hours afterward when I received a message from a vessel 100 miles away to the effect that one of her crew was suffering from an internal illness. The message described in detail the symptoms of the sufferer and I showed it to the physician aboard the Beothic. He sent a message in which he advised a course of treatment and told of simple remedies to be administered. Another ship picked up this message and as a result several requests for medical advice came to the Beothic from various parts of the ocean.

This is the second in a series of articles by Mr. Sarnoff relating his experiences in the Arctic regions. The third will appear in an early issue.

WIRELESS DEFEATS DEATH

Wireless telegraphy helped F. M. Chamberlain, a naturalist in the United States Bureau of Fisheries, win a race against death that extended from the Arctic regions to his home in Oakland, Cal. While in the frozen North, Chamberlain was taken ill with "galloping consumption." His physician said there was only one hope for him—to reach a warm Southern climate—and that he had one chance in 10,000,000 of reaching California alive.

Washington was appealed to and ordered the government wireless stations in Alaska to flash messages all over the Northern seas for a government vessel to rush to Chamberlain's assistance. One wireless message was picked up by a revenue cutter, which hastened to the sick man.

Then the race for life began. Knot by knot the cutter steamed nearer to the warm South air. The engineer used every trick in his "kit" to hurry the vessel. Oil-soaked fuel gained an extra knot and careful nursing of the engines gained another.

When the harbor lights of Seattle hove in view, the question arose as to whether Chamberlain should be left there or be brought to Oakland. It was decided to bring him to Oakland, and never did railroad men speed a train from Seattle to San Francisco as that train was rushed.

By a prearranged plan of the Marconi Wireless Telegraph Company, every ship with wireless apparatus, sailing the Pacific ocean, dipped her flag Friday, September 26, in honor of the anniversary of Balboa's discovery.

WIRELESS ENGINEERING COURSE

By H. SHOEMAKER
Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER XI

Electrical Oscillations

TO clearly understand why oscillations are produced by the discharge of a condenser, we must fully comprehend the nature of the forces involved. The process is as follows: First, energy is stored up in electrostatic or potential form, in the condenser K (Fig. 45). The plates of the condenser are at a difference of potential, and there is a tendency to come to the same potential. This cannot be accomplished unless the plates are connected together. The condenser is capable of storing energy in potential form in the same manner as a water tank at an elevation is capable of storing water, which in turn possesses energy by virtue of its position or elevation above the earth. If the water is allowed to flow from the tank to the earth, then it will be able to do work, and its energy is said to be kinetic. Kinetic energy is the energy a body possesses by virtue of its motion. In the case of the circuit shown in Fig. 45, electro potential energy stored in condenser K is equal to one-half the capacity of K times the maximum voltage squared; or

$$E = \frac{K V^2}{2} \qquad (7)$$

When the condenser discharges through the inductance L (Fig. 45), a current flows through the inductance which builds up a magnetic field. In building up this magnetic field energy is required. This energy is kinetic in form, as it is the energy of the motion of the charge of the condenser.

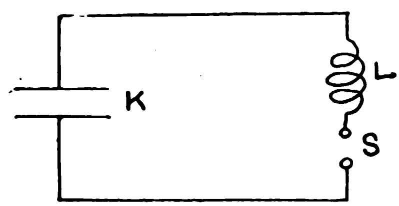


Fig 45

When the current starts to flow through the inductance it is retarded or held back by the magnetic field produced through the inductance; but when the current has reached its maximum, it has imparted all its energy to the magnetic field and it starts falling in value. The magnetic field then starts to collapse, thus causing the current to continue to flow. This energy stored up in the inductance is equal to that stored in the condenser less the loss due to the resistance of the circuit.

This magnetic energy being forced

back into the condenser causes its potential to rise, but in the opposite direction. As soon as the magnetic energy is converted into electro potential energy, the process repeats itself, until all the energy is lost due to the resistance of the circuit.

The magnetic energy can be expressed by:

$$E = \frac{L I^2}{2} \qquad (8)$$

Where L is the inductance and I the maximum current value.

Equation 7 is the expression for the electrostatic energy, or energy in potential form, while equation 8 is the expressions for the magnetic energy or energy in kinetic from. As $\frac{K V^2}{2}$ and $\frac{L I^2}{2}$ are both expressions for energy and they are equal, in the case of the oscillating circuit we can put:

$$\frac{K V^2}{2} = \frac{L I^2}{2} \text{ or } K V^2 = L I^2 \qquad (9)$$

It is to be remembered that V is the maximum voltage and I the maximum current.

The above equation is not strictly true, as it does not take into account the loss due to the resistance of the circuit. This loss is $R I_1^2$ where R is the resistance of the circuit and I_1 the effective current or (root mean square value) per each semi-oscillation. We can then say that for each semi-oscillation:

$$K V^2 = L I^2 - R I_1^2$$

$\frac{K V^2}{2}$ is the total energy of each wave train and is expressed in watts when K is in farads and V in volts. If we multiply $\frac{K V^2}{2}$ by the number of wave trains per second we will have the total energy used. If N is the number of wave trains per second and W the watts, then

$$W = \frac{N K V^2}{2}$$

Thus, if the condenser K (Fig. 45) is charged and discharged 100 times per second to a potential of 10,000 volts, then

$$W = \frac{100 \times K \times (10{,}000)^2}{2}$$

If K = .010 microfarad, or 10^{-8} farads, then

$$W = \frac{100 \times 10^{-8} \times (10{,}000)^2}{2}$$

or

$$\frac{10^2 \times 10^{-8} \times 10^8}{2} = \frac{10^2}{2} = 50$$

If N was 200 instead of 100, then W would equal 100 watts. It will therefore be seen that the energy is proportional to the number of times the condenser is charged and discharged. The energy of discharge is equal to that of the charge, and if it discharges back into the charging circuit there will not be any energy used except that lost by the resistance of the charging circuit. If, however, the condenser is discharged through the inductance and spark gap, so that oscillations are set up, then this energy is so changed in character that it cannot pass back into the charging circuit, and must therefore be dissipated or used up in the form of electrical oscillations.

The rate at which energy is dissipated or used up in the oscillation circuit is enormous, as will be seen from the following example:

If the condenser is charged 100 times

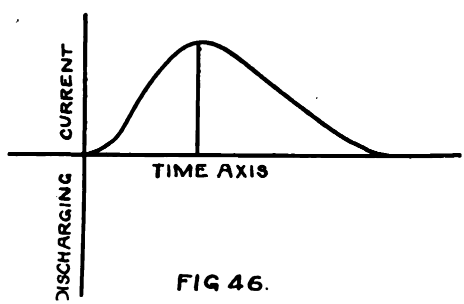


FIG 46.

per second and discharged after each charge, we can say the time required to charge the condenser is approximately 1/200 of a second. If the capacity is .010 M.F. and the voltage 10,000 volts, then

$$W = \frac{10^{-8} \times 10^{8}}{2} = \frac{1}{2}$$

The energy of each charge is therefore ½ watt. Now, if the oscillation produced by the discharge has a frequency of one million (10^6) and there are 10 complete oscillations before they die out, then this ½ watt is dissipated in ten one millionths of a second, or 10^{-5} seconds, and the rate at which energy is being dissipated or used is

$$\frac{1}{10^{-5}} \times \frac{1}{2} \text{ or } \frac{10^5}{2} = 50{,}000 \text{ watts to}$$

maintain these oscillations in a continuous manner.

The above is not strictly true, as the effect of damping has not been considered, but it will serve to illustrate the fact that a great amount of energy is employed for short times in the oscillations.

In practice the condenser is charged from the secondary of an alternating-current transformer, and the condenser will be charged twice for each period. If the frequency is 60 cycles, then the condenser will be charged 120 times per second. The voltage of each charge will be the maximum voltage, or 1.41 times the effective voltage. If the spark gap is adjusted to the proper length, then the condenser will discharge through the oscillating circuit at each maximum voltage, or twice per cycle. If the gap is short, then there may be several discharges per half cycle. It will therefore be seen that the spark gap plays a very important part in the production of electrical oscillations. It must be constructed so as to act uniformly and continuously. After each discharge it should recover it's insulating properties before the condenser starts to charge again. With low frequencies of the order of 100 cycles or less, an ordinary spark gap comprising two metallic terminals separated by the proper distance can be used. If the frequency is higher, then some means for cooling or aiding the gap to recover its insulating properties must be used. This can be accomplished by means of an air blast directed across the gap in such a manner that it will remove the heated gases. Rotary gaps are also used which cause the spark to take place between different sets of terminals, so that the same gap is not used for two successive discharges. Numerous forms of spark gaps have come into use, all of which are designed to produce regular and uniform discharges.

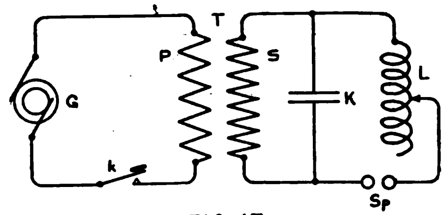


FIG 47

By making the inductance of the oscillating circuit variable, the frequency of the oscillations can be varied at will over wide ranges. This could also be accomplished by varying the capacity of the condenser, but in practice this condenser must be adjusted to the transformer secondary or the secondary adjusted to the condenser, and therefore cannot be varied without varying the secondary of the transformer. In theory, the inductance of the transformer secondary, the capacity of the condenser and the frequency should be so related that

$$L = \frac{1}{p^2 K} \text{ where } p = 2\pi n.$$

In practice this relation must be modified, as the discharge of the condenser at the maximum potential of the secondary causes the energy to be suddenly removed from the circuit, which upsets the resonant relation which would otherwise exist. The secondary of the transformer is therefore adjusted to the condenser while the oscillating circuit is operating.

Fig. 47 is an elementary diagram of circuits used in the production of electrical oscillations. G is an alternating current generator, P is the primary of the transformer T, which is connected to the generator through the key or switch. This switch or key serves to control the oscillations when used for telegraph purposes. S is the secondary of the transformer T, and is connected to the condenser K. This is called the charging circuit.

One terminal of the condenser K is connected to one terminal of the variable inductance L; the adjustable terminal of the inductance is connected to one spark gap terminal, the other spark gap terminal being connected to the other terminal of the condenser.

This constitutes the oscillating circuit, and to distinguish it from other oscillating circuits used in wireless apparatus, and because it is used to excite or produce oscillations in other circuits, it is called the exciting circuit.

Fig. 48 shows two oscillating circuits in inductive relation, the one to the left being the exciting circuit, which is producing the oscillations. The circuit to the right consists of the condenser K_1, the inductance L_1, and an ammeter foı high frequncy currents. The inductance L_1 is brought into inductive relation to the inductance L so that the ammeter indicates a current flow. If either L_1 or K_1 is varied the ammeter will show a variation of current in the circuit and will be a maximum with a certain adjustment.

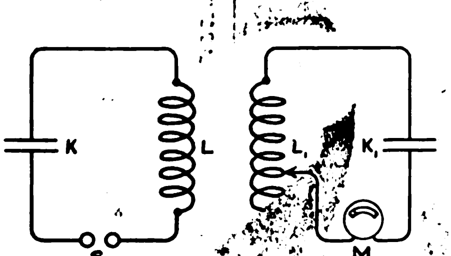


FIG 48.

After maximum is obtained, any increase or decrease of either L_1 or K_1 will cause a decrease of current. The condition for this maximum current is that $L_1 \times K_1$ must equal $L \times K$. The two circuits are then said to be in resonance.

This property of two circuits is used to great advantage in wireless telegraphy, as will later appear.

(To be continued)

This course commenced in The Marconigraph, issue of December, 1912. Copies of previous lessons may be secured. Address Technical Department, THE WIRELESS AGE.

ERRATA

In the chapter of the Wireless Engineering Course published in the October number of THE WIRELESS AGE, equation No. 2 on page 64, second column, should have read:

$$2\pi n = \frac{\sqrt{1}}{KL}, \text{ or } n = \frac{1}{2\pi \sqrt{LK}}.$$

The words attached to figure 46 on page 65, the same number, should have read, "discharging current" instead of "discharging circuit."

The equation on page 66, second column, reading $m = \frac{3.935 = \delta}{\delta}$, should have read

$$m = \frac{3.935 - \delta}{\delta}.$$

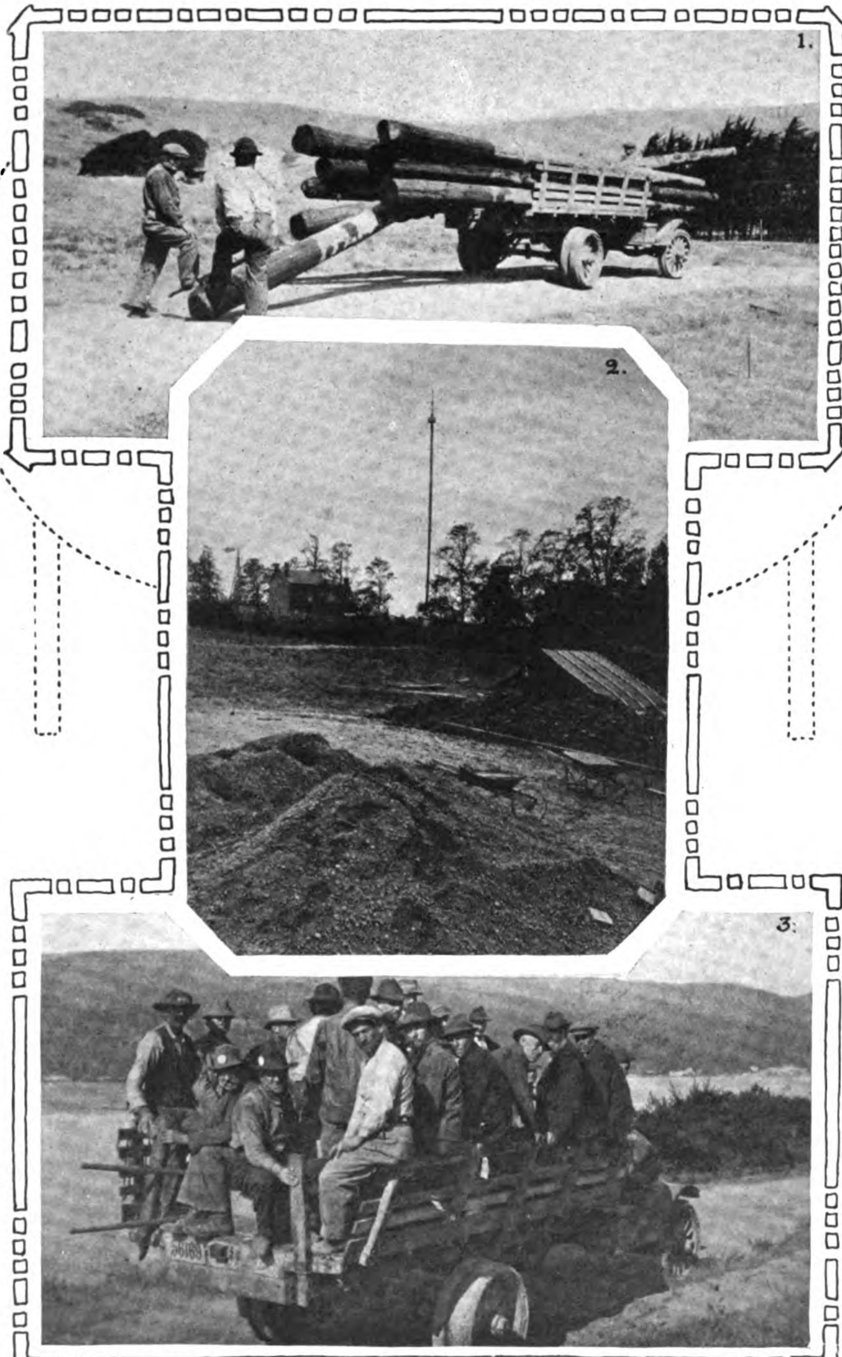
INSTALLATION IN CATHEDRAL

A wireless outfit in the Cathedral of Florence has its antennæ entirely within the edifice. Messages have been received by the Cathedral station from Nordeich, Germany, Toulon, France, and the Eiffel Tower. Despite the fact that it is necessary for the wireless waves to pass through several thick walls in order to reach the apparatus, the messages were distinct.

Three wires, which make up the antennæ, are stretched from the inside of the cupola to a pillar in the interior of the Cathedral and the apparatus is grounded on a lightning rod which ends in a well in one of the walls. It is likely that much of the electrical energy from the messages received is intercepted and carried to the earth by the lightning rods on the cupola. The Cathedral operators have not attempted to send messages from the antennæ within the edifice.

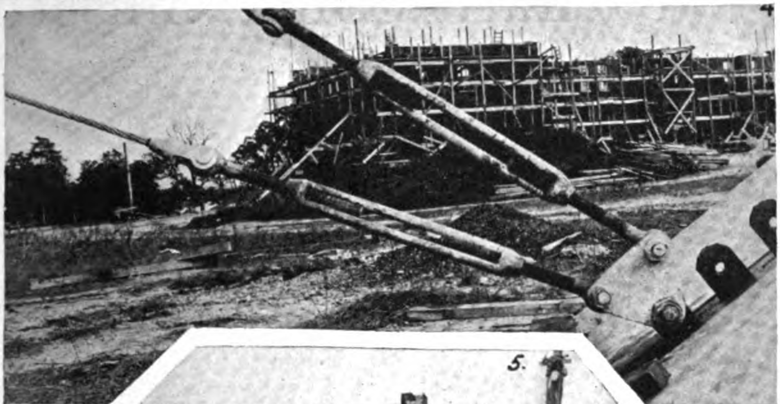
Herbert M. Weeks, a wireless telegrapher in the service of the United States government, died in the Naval Hospital in Brooklyn, N. Y., on Sept. 18.

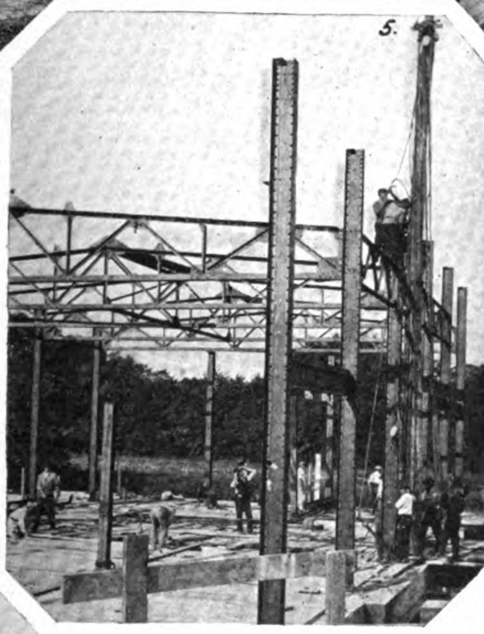
What the Kodak Recorded



1. *Distributing poles for the operating land line by which the receiving unit automatically controls the sending apparatus.* 2. *One of the masts for the Belmar station as it reached the half-way mark. Two others, or three out of the six, are now half completed.* 3. *A typical group of workmen en route to daily tasks. A number of motor trucks have been acquired by the Marconi Company for transporting labor and materials.*

at the High-Power Stations





4. *A good illustration of the simple and effective manner in which the guy cables of the masts are secured to the concrete anchorage blocks. Each cable is capable of sustaining a pull of* 80,000 *pounds. One wing of the Belmar hotel building appears in the background.* 5. *A close view of the structural steel work for the New Brunswick power house.* 6. *Three visitors to the Belmar site, scheduled for a trip to the interior on Thanksgiving Day.*

How to Earn Some Christmas Money

"OH shucks! This Christmas thing's played out. I call it tommy rot to go about spending money every December just because there is a day in that month that we call Christmas. Santa Claus, hanging up stockings, the Kris Kringle yip—it's nothing but a delusion and I can't stand for it any more."

These remarks were uttered by a middle-aged man of prosperous appearance who puffed vigorously at a cigar in the smoking compartment of a Pullman speeding from New York to Chicago. The man with the pipe opposite the speaker took it upon himself to answer.

"Delusion," he repeated slowly. "Yes, I suppose it is."

The other man nodded.

"Of course it is," he said. "This is an age when you've got to see things as they are all the time and it's a dangerous thing to encourage delusions—they're liable to interfere with business."

"What was the happiest time of your life?" said the man with the pipe. "Your boyhood period, made up of as it must have been of make-believe and Christmas, fairy tales and delusions—or were you better pleased with yourself and things when you got to piling up money?"

"I've outgrown those kid things," answered the man with the cigar.

"Suppose you have outgrown them," was the reply. "There are others who haven't, and it's a good thing to keep that Christmas delusion alive."

THE WIRELESS AGE shares the sentiments of the man with the youthful spirit. It believes that Christmas is an excellent institution and to encourage the Kris Kringle spirit it has planned to start a prize contest. It is a contest that will be open to every one. Young readers of the magazine will have as much chance to win as those of mature years.

What in your opinion would be the best wireless messages to send from a vessel at sea to land and from land to a vessel at sea on Christmas day? To the reader writing the best examples of messages THE WIRELESS AGE will give a prize of $1, or a year's subscription to the magazine. The messages should be mailed in time to reach THE WIRELESS AGE not later than December 10. The winner of the prize will be notified regarding the result of the contest in time for him to use the cash or the subscription to the magazine for a Christmas gift if he wishes to do so.

The messages should not exceed fifty words and it is desirable to have them written legibly in ink on one side of the paper. Competitors should send two messages, one to be sent from a vessel to land, and another to be sent from land to vessel.

There was a happy ending to a love story in a marconigram which a man of wealth received one Christmas day from a comic opera star while she was on a steamship in mid-ocean en route to London. The man, who had accumulated a fortune in the West, had pleaded with the singer to marry him. She declined to give him an answer and sailed away leaving him in doubt. While he was spending the gloomiest Christmas of his life in a hotel in New York he received a wireless message from the girl containing one word, "Yes." It sent him scurrying to a steamship pier to catch a vessel which was just about to depart for England.

THE WIRELESS AGE wants to obtain your idea of the most appropriate wireless messages to be transmitted on Christmas day. Imagine that you are aboard a steamship at sea on the day devoted to the presentation and reception of gifts. What kind of a communication would you send to your relatives or friends on land? On the other hand, picture yourself at your home ashore and a member of your family or a friend on a vessel at sea. The messages which you believe would be most gladly welcomed are the one that will be likely to win a prize. Address, Contest Department.

CHAPTER V

Oil Condensers—Operators in the Marconi service should have a thorough understanding of the assembly of the standard oil condenser. This is an absolute necessity, as occasionally a plate may be punctured making it necessary to dismantle the unit.

The operator should first note the difference between a "right" and "left" condenser plate. A "right" plate is one (when held with both hands in front of the operator) where the connecting "tab" nearest him issues from the upper right-hand side of the plate. A "left" plate is one where the "tab" issues from the upper left-hand corner.

These are clearly shown in the lower left-hand corner of Fig. 9. In assembling the condenser, when considering two plates, the inside tab of the left-hand plate is connected to the inside tab of the right-hand plate. The entire unit consisting of 36 plates is shown in detail in the upper portion of the sketch. In each bank 12 plates are connected in parallel, forming a unit, and the three units are connected in series.

A separating plate of thick, heavy glass is placed between the units as indicated. While the glass plates are shown in the drawing as being separated, they are in reality pressed closely together.

A safety gap is placed across each unit as shown in the sketch. These protect the condenser from a break-down should the spark gap be abnormally widened by the operator.

During assembly one complete unit of 12 plates is set up, with alternate left and right plates connected together. The 12 plates are then tied together by a strip of canvas known as "condenser tape." These plates may easily be lifted by means of the canvas tape and carefully lowered into the oil. The three units are then connected up in series as shown in the drawing.

Those tabs issuing from a single unit are connected to a binding post on the underside of the wooden cover of the condenser by means of a clamp. Connections between the units are made on the surface of the lid of the cover by a brass rod, which also carries the safety spark discharge points. The condenser completely assembled is shown in the lower right-hand corner of the sketch.

Locating a Punctured Plate—Should one of the plates be punctured the entire unit will be "short-circuited" and the whole set rendered practically inoperative.

To locate a punctured plate the primary voltage is reduced from 500 to about 240 volts, the cover is removed from the condenser rack, the connecting tabs disconnected from the binding posts and the units electrically separated from one another. The secondary terminals of the transformer are directly applied to each unit, the transmitting key is depressed and the punctured plate is noted by a spark discharge passing through the fracture.

When the punctured plate is located, by studying the assembly in figure 9 closely, the operator will note that if but one glass plate is removed from a single unit of 12, and the unit reassembled, *that* unit will be short-circuited, because two

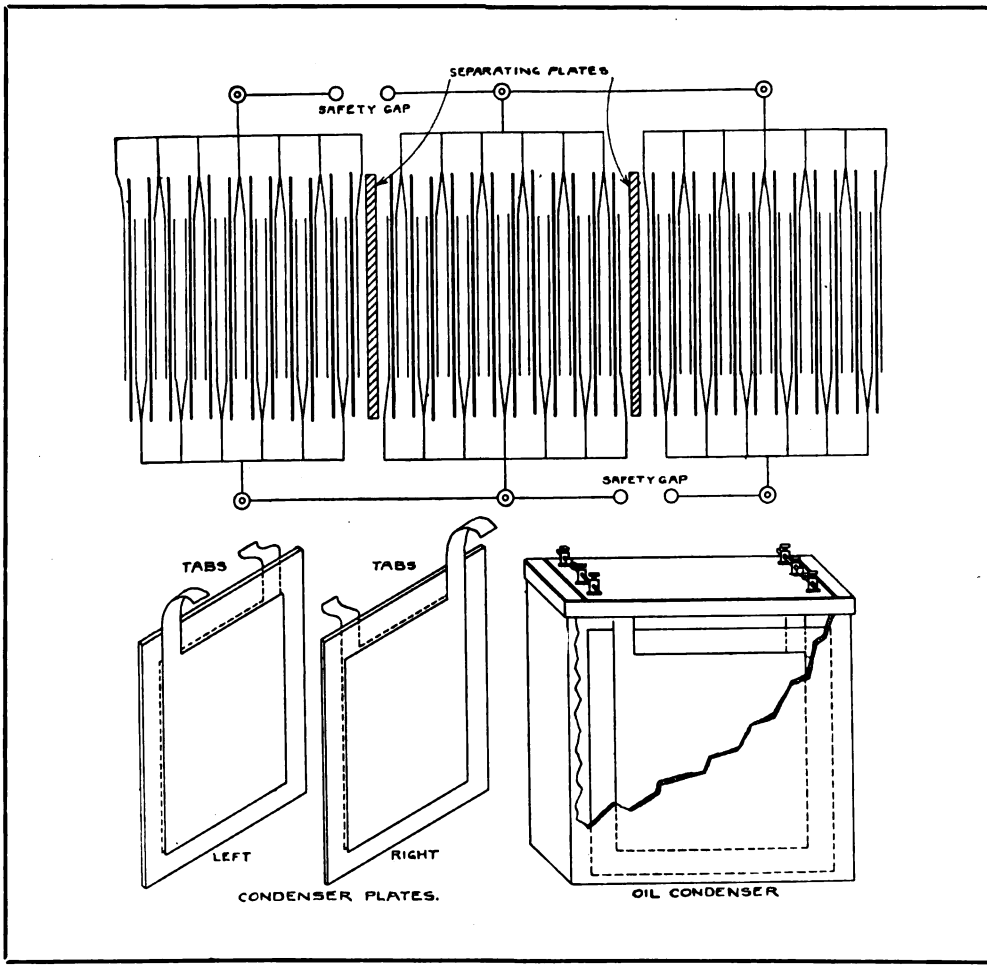


Fig. 9

plates of opposite polarity will be in direct contact.

The punctured plate should be replaced by a spare plate furnished with each equipment, making sure it is replaced by the proper type of plate (right or left).

In case there are no spare plates aboard the ship, and it is necessary to remove two plates, the good plate may be placed at either end of the unit and connected in for use.

During the assembly and after the final connections are made, operators should take particular care to see when the lid is dropped into place that the connecting tabs of two different units do not come in contact with one another, for if they should these units will be "short-circuited" and the condenser again made inoperative. A careful study of Fig. 9 will enable any operator to dismantle and assemble the oil-immersed condenser with little difficulty.

Condenser Combinations—Operators in the Marconi service should always be prepared to remedy an unexpected breakdown. For while it is true that, generally speaking, very little difficulty is experienced with wireless telegraph sets at sea, occasional accidents or injury to the apparatus may occur.

In Marconi radio sets equipped with copper-plated Leyden jars, it will be found that the 1-K. W. sets contain 12 copper-plated Leyden jars divided into two units of six each; that is, there are six jars in parallel in each unit, and the two units are connected in series. According to the formula, the capacity of condensers in parallel is:

$$C = C_1 + C_2 + C_3 \qquad (1).$$

Therefore, if the set of jars is connected in parallel, the capacity of each jar averaging .003 M. F., the total capacity will be:

$$12 \times .003 \text{ M. F.} = .036 \text{ M. F.}$$

Since, however, the jars are connected in series-parallel, the capacity is given by another formula:

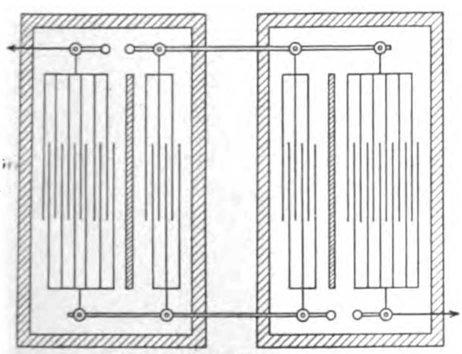
$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}} \qquad (2).$$

In the case cited, since there are six jars in each unit the capacity of each unit will be 6 × .003 M. F. = .018 M. F., and according to the formula (No. 2) the combined capacity of the unit

$$C = \frac{1}{\frac{1}{.018} + \frac{1}{.018}} = \frac{1}{\frac{2}{.018}} =$$

$$1 \times \frac{.018}{2} = .009 \text{ M. F.}$$

Therefore the combined capacity is .009 M. F.



OIL CONDENSER

Fig. 10

Suppose, for example, five of the jars should be punctured or break down; it is evident there are insufficient jars remaining to allow the use of a series-parallel connection. It will then be found that three jars in parallel will give a capacity equal to twelve jars connected in series parallel, that is:

$$C = .003 + .003 + .003 = .009 \text{ M. F.}$$

Since the resultant capacity is of the same value as that secured previously (i. e., by the series-parallel connection), the wave length of the closed oscillatory circuit remains unchanged, but as a matter of safety the length of the spark gap should be reduced and the primary voltage cut down to prevent an abnormal strain on the condenser. The practical use of the formulæ given can be readily seen.

Let us consider, as an example, the oil condensers employed in connection with the 240-cycle disc discharger sets. In this set the condenser consists of 3 banks of glass plates in series, each bank consisting of 12 plates in parallel. Suppose breakage should occur—for example, say 18 were broken. Since but 18 plates remain, it is evident that there is an insufficient number on hand to permit the use of three banks in series. It is then to be determined what number of plates in parallel will give the same capacity in microfarads as 36 plates connected in series-parallel (in the regular manner). We may calculate the number of plates required by the formula (No. 2). Substituting for values of C the number of plates, N, then,

$$N = \frac{1}{\frac{1}{12} + \frac{1}{12} + \frac{1}{12}} =$$

$$1 \times \frac{12}{3} = 4 \text{ plates}$$

Since 18 plates are available, it will be of advantage to connect two banks in series, but it must not be forgotten that we desire the equivalent capacity of four plates in parallel; and since by the formula the capacity of two equal condensers in series gives a resultant capacity of one-half of one, it will be evident with such an arrangement that four times more plates are required than when one unit in parallel alone is used; consequently 16 of the 18 plates are necessary, 8 in parallel in each unit, and two units in series. This may be readily proven by the student from formula No. 2.

The Effect of Series-Parallel Connec-

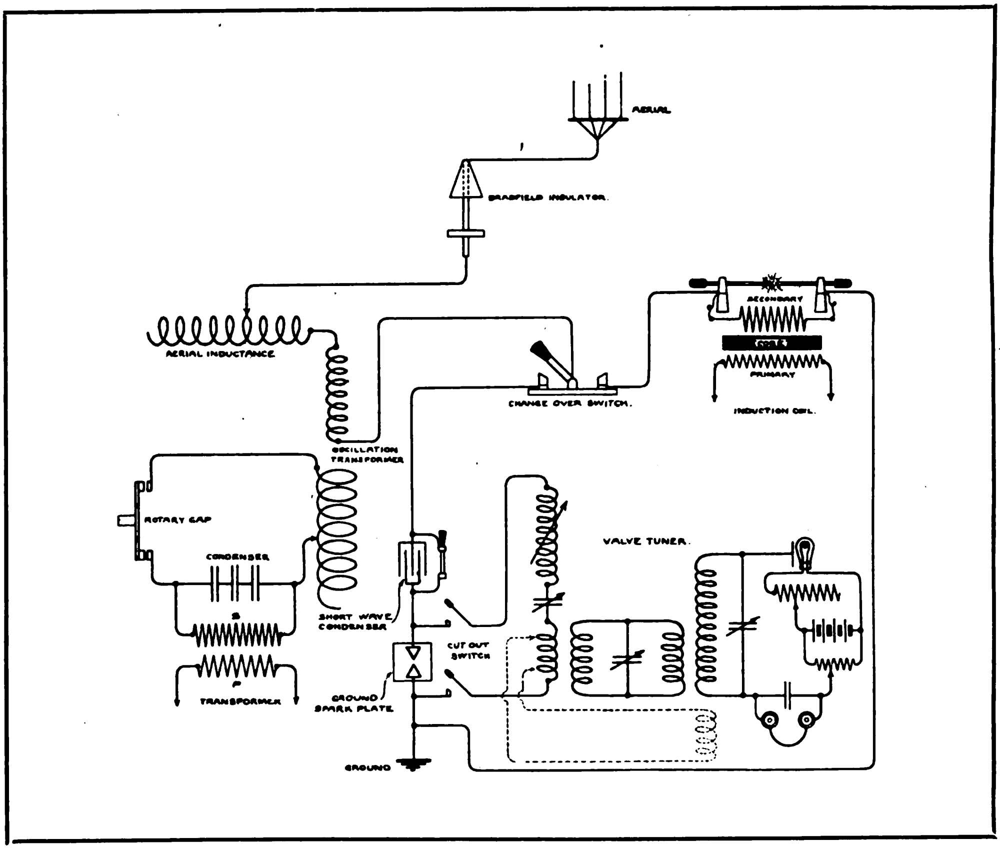


Fig. 11

tion—If the secondary voltage is 15,000, as it generally is in the 240-cycle sets, then, when three condenser units connected in series are employed, the potential on each unit is reduced to 5,000 volts. If but two units are connected in series, the potential strain is increased to 7,500 volts per unit. The operator will find, in case of emergency, that this connection may be employed with little fear of break-down, provided the primary voltage is slightly reduced; nor under these conditions will the range of the set be materially decreased.

Suppose, as a further example, that all plates in the condenser tank should be punctured; the operator may meet the emergency by removing the short-wave condenser from the open oscillatory circuit. This condenser consists of four plates connected in series, each of which has approximately the same capacity as one plate of the oil condenser. The operator will then remove the four plates from their rack, connect them in parallel, place them in the closed oscillation circuit, using the same length lead as formerly employed with the standard condenser; the set may then be operated as before. This, however, must be done with a considerably reduced primary voltage.

By carefully applying the formula supplied, any number of combinations of Leyden jars or glass plates may be used to give the capacity of the original unit and the set may then be operated in emergencies as before.

Fig. 10 shows diagramatically two condenser tanks occasionally found in the Marconi service. Each tank contains 18 plates, one unit of 12 in parallel and a second unit of 6 plates in parallel. Since three banks in series are required, it will be observed that 6 plates of one tank are connected in parallel to six plates of the second tank, finally making three units of 12 plates in series.

Auxiliary Sets—A recent regulation issued by the Department of Commerce, based on the London convention's determinations, requires all auxiliary sets to be operated on a wave length of 600 meters. It has been the custom to operate the auxiliary sets at the natural wave length of the antenna.

Since plain aerial connection (i. e., direction excitation) is employed in these sets, no difficulties are realized in the matter of coupling. The open circuits, as adjusted for the power transmitter, is already set at a wave length of 600 meters, making it necessary only to connect the spark gap of the auxiliary set in series with the open circuit.

This is accomplished by means of a

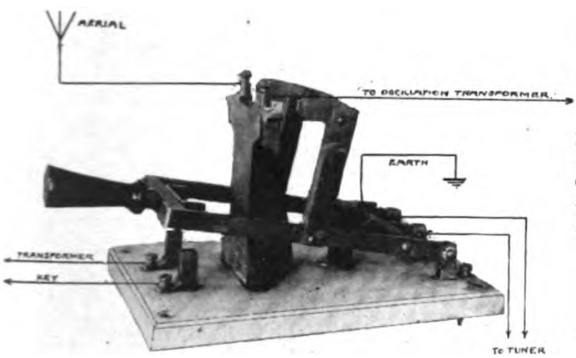


Fig. 12

single-blade double-throw switch as in Fig. 11. When this switch is thrown to the left the power set is connected for transmitting; when thrown to the right the power set is disconnected and the spark gap of the auxiliary set is connected directly in series with the open circuit. The operator should not fail to observe that when transmitting with the auxiliary set this switch must be thrown to the left in order to connect in the receiving apparatus. (This applies only to installations employing the valve tuner in connection with the ground spark plate.)

Elimination of Anchor Gaps—The oscillation transformers of all radio transmitters are now adjusted for a very loose coupling. Since this results in considerable reduction of potentials in the antenna, it has been found desirable (in the United type of transmitter) to eliminate the anchor spark gap, thus doing away with the destructive effects of unnecessary resistance and decreasing the decrement of the radiated waves.

This desirable feature is now accomplished by means of an attachment to the United type antenna switch. By reference to the photograph, Fig. 12, it will be observed that, when the switch is depressed (placed in the sending position) a special copper bar, A connects contact C to D. D, in turn, is connected to the secondary of the transmitting oscillation transformer, while C is connected to the antenna.

When the handle of the switch is raised, A B breaks connection between C and D, and C is then connected to blade E. Blade E is in turn connected to the receiving tuner. The positions of C and D connections may be reversed, making sure that the connection from the knife blade (underneath the aerial switch) is at the same time reversed.

New Method of Connection for Type D Tuners—The use of the loop aerial has been discontinued; therefore a single deck insulator now meets the requirements and but one lead from the antenna to the receiving apparatus is necessary.

On ships equipped with type D tuners, this change may result in a decrease of receiving range for the longer wave lengths, because when the inductance of the open and closed circuits is increased for the longer values the coupling is abnormally increased, seriously affecting the factor of efficiency.

On the shorter wave lengths the connections shown in Fig. 13 may be employed. The right-hand binding post,

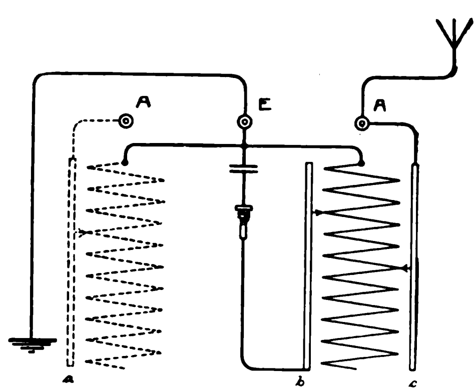


Fig. 13

marked A, is connected to the lead-in from the antenna (through the aerial

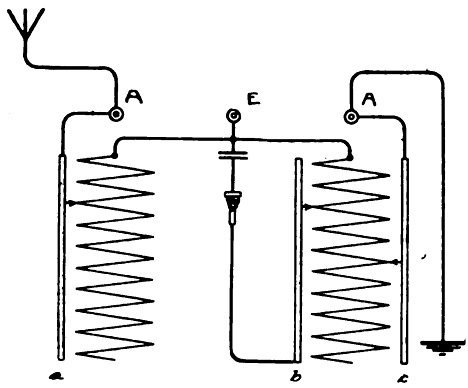


Fig. 14

changeover switch). The left-hand tuning coil is then out of the circuit.

If it is desired to receive the longer wave lengths with increased efficiency, considerable benefit may be derived by the connection in Fig. 14. The left-hand coil then becomes the aerial tuning inductance for the right-hand coil.

If loose coupling is desired, the inductance in use under slider C is decreased in value and its equivalent added in the left-hand coil by means of slider A; thus the mutual inductance in the right-hand tuning coil (the coupling coil) is reduced, and therefore the percentage of coupling decreased.

(*To be continued*)

HE BET A NICKEL WE WOULDN'T PRINT THIS

Mr. A. Hagen, who hails from Duluth, Minn., takes exception to the article which appeared in the September *Marconigraph,* headed "Naval Reserves Pleased with Set."

Mr. Hagen's trouble seems to be confined to misdirected credit, for, according to his statement, Mr. Zucks, who, we were assured, served as operator on the United States steamship Gopher during a recent manœuvre, was presumably swabbing the decks at the time.

Now it appears that Mr. Hagen was in charge of the wireless equipment on this trip, and he rises to remark that the distance worked during the daytime with a Marconi 1-kilowatt set was 125 miles, which he considers very good work on the Great Lakes.

Our interesting correspondent informs us that Bark Bay is 50 miles from Duluth and 125 miles from Calumet, which statement we accept without even looking at the atlas.

Mr. Hagen closes by offering to bet us a nickel that we wouldn't print his side of the story. Mr. Hagen loses, not because we need the money, but because we are strong on facts.

SERVICE ITEMS

Arrangements have been made for the marriage of Miss Myra Morrill, of Wallingford, Conn., and Nugent H. Slaughter, manager of the Marconi Trans-Pacific station at Honolulu. Miss Morrill sailed from San Francisco for Honolulu on October 22, and will be married on her arrival. She and Mr. Slaughter met more than a year ago on an ocean steamship while they were bound for Europe.

Miss Laura Ricker and J. B. Duffy were married at the home of the bride's parents, Mr. and Mrs. Josiah Ricker, in Midvale, N. J., on October 23. Mr. Duffy is assistant to E. T. Edwards, manager of the operating department of the Marconi Company.

Miss Lillian Coffin, of Siaconsett, Mass., and M. C. Tierney, operator at the Marconi station in that place, were married on October 23.

Miss Hannah A. Demerest, of New York City, and J. E. Hudson, inspector for the Marconi Company, were married on September 23.

Mr. and Mrs. James Reoch, of Macfarlane Park, Fla., have announced the marriage of their daughter, Miss Elizabeth McIntosh Reoch, to Robert Irving Young on October 6. Mr. Young is manager of the Marconi station at Tampa.

U. P. Kent, operator at the Marconi wireless station at Cape May, N. J., has been promoted to the managership of the Jacksonville (Fla.) station in place of W. R. Byrd.

No Lives Lost!

How Robert Emanuel, Unsung Hero of the Wireless Key, Saved the Lives of All Those Aboard the British Steamship Templemore and Stood by the Captain When All the Others had Gone to Safety from the Raging Flames.

"IT was Hades, that's all."

This was the terse statement of Captain Isaac H. Jones, master of the British steamship Templemore, which was burned at sea 800 miles east of the Virginia Capes, in describing the scene aboard the vessel while he and his men were fighting the flames that finally drove them to take refuge in small boats. Again the wireless operator figured as one of the chief actors in a drama of the sea. On this occasion Robert Emanuel worked by candle-light in the wireless house on the burning vessel to send out the S. O. S. call which resulted in the rescue of fifty-four men. The survivors were brought to Baltimore, Md., by the steamship Arcadia, of the Hamburg-American line, which picked them up. The Templemore was destroyed by the flames. Fire started on the Templemore on the night of September 29. The story of how those aboard the ship, all of whom consisted of its officers and crew, were saved, was told as follows by Captain Jones:

"Sorry as I am to have lost my ship, I saved my men, and that was a great accomplishment. Not a soul was lost, but what we had to endure nobody will ever be able to understand.

"We were 800 miles east of the Virginia Capes at half-past eleven o'clock at night, when my chief engineer, Louis Green, came to the bridge and said he smelled smoke near his stateroom.

"I went aft with him, and soon we saw fire coming from the hatch just back of the engineroom. It was the hold where cotton was stored, and it is my belief that the fire was caused by spontaneous combustion. I ordered the hold flooded by means of the fire-fighting apparatus which we had in every part of the ship, and, besides, two powerful streams of water were sent into the ventilators just above the burning cotton.

"Our experience in the small boats was the worst of all. A storm was raging, and when the rain was not soaking our clothing the wind was nearly upsetting our slender craft."

"Green thought the fire was under control within ten minutes after it was discovered, but I told him we had better be cautious. All hands were ordered on deck, about half the crew having turned in several hours before.

"Within twenty minutes after Green reported to me on the bridge, the fire reached the oil and lumber, which was stored next to the cotton, and an explosion shook the vessel from end to end. I saw that we were in a desperate situation and ordered the Marconi operator to send out an 'S. O. S.'

"Word came at ten minutes to midnight that the Arcadia, fifty miles away, had heard our call and was coming at full speed to pick us up. Still we fought the blaze, my men appearing unmindful of the danger, and prepared to stay as long as I desired.

"The fire reached the engineroom so quickly that the steering gear was put out of commission five minutes after the fire began. The pumps were still working, however, and we managed to keep the blaze away from the wireless operator's room and the bridge until nearly one o'clock. Finally, Robert Emanuel, the Marconi man, reported that the lights were out in his room.

"He ordered candles lighted and kept in communication with the Arcadia for fifteen minutes longer.

"I saw we had done the best we could, and three boats were lowered. No man left the ship until he received instructions to do so from me. I have never heard of men who behaved so admirably under such trying conditions. It was a few minutes after one o'clock when I left the ship.

"Our experience in the small boats was the worst of all. A storm was raging and when the rain was not soaking our clothing the wind was nearly upsetting our slender craft. Under such conditions we managed to keep our boat's head to the wind until ten minutes to four o'clock, when the Arcadia came up. Many of the crew were seasick and exhausted. Some were too weak to walk and had to be lifted out of the boats.

"When the Arcadia started toward Baltimore the Templemore was aflame from bow to stern."

The appearance of the Templemore's crew attested the harrowing experiences through which they had passed. Their faces bore marks of the battle they had waged against the flames and one of the mates had his arm in a sling. Captain Jones had lost his cap and wore one which had been given him by Captain George Boldt, commander of the Arcadia.

The Marconi operator, Emanuel, and Captain Jones were the last to leave the Templemore.

"I had just finished taking down press from Arlington," said Emanuel, in telling about the fire, "when the captain came to me and told me to send out at once a distress signal. Immediately I sent out S. O. S. which was answered by the Hamburg-American liner Arcadia. We exchanged ships' positions and found them to be within fifty miles range of each other. I then told the Arcadia that fire had broken out and to hurry up and come as quickly as possible. The Arcadia answered, 'Coming full steam, we will be with you soon.' I kept in communication with her until twelve o'clock on the power set. She then called me up again and said that she could not see our rockets, but was making all haste. The distance between the two vessels was then about thirty-five miles.

"Then the ship's dynamo went out of commission and I put on the accumulators. I then worked the auxiliary set by the light of a candle which was given me by the chief steward. The captain and I were the only two left on board, and I used the accumulators at short intervals. At no time did they show signs of weakening, and in fact the whole outfit was in perfect condition and operated very successfully. The smoke was becoming dense in the wireless cabin and the flames were spreading, so the captain compelled me to leave the cabin with him. We had to leave so quickly that I was unable to save any of my effects and could carry away only what I was wearing."

Emanuel's first S. O. S. call was answered by Alfred Freeman, wireless operator aboard the Arcadia. While Emanuel sent messages giving the position of the burning ship, Freeman replied with words of encouragement. The assistant wireless operator on the Templemore was J. H. Miller.

The value of the Templemore and her cargo is estimated at $700,000.

S.O.S. EFFECTS ANOTHER RESCUE

For the second time within less than two months wireless telegraphy has saved passengers and crews of vessels owned by the Pacific Coast Steamship Company from finding graves along the Western coast. On August 17 the steamship State of California struck an uncharted rock in Gambier Bay and sank after Donald Perkins, the wireless operator aboard, had sent out the S. O. S. call which resulted in the rescue of a considerable number of her passengers and men. On the night of October 3 the steamship Spokane went ashore on the beach off Cape Lazo, B. C., and her wireless man brought to the aid of those on board the freighter La Touche. The rescue ship found the survivors of the Spokane in lifeboats and took them aboard.

Cape Lazo is 100 miles north of Victoria. The coast in this section is extremely dangerous.

The first call for assistance sent out by the Marconi operator on the Spokane following her last mishap gave the regular distress signal, S. O. S., and was followed by a brief message:

"Sinking fast. Rush help."

Several steamers heard the call. The freighter La Touche, of the same line, announced that she was nearest to Cape Lazo, but in order that there might be no lack of assistance the steamships Dolphin, Minnesota and Alki followed La Touche.

At half past ten o'clock, a few hours after the distress signal had gone forth, La Touche reached the scene of the wreck. The work of transferring the occupants of the life boats to the freighter began fifteen minutes later.

The Spokane was a vessel of 2,056 tons net, 4,000 gross tonnage, 270 feet long, schooner-rigged, and had triple-expansion engine developing 2,000 horsepower. She was built at the Union Iron Works, San Francisco, in 1902, for the Pacific Coast Company.

She left Ketchikan, Alaska, her last American port of call, with 108 passengers aboard. At Prince Rupert she picked up a dozen more. As cargo the vessel carried 16,000 cases of canned salmon and about 100 tons of fresh fish.

INSTRUCTION TO BOY SCOUTS

By A. B. COLE

CHAPTER II

Batteries for Wireless Telegraph Use

THE simple primary cell illustrated in Fig. 3 would not be satisfactory for operating wireless spark cells, because its E. M. F. would diminish rapidly in actual service. This drop in E. M. F. is due to the formation of small bubbles of hydrogen gas upon the surface of the carbon, or negative electrode, caused by the chemical action of the cell. This gas accumulates until the entire surface of the carbon plate is covered with it, when practically no current can be drawn from the cell, on account of the high resistance of the hydrogen bubbles, which are an insulator. When the negative electrode becomes covered with a film of hydrogen gas it is said to be *polarized*.

All practical cells provide some means of eliminating the hydrogen. In many types of cell some material is placed in or around the negative electrode to absorb the gas as quickly as it is formed. This material is known as a *depolarizer*.

DRY CELLS.—The general construction of a dry cell is shown in Fig. 7. (A) is a zinc cylinder in close contact with an inner cylinder of a special variety of blotting paper, which is saturated with a mixture of salammoniac and other chemicals which retain moisture. Inside the paper cylinder (B) and around the carbon plate (C) a quantity of manganese dioxide and powdered carbon is very tightly packed. The top of the cell is then sealed to prevent access of air by pouring in hot asphaltum.

A dry cell is not actually dry, since the paper cylinder (B) must be moist if the cell is to operate. As soon as one of these cells dries out it will no longer give current. Dry cells are made, however, which will not dry out for a year or more if not used. The E. M. F. of any ordinary dry cell is 1.5 volts, and this does not depend upon the size of the cell. The E. M. F. of a large cell will be the same as that of a small one, but the ampere hour output will, of course, be greater.

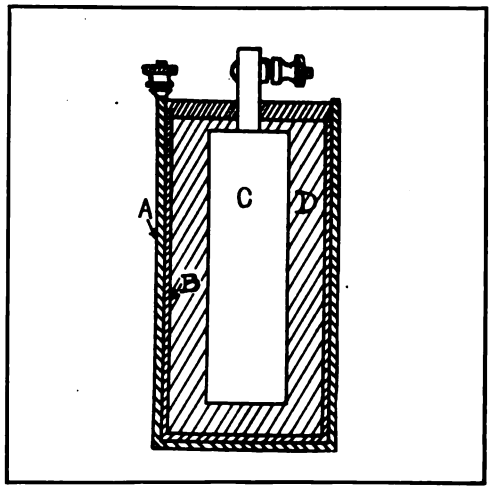


Fig. 7.—Construction of a Dry Cell

Experimenters should not attempt to build dry cells for practical purposes, since considerable experience is required and since the use of special machinery to pack the depolarizer is necessary to produce a good cell.

Not more than three-quarter ampere should be drawn from the regular size dry cell for any considerable length of time, as the use of a greater current will cause the cell to polarize, with a consequent drop in E. M. F.

Dry cells have the remarkable characteristic that, if allowed to stand idle for a time, they will recuperate and the E. M. F. will return to almost its original value. For this reason they are especially adapted to intermittent service. Dry cells are the most satisfactory kind for field work, since they have no loose liquids to spill, and can be readily packed in quite a small space. The weight of the average cell of regular size is about two pounds.

THE FULLER CELL.—The Fuller cell is especially useful in station outfits, and is not portable. The E. M. F. is close to two volts per cell, and a large current may be taken from it for a con-

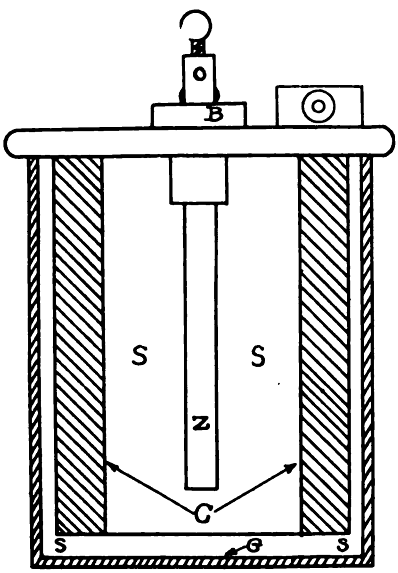


Fig. 8.—Simple Fuller Cell

siderable length of time with a small drop of E. M. F. The simplest type of this cell for wireless purposes is made from an ordinary carbon cylinder cell, such as is used for doorbell work. This cell consists of a carbon cylinder (C) set in a glass jar (G), the cylinder having a hole at the top into which a porcelain bushing is fitted. The bushing (B) holds the zinc rod (Z) in place. The solution or electrolyte (S) contained in the jar is composed of the following chemicals: 2 pounds of sulphuric acid, dissolved in 3 quarts water; 1 pound bichromate of potash, dissolved in 1½ quarts water.

The acid *must* be poured *slowly* into the water, never the water into the acid, on account of the high temperature which the mixture will have. If the water were poured into the acid the mixture would become very hot and splash. Remember that the acid or solution will burn its way through any kind of cloth and will burn the skin. If any should come in contact with the skin it should be washed off immediately with cold water.

After the acid solution has been slowly made and allowed to cool off, the bichromate solution may be poured into it. This solution should be made by breaking the bichromate into small pieces before attempting to dissolve them. This will save considerable time.

The zinc rod should be amalgamated by rubbing it with mercury until it is entirely coated with it, as otherwise the acid solution would dissolve the zinc at an excessive rate.

The zinc should be withdrawn from the solution as soon as the cell is no longer required. This preserves it from the action of the acid.

This type of cell gives excellent results in operating the spark coils of wireless stations and in other work requiring a high E. M. F. and large current. It has the disadvantage of employing acid in its solution, which will damage almost any material with which it may come in contact, and for this reason the cell must be carefully handled to prevent spilling. It is one of the best cells for wireless use, however, and no equally powerful cell has been invented employing an acid solution.

The storage cell is a type which is in general use for operating the spark coils of wireless equipment. Its normal E. M. F. is high, about 2 volts, and a much larger current can be taken from it without injury, even in the small sizes, than from a dry cell.

When a storage cell has been exhausted, it may be renewed, or "Recharged," by proper connection with a source of current, such as an electric lighting circuit or a dynamo.

Fig. 9 illustrates a complete commercial storage cell in a glass jar.

The capacity of a storage cell is measured by the number of amperes which it will deliver for a certain length of time before it becomes exhausted. This length of time is 8 hours for any size cell of the type to be described. The cell shown in the cut is rated as having a capacity of 15

Fig. 9.—Small Storage Cell

ampere hours, that is, it will deliver 1⅞ amperes for 8 hours. The charging rate is the same as that of discharge. If a storage cell is allowed to discharge in less time than 8 hours, that is, to deliver a greater current than the normal for a shorter time, the plates are likely to be injured. Thus, it will be possible to take 3 amperes for about 5 hours, at the risk of injuring the cell, or ½ ampere for 30 hours. At this rate the cell will have a very long life.

The form of one type of electrode or plate of a storage cell is illustrated in Fig. 10. This plate is a casting of lead having spaces into which the "paste" is set. In Fig. 11 we show a mould for casting the plates. It is made from a block of wood, cut out with a small chisel to give the proper shape to the plates. All the wood which is cut out is that which forms the plate itself when the hot lead is poured into the mould, and the small projections which are left form the spaces or holes in the plate which serve to hold the active material or "paste." The projections are ¼ inch wide and ⅜ inch long, and are spaced apart

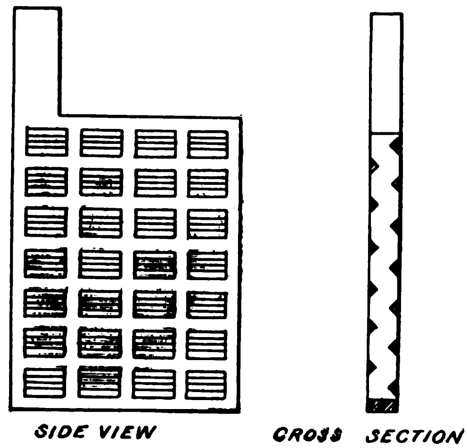


Fig. 10.—Plate of Storage Cell

about ¼ inch. The oblong piece at the top of the plate is called the "lug," and serves as an electrical connection with the plate when the cell is assembled. The lug projects above the acid solution.

A good grade of lead should be employed in casting the plates. This may be obtained from a local hardware or plumbing store. The mould should be protected from the hot lead by rubbing chalk thoroughly over its surface. This will also assist in the easy removal of the plates from the mould. As soon as the casting cools sufficiently to become strong, the mould should be turned upside down, and the casting will fall out. If the casting is allowed to cool off too much, it will be a more difficult matter to remove it. A little experimenting will serve to show the proper time for removal. Three cells should be made to operate a one-inch spark coil, or four cells for a two-inch coil.

After the castings of the plates have become cold, the spaces are to be filled with the paste, which is made of a mixture of red lead and sulphuric acid, or litharge (lead monoxide) and sulphuric acid, depending upon whether the plate is to be a positive or a negative. The acid for the mixture is about 20% acid and 80% water. Only sufficient is used to make the paste moist. The red lead and litharge can be obtained from a hardware or drug store. After the paste is set in place it should be allowed to dry thoroughly, when it will become hard.

A negative and a positive plate are then placed in a glass jar and are separated by a thin strip of wood. A dilute acid solution consisting of 25% sulphuric acid and 75% water is then poured slowly into the jar, and the cell is ready to be charged. In commercial practice, one more negative than positive plate is used, but in a small experimental cell it is better for the beginner to use

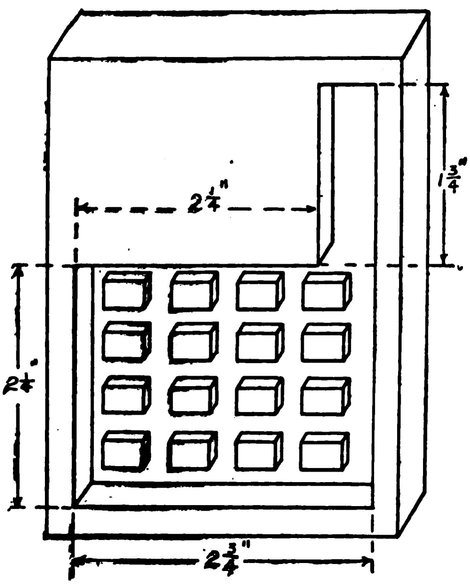


Fig. 11.—Mold for Plate

one of each, as there will be less chance of making mistakes, and the cell will give good results.

Where the cells are designed for portable use, a strip of hard rubber is made to fit around the lugs inside the top of the jar, and then the top of the cell is filled with asphaltum, which is used in the tops of dry cells. A hole is left through the sealing compound to the acid solution so that the gases formed during the process of charging the cell may escape.

CHARGING THE CELL.—The finished cell is to be charged from a source of direct current. Alternating current will not do, unless changed to direct by a rectifier.

Usually, the best method of recharging is afforded by a direct current lighting circuit. The proper method of connection is shown in Fig. 12, (L) represents one 32-candlepower *carbon filament* lamp.

The positive wire of the supply circuit *must* be connected to the positive pole of the battery of cells. A simple way of determining which is the posi-

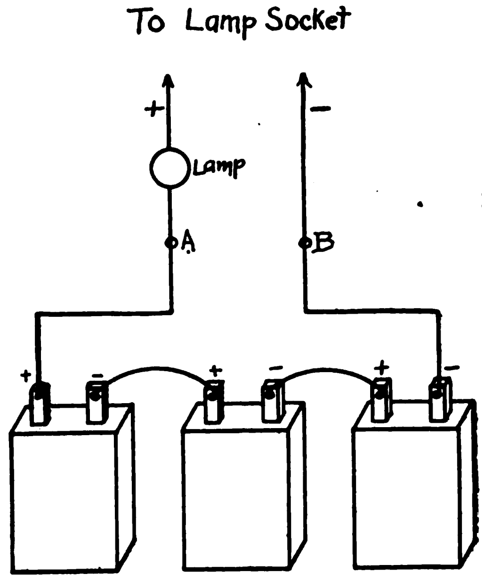


Fig. 12.—Charging Diagram

tive wire is to insert both in a glass of water containing a small quantity of common salt. The wire at which most bubbles appear in the solution is the *negative*. To make this test, use the wires so that the current must first pass through the lamp before entering the solution, by taking the wires from the points (A) and (B) shown in the diagram. Under no circumstances take the wires directly from the lamp socket, since by so doing considerable trouble may result.

The operator should attempt to always charge and discharge storage cells at not more than the normal rate. After the cell has been charged, the positive plate will turn a dark brown color, and the negative will become a light gray.

Storage cells should not be allowed to stand in a discharged condition, but should be recharged immediately to prevent *sulphation,* which is caused by the action of the acid solution upon the plates when in a discharged condtion.

Care should be exercised in handling the cells not to allow any of the acid to some in contact with cloth, as the acid would attack it rapidly, leaving a bright red mark. Such marks, or drops of acid on the cloth, should be washed at once with strong soap and water.

One method of recharging storage cells, where a direct current lighting circuit is not available, is to connect a large number of old dry cells in multiple series as explained a little later on. A set made up of 24 dry cells arranged 6 in series, four in parallel, will give fair results in charging three storage cells. If four storage cells are to be charged, 32 dry cells should be used in sets of 8 in series, four in parallel. The dry cells can be obtained from almost any garage, where the old ones are taken out of automobiles.

In charging storage cells in this way, always connect the carbon, or positive terminal of the set of dry cells, to the positive terminal of the battery of storage cells.

METHODS OF CONNECTING CELLS.—Any number of cells of any type may be connected in several different ways, depending upon the character of the work required of them. One of these is known as the *series* method of connection, and is illustrated in Fig. 13, which shows three dry cells connected in this way. The positive pole or the carbon of the first is connected to the negative pole or zinc of the second, the positive of the second

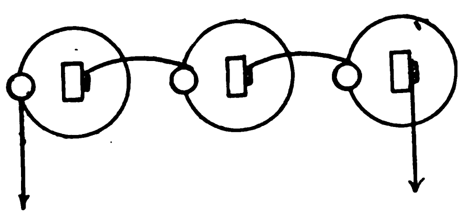


Fig. 13.—Cells in Series

to the negative of the third, and so on. The remaining poles, the zinc of the first, and the carbon of the last, are taken as terminals of the battery of cells thereby formed.

This method of connection corresponds to arranging three tanks of water as shown in Fig. 14. The water pressure in this case will be the sum of the pressures of the individual tanks. In the same way the total E. M. F. of the electric battery will be the sum of those of the separate cells. If each cell has an E. M. F. of 1.5 volts, the total E. M. F. of a battery of three connected in series will be three times 1.5 or 4.5 volts, and the same rule will apply to any number of cells arranged in this way.

It will be readily understood that a battery of cells arranged in series will

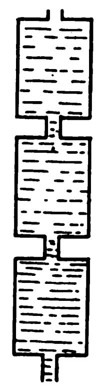


Fig. 14.—Tanks in Series

be capable of delivering only, as a total, at this pressure, the quantity or volume of current which any one of the cells would deliver, just as in the hydraulic system the quantity of the water at the total pressure will be that of any one tank, for as soon as the upper tank becomes empty, the pressure is reduced to that of only two tanks. Only similar cells should be connected in series if best results are desired, for a poor cell will impede the flow of current of the others.

MULTIPLE OR PARALLEL CONNECTION.—The method of connecting cells in multiple or parallel is illustrated in Fig. 15. All the positive poles are joined together by means of one wire, and all the negative poles are connected by another wire. These wires form the terminals of the battery.

The result of multiple connection is shown by the hydraulic system in Fig. 16. The pressure at the lower end of the outlet is equal to that of any one tank, but the total volume which the system can deliver is the sum of the capacities of all tanks. In like manner, the E. M. F. of three cells connected in multiple is equal to that of one cell, but the total volume of current which may be drawn will be the sum of those of the three cells.

Only cells of the same E. M. F. may be connected in multiple, for otherwise those of higher E. M. F. would force current against the others, just as in the hydraulic system the levels of the water in the several tanks must be the same.

MULTIPLE SERIES CONNECTION.—When cells are connected in a combination of both the multiple and series methods, they are said to be connected in "multiple series." Fig. 17 shows this method of connection applied to dry cells, although any type of cells may be arranged in this way, provided they are all of the same kind and size. This method comprises several batteries of cells in series, the series sets being connected in multiple.

This combination has the E. M. F. of any one of the series sets, and also the total current output of the number of sets which are connected in multiple. It has been found by actual test that two sets of dry cells connected in multiple series have three times the life of a single set, and three sets connected in this way may have from four to five times the life of a single set under ordinary conditions of use.

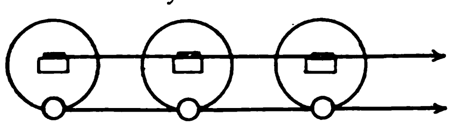


Fig. 15.—Cells in Multiple

Thus, if each cell of the battery illustrated in Fig. 17 has an E. M. F. of 1.5 volts and a total output of 25 ampere hours, the battery would have an E. M. F. of four times this quantity, or 6 volts, and since three series sets are connected in multiple, the total current output would be from four to five times 25 ampere hours, or about 115 ampere hours. In this arrangement, only 1/3 of the total current is taken from any one of the series sets, which results in much greater life of the individual cells.

If dry cells are employed to operate the spark coils of wireless telegraph sets, the multiple series method of connection is strongly recommended, for while the initial expense of the battery will be greater, the service obtained per dollar expended will be much greater, and the outfits will do better work on account of the low internal resistance of the battery so formed.

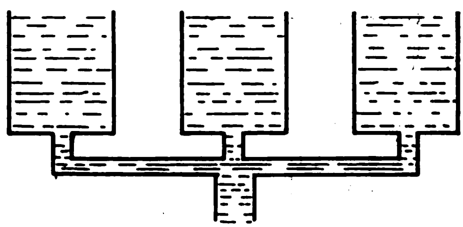


Fig. 16.—Tanks in Multiple

The diagram in Fig. 17 illustrates the proper method of connection for dry cells to operate a one-inch spark coil.

Chapter III

Magnets and Magnetism.

Since magnets and magnetism play very important parts in the operation of wireless telegraph equipment, a knowledge of the laws and actions is essential to an understanding of wireless apparatus.

A piece of iron or steel which has the power of attracting other bodies of these materials is said to be a *magnet* and to have *magnetic* properties. Any piece of iron or steel may be made magnetic by several methods. If a bar of steel is rubbed over one end of a magnet, it will be found to have become a magnet itself. It may retain its magnetism for a considerable period of time, in which case it is said to be a permanent magnet. A bar of soft iron will retain its magnetic properties for only a short time, and for this reason all permanent magnets are made of steel.

There are several kinds of permanent magnets, of which the bar and horseshoe types are most generally used.

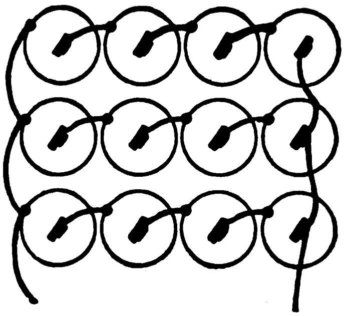


Fig. 17.—Cells in Multiple Series

They are given these names on account of their shapes, which are shown in Fig. 18.

MAGNETIC FIELD OF FORCE.—If a quantity of iron filing are placed upon a flat piece of paper, held immediately above a horseshoe magnet, and the paper is tapped lightly, it will be found that the filings arrange themselves illustrated in Fig. 19, which shows that most of them remain between the ends of the horseshoe.

If the same process is followed with a bar magnet, the final arrangement will be as shown in Fig. 20. The ends of the magnets, near which most of the filings come to rest, and where the

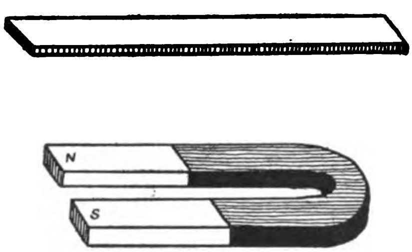


Fig. 18.—Bar and Horseshoe Magnets

greatest magnetism is manifest, are known as the *poles* of the magnet. One is called the North pole, and the other the South pole, since if a bar magnet is suspended from a very light thread from its center its North pole would, in time, point toward the North magnetic pole of the earth.

The paths along which the filings arrange themselves in the above experiment are known as the *magnetic lines of force,* or simply the lines of force,

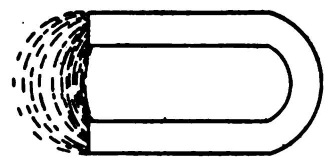


Fig. 19.—Field of Horseshoe Magnet

of the magnets. The space in which the filings are effected by the magnet is termed the *magnetic field* of the magnet. Lines of force are only imaginary lines, but the idea is useful in understanding the actions of magnets.

ELECTROMAGNETS.—If a coil of insulated wire is wound around a bar of soft iron, and a current of electricity is caused to flow around the coil, the bar

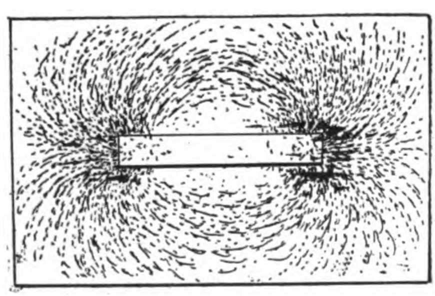
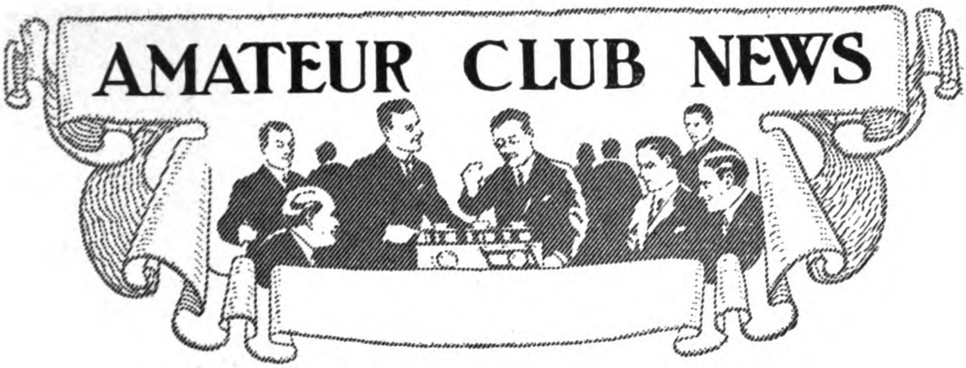


Fig. 20.—Field of Bar Magnet

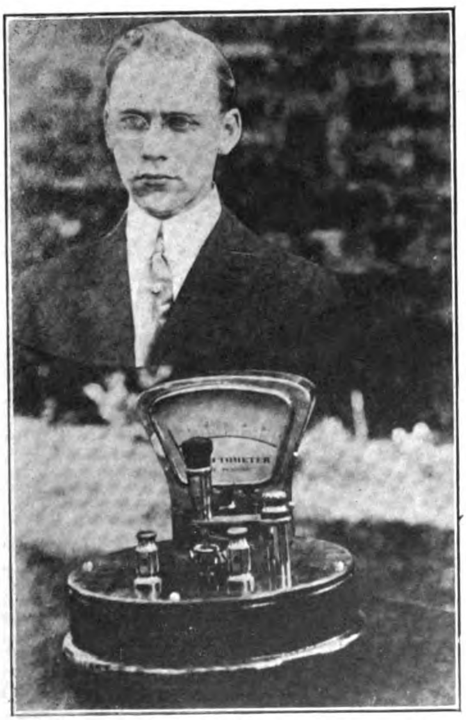
will show all the magnetic properties of a permanent magnet while the current continues to flow, but immediately upon the cessation of the current it will return to its original condition. If a bar of steel were used instead of soft iron, it would continue to act as a magnet after the current had ceased to flow. The magnet formed by winding the wire around the bar of soft iron is called an *electromagnet.*

This is the second installment of instruction for Boy Scouts. The third lesson by Mr. Cole will appear in an early issue.



In his efforts to improve wireless telegraphy, Arthur G. Carlson, of North Easton, Mass., has invented a detectometer, which has been given a test at a Government station, as well as on an ocean liner. The results have been very gratifying. With the device, it is claimed, Carlson can always be positive of receiving a message at the time it is sent.

He has arranged a meter or scale where a pointer reads the adjustment. At a certain position on the meter messages can be recorded loudly and distinctly. Any electrical disturbance will move the needle so that it becomes apparent at once that the adjustment is not right.



Arthur G. Carlson and His Detectometer

Carlson was born in North Easton, August 19, 1894. He attended the grammar schools in North Easton, and this year was graduated from the Oliver Ames High school, where he installed a wireless outfit. He has received messages from as great a distance as 2,500 miles.

The atmosphere over Milwaukee, Wis., will be a jungle of wireless "flashes" between seven and eight o'clock every night before long. This is the hour when, under the law, amateurs will have the air to themselves for wireless messages, and the Y. M. C. A. boys' department has organized the city's young wireless enthusiasts into a club to promote the building and operating of radio apparatus.

A wireless specialist from the engineering school will move his outfit to the boys' building, where it will be installed in the skylight room on the second floor. The 150-foot Y. M. C. A. chimney will serve to bear the antennæ by means of which the flashes will be snatched out of the atmosphere and conducted down to the receiving apparatus, to be translated into the dots and dashes of the telegraphic code. The class is in two sections, and two meetings will be held each week to give the members instruction in wireless telegraphy.

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By Wm. H. Priess, R. E.

ARTICLE II

Multiplication

23. In arithmetic multiplication is the simple process of taking one member as many times as there are units and fractions of a unit in the second number. Usually the multiplier and multiplicand are whole integers, positive, and of the first degree. On the other hand, algebraic multiplication generally consists of a multiplier and a multiplicand, comprising several terms. These terms may be positive or negative, and of various powers. Thus, besides the process of finding the product of two positive numbers of the first degree, we must also deal with quantities which may consist of many positive or negative terms of a higher power than unity.

24. *Multiplication is an abbreviated process of addition or subtraction. It consists in adding or subtracting one quantity as many times as there are units and fractions of a unit in the second quantity.*

Instead of writing,

$$+a+a+a+a$$

we may simplify and condense this expression, by using the algebraic multiplication form,

$$4 \times a \text{ or } 4a;$$

and instead of

$$-a-a-a-a$$

we may write

$$-4 \times a \text{ or } -4a$$

By $a \times b$ is meant that a is to be added as many times as there are units in b. If $b = 5$

$$a \times b = 5a$$

Law of Signs

25. In regard to the sign of the product, it naturally depends upon the sign of the multiplier (whether we are adding or subtracting), and likewise upon the multiplicand (whether the quantities we are adding or subtracting are positive or negative quantities). If we examine the following four possible combinations of signs,

$$+4 \times (+a) = +a+a+a+a = +4a$$
$$+4 \times (-a) = -a-a-a-a = -4a$$
$$-4 \times (+a) = -a-a-a-a = -4a$$
$$-4 \times (-a) = +a+a+a+a = +4a$$

we find that the multiplication of two quantities *each* of which is +, or —, terminates in a + product; while the result of multiplying two quantities of different signs, one of which is + and the other —, is a — product. This is known as the law of signs. *Briefly stated, like signs produce a positive, unlike signs a negative product.*

A practical physical illustration of the actuality of this statement may be found in the character of the work done, when a charge of positive or negative electricity placed in an electric field, is moved in the direction of the field (lines of electric force) or against that direction. In Figure 2 the parallel lines represent the electric field, having the direction shown by the arrow tips, and for the sake of simplicity it is assumed to be parallel uniform, and of unit intensity. The distance d in the direction of the field is called $-d$, and in the opposite direction $+d$. In (a), the positive charge $+q$ is placed in the field, and in (b), the negative charge $-q$ is likewise placed in the field. Arrows placed on the charges indicate the directions that the charges tend to move. If a body is acted on by a force, and moves against that force, *work is done on that body,* i. e., it can itself do work because of its displacement. *This work is positive,* for if the body is released it will return to its original position, and deliver up the energy that has just been given to it. If a body is acted on by a force, and moves in the direction which the force urges it, *the body does work,* i. e., the body will drag an object to its new position. *This work is negative,* for we must expend positive work to return the body to its original position. This discussion may be applied to the case now being considered. The work required

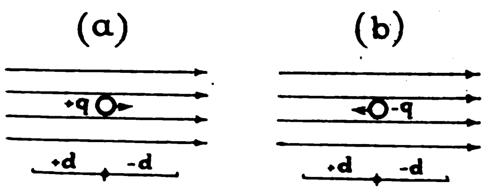


Fig. 2

to move an electric charge *q,* a distance *d* parallel to a uniform electric field of unit intensity, in which the charge is placed, is equal (regardless of the sign) to the product of the distance and the charge. In this case

$$\text{Work} = qd.$$

A positive electric charge tends to move in the direction of the field which surrounds it. Therefore, if [diagram (a)] we move the charge $+q$, a distance $+d$, we *do work on the charge,* which according to the previous explanations is positive, and equal to $+qd$. If we move the charge $+q$. a distance $-d$, the *charge does work,* and from the same reasoning, the work is negative and equal to $-qd$. If on the other hand [diagram (b)] we move the charge $-q$, *a* distance $+d$, the charge moving in the direction the forces urges it, *does work.* The resultant work, is therefore negative, and equal to $-qd$. To move the charge $-q$ a distance $-d$, we must *do work on it;* this work being performed on the charge is positive and equal to $+qd$. These results can be placed in the following table,

$$\text{Force} \times \text{Distance} = \text{Work}$$
$$+q \times +d = +W$$
$$+q \times -d = -W$$
$$-q \times +d = -W$$
$$-q \times -d = +W$$

It is to be understood that the above results do not originate from mathematics, but are the result of trial, confirmed by laboratory and mathematical experience.

Index Law

26. *When the same letter appears in both the multiplier and the multiplicand, its product is expressed by the sum of the indices of that letter.* For since

$$a^3 = a \times a \times a$$
$$\text{and } a^2 = a \times a$$
$$a^3 \times a^2 = a \times a \times a \quad \times a \times a = a^5 = a^{3+}$$

Keeping in mind the fact that the multiplier and multiplicand can be interchanged without altering the product, we then have all the information necessary to perform the function of multiplying two expressions.

Multiplication of Expressions

27. In the example $(a + b)\,c$, each term of the multiplicand must be multiplied by c;

$$(a + b)c = ac + bc.$$

It is convenient to enclose an expression in a parenthesis ( ), when we wish to indicate that it is to be treated as a factor of the product.

In the example $(a + b)\,(e - f)$, the apparent complexity of the problem may be made to vanish by substituting a letter—for instance *g*—for the multiplier $(e - f)$. The example then reduces to $(a + b)\,g$, which has the simple solution,

$$(a + b)g = ag + bg.$$

Substituting for g its value $(e - f)$, we have

$$ag + bg = a(e - f) + b(e - f);$$

which reduces to

$$ae - af + be - bf.$$

In short, to multiply one expression by another, we multiply each term of the multiplier by each term of the multiplicand, giving every letter its proper index, and writing the answer as the sum of the partial products, which partial products are preceded by their correct signs. It is readily seen that if terms contain coefficients, the partial products will also contain coefficients, which do not remain in the answer as factors, but are multiplied out to form the new coefficients.

$$(3a^2b - 4bc^2)(ab^2 + 3c^2)$$
$$= 3a^3b^3 + 9a^2bc^2 - 4ab^3c^2 - 12bc^4.$$

Arrangement of Work

28. In multiplying two expressions we arrange each according to the descending powers of some letter, and write them in rows one under the other. Then multiply each term of the upper row by each term of the lower row, arranging the partial products in rows with like terms in columns. The addition of these partial products, evolves the required answer.

Multiply $(2ab + 3a^2 - b + b^2)$
by $(a^2 - b^2 + 2ab)$

Arrange both expressions according to the decending powers of some letter (for instance *a*) in horizontal rows, and follow rules laid down above.

$$\begin{array}{l}
3a^2+2ab-b+b^2 \\
a^2+2ab-b^2 \\
\hline
3a^4+2a^3b-a^2b+a^2b^2 \\
\quad +6a^3b \quad +4a^2b^2-2ab^2+2ab^3 \\
\quad\quad -3a^2b^2 \quad -2ab^3+b^3-b^4 \\
\hline
3a^4+8a^3b-a^2b+2a^2b^2-2ab^2 \quad +b^3-b^4
\end{array}$$

29. Of special interest are the three following and often recurring cases, that are well to memorize.

(a) The square of the sum of two quantities,

$$(a + b)^2 = (a + b)(a + b) = a^2 + 2ab + b^2.$$

(b) The square of the difference of two quantities,

$$(a - b)^2 = (a - b)(a - b) = a^2 - 2ab + b^2.$$

(c) The product of the sum and difference of two quantities,

$$(a + b)(a - b) = a^2 - b^2.$$

30. In the circuit illustrated in Figure 3, a battery (B), in series with a generator (G), supplies a difference of potential across the condenser bank (C_1, C_2), when the series key (K) is closed. The condenser forms an element of the oscillating circuit consisting of the disc discharger (D), and the inductance L. It is required to find (a) The energy stored up in the condenser bank, at each charge, if the voltage of the battery is V_1 volts, the voltage of the generator V_2 volts, and the capacity of the condenser units C_1 and C_2 microfarads (μ f. s.) respectively; (b) The rate of input into the oscillating circuit if the disc discharger produces a spark frequency of *n* per second. The energy stored up in a condenser is expressed by the equation

$$J = \frac{1}{2,000,000} CV^2 \text{ joules,}$$

or replacing $\frac{1}{1,000,000}$ by 10^{-6},

$$J = \tfrac{1}{2}CV^2 \times 10^{-6} \text{ joules} \qquad (1)$$

where C is in μ fs., and V is in volts.

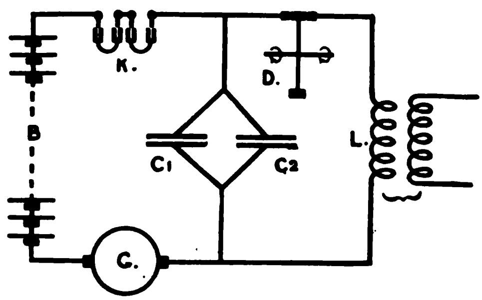


Fig. 3

A *joule* is that amount of energy expended in a second, when a current of one ampere passes through a resistance of one ohm. The *rate of input* is the number of joules a second delivered to a circuit, and is expressed in terms of *watts*. A watt corresponds to an input rate of one joule a second. In the case under consideration, since there are J joules expended each time the condenser is charged, and as we have n charges a second, then,

$$W = nJ \text{ watts,} \qquad (2)$$

or from (1)

$$W = \tfrac{1}{2}nCV^2 \times 10^{-6} \text{ watts.}$$

Substituting for V_1 in equation (1), its value ($V_1 + V_2$), and for C, its value ($C_1 + C_2$), the expression for the energy in the condenser may be written

$$J = \tfrac{1}{2}(C_1 + C_2)(V_1 + V_2)^2 \times 10^{-6} \text{ joules}$$
$$= \tfrac{1}{2}(C_1 + C_2)(V_1^2 + 2V_1V_2 + V_2^2) \times 10^{-6} \text{ joules}$$
$$= \tfrac{1}{2}(C_1V_1^2 + 2C_1V_1V_2 + C_1V_2^2 + C_2V_1^2 + 2C_2V_1V_2 + C_2V_2^2) \times 10^{-6} \text{ joules.}$$

The rate of input from equation (2) is

$$W = nJ = \frac{1}{2}n(C_1 + C_2)(V_1 + V_2)^2 \text{ watts.}$$

If $V_1 = V_2$, and $C_1 = C_2$, then

$$J = 4C_1V_1^2 \times 10^{-6} \text{ joules,}$$
$$W = 4nC_1V_1^2 \times 10^{-6} \text{ watts.}$$

Further if $V_1 = 5{,}000$ volts, $C_1 = .002\ \mu$ f. and $n = 1{,}000$

$$J = 4 \times .002 \times (5000)^2 \times 10^{-6} = 0.2 \text{ joules}$$
$$W = 4 \times 1000 \times .002 \times (5000)^2 \times 10^{-6} = 200 \text{ watts.}$$

The high-power Marconi stations successfully employ this principle in transacting commercial business.

Division

31. In multiplication two factors were given, and we were required to find their product. In division we are given one factor and a product; the problem being to find the other factor. Division is therefore the inverse of multiplication. It is evident that a law of signs and indices must enter the discussion. This is found to be the case.

Sign Law

32. As in multiplication, so in division, *like signs produce a positive, unlike signs a negative quotient.*

For since $(+a) \times (+b) = +c$, therefore $\frac{+c}{+b} = +a.$

For since $(+a) \times (-b) = -c$, therefore $\frac{-c}{-b} = +a.$

For since $(-a) \times (+b) = -c$, therefore $\frac{-c}{+b} = -a.$

For since $(-a) \times (-b) = +c$, therefore $\frac{+c}{-b} = -a.$

Index Law

33. *When the same letter appears in the division and the dividend, its quotient is expressed by that letter, raised to a power equal to the difference obtained by subtracting the index of the divisor, from the index of the dividend.*

$$\frac{a^5}{a^2} = a^3 \times \frac{a^2}{a^2} = a^3 = a^{5-2}$$

If the index of the division is greater than the index of the dividend, the answer is a fraction.

$$\frac{a^5}{a^7} = \frac{a^5}{a^5} \times \frac{1}{a^2} = \frac{1}{a^2}$$

According to the rule, the difference of the indices is —2. Therefore, to make the rule general, we must interpret a quantity with a negative index as the equivalent of a fraction, the numerator of which is unity, and the denominator of which is that quantity raised to the corresponding positive index.

$$a^{-3} = \frac{1}{a^3}$$
$$a^2b \times^{-2} = \frac{a^2b}{x^2}$$

If the difference of the indices is zero, the result is unity, and the letter disappears from the quotient (being replaced by $+ 1$).

$$a^3b^2c^2 \div a^2b^3c^2 = a^{3-2}b^{2-3}c^{2-2} = \frac{a}{b}$$

Keeping the additional fact in mind, that multiplications and divisions can be performed in any order, the reader has at his disposal enough information to perform directly, simple algebraic division.

Division of an Expression by a Term

34. In dividing the expression $(a + b)$ by c, we divide each term of the dividend $(a + b)$, by the divisor c.

$$\frac{(a+b)}{c} = \frac{a}{c} + \frac{b}{c}$$

From inspection of the example,

$$\frac{a^2b + 3c^2d - 2a^3b^4c}{2a^2bc} = \frac{1}{2c} + \frac{3cd}{2a^2b} - ab^3$$

we may formulate the rule for the division of an expression by a term. To divide an expression by a term, divide every term of the dividend by the divisor, giving each letter its proper index, and each term its proper sign, writing the answer as the algebraic sum of *the partial products.*

Division of an Expression by an Expression

35. In dividing one expression by another, the process is a roundabout one; resolving itself into the problem of finding one factor, giving the other factor and the product. It is best understood by taking a solved problem and working back so as to obtain the method.

$$(a+b)(b^2+a^2+2ab) = 3ab^2+a^3+3a^2b+b^3$$

Let it be required to find the quotient of $3ab^2 + a^3 + 3a^2b + b^3$ is the dividend, and $(a + b)$ the divisor. The answer is obviously $(b^2 + a^2 +$

$2ab$). Rearrange the terms according to the descending powers of the letter a, and write the equation in the following form,

$$(a + b)a^2 + (a + b)2ab + (a + b)b^2 = a^3 + 3a^2b + 3ab^2 + b^3$$

Then it is evident that the first term in the dividend a^3 (containing the highest power in a), is made up of the product of a^2 and the divisor $(a + b)$. Perform this multiplication, and subtract the product from each side of the equation. Multiplying and subtracting (indicated by cancellation),

$$\cancel{a^3} + \cancel{a^2b} + (a + b)\,2ab + (a + b)\,b^2 = \cancel{a^3} + \cancel{a^2b} + 2a^2b + 3ab^2 + b^3.$$

a^2 is then the first term of the quotient. It is clear that $2a^2b$ (the term containing highest power of a in the remainder) is obtained through the product of the divisor $(a + b)$ and $2ab$. Performing this multiplication and subtracting the product obtained from each side,

$$\cancel{2a^2b} + \cancel{2ab^2} + (a + b)\,b^2 = \cancel{2a^2b} + \cancel{2ab^2} + ab^2 + b^3$$

the term $2ab$ forms the second term of the quotient. It is apparent that the remainder $(ab^2 + b^3)$ is the product of b^2 and the divisor $(a + b)$. If we multiply the divisor $(a + b)$ by b^2, and subtract its product from both sides, the remainder disappears. Therefore b^2 is the third and last term of the quotient. The process may be written in the following form,

$$\begin{array}{r|l}
 & a^2 + 2ab + b^2 \\ \hline
a + b & a^3 + 3a^2b + 3ab^2 + b^3 \\
 & a^3 + a^2b \\ \hline
 & \quad 2a^2b + 3ab^2 + b^3 \\
 & \quad 2a^2b + 2ab^2 \\ \hline
 & \qquad ab^2 + b^3 \\
 & \qquad ab^2 + b^3 \\ \hline
 & \qquad\qquad 0
\end{array}$$

From the example we have just examined, it is seen that four steps are required in division.

(1) *Arrange the terms of the divisor and dividend according to the descending powers of some common letter.*

(2) *Divide the first term of the dividend by the first term of the divisor; this gives the first term of the quotient.*

(3) *Multiply each term in the divisor by the term in the quotient we have just obtained, and subtract the resulting product from the dividend.*

(4) *Consider the remainder as a new dividend and repeat the process.*

If after dividing we find a remainder that does not contain the divisor, we write the answer as the sum of the terms we have obtained in the quotient; to this we add a fraction, the numerator of which is the remainder, and the denominator the divisor. Actual divisions are seldom performed in engineering problems because of the labor involved. Other methods are employed for approximation, which (in radio work) permit the use of an error of 0.5%, instead of the ordinary engineering error of 0.1%.

Simple Equations

36. *An equation is simple if it contains but one unknown quantity, and that quantity appears with the same index, throughout the equation.* This is by far the most common form of equation that the radio worker meets. For example, calculations of inductance, capacity and resistance, as well as combinations of the above for solutions for wave length and decrement, appear in the form of simple equations. The solution of such an equation consists in finding a value of the unknown quantity, that will reduce the equation to an identity, or an equation all terms of which contain nothing but known quantities.

Solution of Simple Equations

37. There are four axioms upon which the solution of all algebraic equations depend. These the reader may verify, by trying them on an identity consisting, of the sums or differences of integers. In an equation:

(1) *Equals added to equals, the sums are equal;*

(2) *Equals subtracted from equals, the differences are equal;*

(3) *Equals multiplied by equals, the products are equal;*

(4) *Equals divided by equals, the quotients are equal.*

We may illustrate the solution of a simple equation by the following example.

$$\frac{aX + b - c}{d + e} = g$$

From (3) $aX + b - c = (d + e)g$

From (1) $aX + b = (d + e)g + c$

From (2) $aX = (d + e)g + c - d$

From (4) $X = \frac{(d + e)g + c - d}{a}$

This is the answer required, for we have as a result an equation, one side of which contains x alone (or the unknown quantity), the other side nothing but known quantities. If the index of the unknown quantity were other than unity it can be reduced to unity by performing the inverse operation of that indicated by the index on both sides of the equation.

If $y^2 = a$

then $y = \sqrt{a}$.

and if $\sqrt[3]{z} = b$

then $3 = b^3$.

This is the second in a series of articles on mathematics by Mr. Priess. The third will appear in an early issue.

ERRATA

In the October issue of THE WIRELESS AGE the figures in the article on Elementary Engineering Mathematics, page 36, second column, following the phrase, "coefficients of the terms in the vertical rows," should have read as follows:

$+ 2a^2 + 3ab + 7b^2.$

$- 4a^2 + ab + 4b^2 + 3c^2.$

$+ 6a^2 + b^2 - 9c^2.$

$+ 4a^2 + 4ab + 12b^2 - 6c^2.$

On page 37, second column, in the same article, the expression "(currents in circuits A and B)," should have read, "currents in circuits A and C."

CAPTAIN BULLARD ABROAD

Captain W. H. G. Bullard, superintendent of the United States Naval Radio Service, sailed from New York on the Kaiser Wilhelm der Grosse on October 14. He will attend the International Conference on Safety at Sea to be held in London November 12, being one of the delegates of the United States recently appointed by the President.

GERMANY CURBS WIRLESS ACTIVITIES

Germany has taken decisive steps toward regulating the activities of amateur wireless operators in that country. The law of Germany now reads that private stations may be erected only on condition that the government shall have the privilege at any time of ordering their demolition.

The law was promulgated by the post-office and interior departments of Germany.

DELEGATES TO SEA SAFETY CONFERENCE

The following have been appointed by President Wilson to represent the United States at the International Conference on Safety at Sea, to be held in London on November 12:

Representative J. W. Alexander, of Missouri, chairman of the Committee on Merchant Marine; Senators Fletcher, of Florida, and Burton, of Ohio; E. T. Chamberlain, of New York, Commissioner of Navigation; Capt. E. P. Bertholf, of New Jersey, revenue cutter service; Rear Admiral Washington L. Capps, U. S. N.; Capt. Geo. F. Cooper, hydrographer of the United States navy; Captain W. H. A. Bullard, superintendent of the United States Naval Radio Service; Homer L. Ferguson, of North Carolina, general manager Newport News Shipbuilding and Dry Dock Company; Albert Gilbert Smith, of New York, vice-president of the New York and Cuba Steamship Company; Andrew Furuseth, of California, head of the Seamen's Union, and George Uhler, supervising inspector general of the Steamboat Inspection Service.

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.

C. F. J., Brooklyn, N. Y., sends us a circuit diagram of his receiving apparatus and inquires why he is not able to receive at distances of from 1,000 to 1,500 miles, as different magazines state he should be able to do. He also sends us a description of his equipment.

Ans.—Looking over your sketch we find you are using an inefficient hookup, and therefore you experience a decrease in range. We show in Fig. 1 a satisfactory hookup of the apparatus you have on hand.

Your diagram shows two fixed condensers in series with the galena detector. Taking into consideration the capacity for which these condensers are generally constructed, the resultant capacity will be too small. Note that we have connected the headphones around the fixed condenser; this gives increased strength of signals. The variable condenser which you have in shunt with the primary we have connected in shunt with the secondary. Do not be guided solely by statements made in magazines regarding the distances which ought to be covered with a given equipment. There are so many variable factors entering the case that no one can accurately prognosticate your range in advance. Keep in mind the fact that inefficiencies in receiving do not lie wholly in the apparatus, but may be largely governed by conditions external to the antenna.

* * *

L. A. V., New Orleans, La., says:

I note that you state on page 472, in the July issue of the *Marconigraph*, that a 60-cycle current is composed of 120 alternations per second, two alternations constituting a cycle; A. P. Morgan's book, "Wireless Telegraph Construction for Amateurs," gives the following definition for a cycle: Cycle—the full period of reversal of an alternating current; a 60-cycle current is one making 60 complete reversals per second.

I should be very thankful to you if you would explain this to me, as there seems to be a mistake somewhere.

Ans.—Mr. Morgan's statement, as well as ours, is correct. If you will pick up any elementary book on alternating currents, the first thing to meet your gaze will be a sine curve. We cannot give you a complete course of instruction in alternating current work, but, briefly, a sine curve is a graphic illustration in terms of trigonometry of the rise and fall of a complete cycle of alternating current. It gives instantaneous values of current during a complete reversal, and if you will note these books carefully you will see that the upper part of the curve is positive and the lower part negative. In other words, the upper half represents the values of current from the point of origin around the circuit and back again; the lower half represents the reverse condition; meaning that during one cycle the current flows around the circuit first one way and then in the opposite direction. Therefore a cycle is composed of two alternations. This matter is fully explained in the "Wireless Engineering Course," by H. Shoemaker, in the February issue of the *Marconigraph*. Back numbers can be secured by addressing the The Wireless Age.

(2) Please give me a good explanation regarding how to draw a wave curve to be used in connection with a wave meter to tell the wave length.

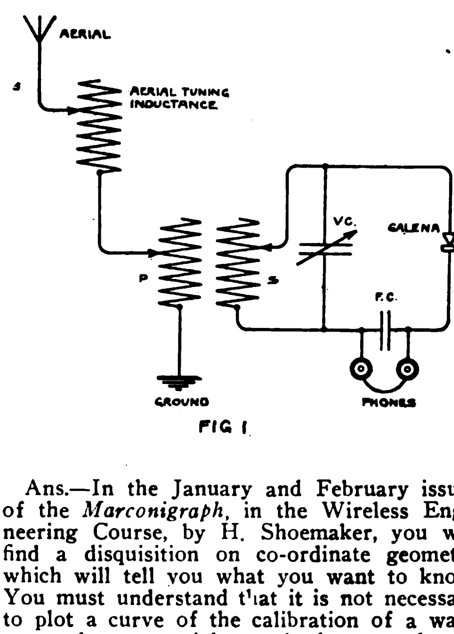


FIG 1

Ans.—In the January and February issues of the *Marconigraph*, in the Wireless Engineering Course, by H. Shoemaker, you will find a disquisition on co-ordinate geometry which will tell you what you want to know. You must understand that it is not necessary to plot a curve of the calibration of a wave meter, but you might mark the wave length direct on the wave meter scale. There is no reason why this cannot be done.

Briefly, a curve is plotted as follows: Suppose you are calibrating a wave meter having a variable condenser, and the scale of the condenser has a range of from 0 deg. to 500 deg., the wave meter being calibrated against a known source. For purposes of illustration, let us say that when the pointer of the variable condenser (the wave meter being calibrated) is placed at various positions on the variable condenser scale the following readings are obtained (from the calibrated meter):

Degrees on Condenser Scale Wave Meter Under Calibration.	Wave Length in Meters of Standard.
5	110
10	204
15	292
20	347
25	407
30	458

The values of wave length lying between these condenser readings mav be secured by plotting a curve on cross-section paper as in Fig. 2.

By a proper selection of the divisions on the paper we may divide the vertical lines into condenser readings and the horizontal lines into wave length.

Taking the first tabulation, 5= 110, we proceed along the vertical lines corresponding to 110 meters until we meet the horizontal line corresponding to condenser reading 5 and at the intersection of the two lines we place a dot or cross. For the remainder of the values in the table the points are located on the cross-section paper in the same manner. After the series of points are properly located, a line is drawn common to all.

Readings of wave length between the points of calibration may now be had (by reference to the curve). Taking the curve in Fig. 2, suppose the wave meter indicated resonance at degree 23 of the condenser scale, the horizontal line corresponding to 23 meets vertical line 385 on the curve; the wave length reading therefore is 385 meters.

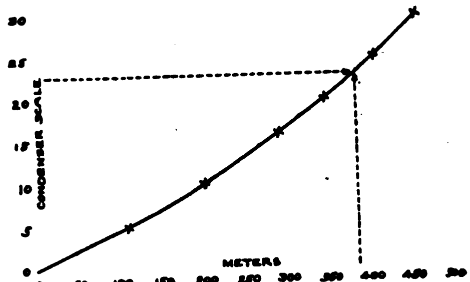
(3) How can a wave meter be calibrated with one that is already calibrated?

Ans.—This may be accomplished as in Fig. 3-A and B. Wave meter A, the standard is excited by a buzzer circuit, as shown; the magnets of the buzzer are shunted by a condenser of 2 mfds. capacity. When the buzzer is in operation wave meter A becomes a transmitter, sending out oscillations of a definite frequency. If wave meter B (the one of unknown calibration) is placed in inductive relation to A, it will absorb energy from A and will be in resonance with A at whatever point the condenser (of B) gives the loudest sound in the headphones. The coupling between L and L^1 should be kept as loose as is consistent with strength of signals.

For calibration, condenser C of wave meter A is then set at some definite wave length. The crystal of wave meter B is adjusted for sensitiveness and C^1 is varied until maximum response is procured from A. At the particular point at which C^1 is set, wave meter B obviously has the same wave length as wave meter A. Thus, a series of readings may be made on C and corresponding reading found on C^1; hence the calibration of the wave meter.

(4) What is the inductance of the following coil—wound on a tube, outside diameter 4 5/16 inches, length 4 1/16 inches, consisting of 53 turns of No. 18 bell wire D. C. C.[1]?

Ans.—The inductance of the coil is quite closely 41,200 centimeters.



CALIBRATION CHART.

FIG 2

(5) What would be the lowest and highest wave length to which the inductance mentioned in connection with a variable condenser of .0008 and .0004 mfds. capacity could tune to?

Ans.—At .004 mfds. capacity the wave length would be 762 meters; with .0008 mfds. in shunt with this inductance the wave lengh would be 342 meters.

* * *

W. J. C., St. Louis, Mo., asks:

Please give me names of makers of 500-cycle generators. I want a 120-watt generator, like that used in army scout work; the generator to be self-excited. I have written a number of manufacturers, but cannot locate the maker.

Ans.—Communicate with the Holtzer Cabot Manufacturing Co. for the 120-watt generator, 500 cycles.

* * *

B. S., Wilmington, N. C., asks:

(1) Is a pipe driven 10 feet in the earth a good ground for lightning only; if not, what would effect the purpose?

Ans.—If the pipe is driven in moist earth it may be considered as a fair connection for lightning discharges. We prefer, however, a zinc or copper plate buried in moist earth. A copper connection being brought to the surface, a plate 6 x 6 feet is sufficient.

(2) My wave length is about 250 meters using only a spark coil, condenser and gap; please give size of series condenser and oscillation transformer, with instructions how to make and use them to keep my wave length under 200 meters. My aerial has five wires 70 feet long with 80 feet "leadins"; the coil runs on six dry cells, using about eight volts.

Ans.—You will find helpful hints regarding the solution of the problem in the article in this issue of THE WIRELESS AGE entitled "A 200-Meter Amateur Set." As regards the series condenser, if we knew the exact capacity of your antenna we could answer your question very accurately. We do not know the spread or size of the wires, but can give you a calculation based on an aerial (80 by 70 feet) having four wires separated 2 feet. This will approximate the conditions of your stations.

A flat top antenna having four wires 70 feet in length and 80 feet from the earth will have a capacity of .00033 mfds. — inductance 65669 chms., and therefore a wave length of 277 + meters. To be reduced to a period of 200 meters the antenna should have a capacity of .000171 mfds. It will therefore require a condenser in series having a capacity of .000357 mfds.

The series condenser, then, may consist of a single plate of glass, 8 by 8½ inches, having foil on both sides of 5 by 5½ inches. This is calculated on the basis of the dielectric constant of glass being 7; as you have no facilities for making these calculations it is likely that you will have to vary the size of the foil. You will find, however, that our data fairly approximate the conditions and will be very nearly correct to reduce your antenna to a wave length of 200 meters.

* * *

H. D. J., Richmond, Cal. (S. S. Ascunsion), writes as follows: The other day I had an argument with the chief engineer about a generator. He said, "If a generator is put in vacuum it will not generate, as the machine will burn up immediately," He also said that "If there is no air around the machine it will not generate, as it is the movement of air which causes the current to be generated, the particles of air being charged with electricity."

My side of the argument was that the machine would generate no matter where it is located; electricity is supposed to be a movement of the ether; and if some means are at hand to cool the machine and overcome the heat caused by friction at the bearings it will generate in vacuum as well as in the open air.

Ans.—Electricity is not produced by friction between air and the dynamo armature, but is due to the fact that the armature wires are cutting through magnetic lines of force; this will take place in vacua as well as in air. The problem presents another possible condition; you should understand that partial vacuum is a better conductor than air at ordinary pressures. If, for example, a high potential generator (say 6,000 to 8,000 volts) were placed in vacuum there might be considerable conductance leakage. On the other hand, perfect vacuum (an impossible condition) has infinite insulation qualities and no conductance leakage would occur. Under these conditions the generator can perform its functions quite as well as in air, if not better, at least as far as generation of electricity is concerned.

(2) I should like information on the Marconi high frequency sets, with the rotary gap on the shaft of the motor-generator. I note that when a distant transmitting station is sending, and after the machine attains its maximum speed, the spark is not so loud as it is during some periods of speeding up and stopping. It seems to me that the gap is run at a speed which is too high to get maximum efficiency. The spark seems to be much louder before the machine gets to the maximum speed. I would like to know if this set would not do better work if the machine were run at a lower speed. I have noticed this on several sets when we were a few hundrd miles away.

Ans.—We have noticed the same effect. While it is true that the ordinary telephone receivers used in wireless telegraph communication are more responsive to currents of high frequency (300 to 500 cycles), yet with a given power and as compared with a lower frequency, say 60 cycles, the oscillations given off by the transmitter are of less amplitude.

In the case of the signals being received at any station, you have a factor other than the headphones to consider. You must also take into account the effect of the amplitude of the oscillations on the energy rectified by the crystal. In the particular case in point it is more than likely that at a particular speed (lower than the normal speed, as you say) the current input into the transformer will considerably increase in value, thereby increasing the amplitude of the oscillations given off by the antenna and therefore the stronger signals; the greater amplitude may also be due to the decrease in frequency, as previously explained. At slower speeds the signals undoubtedly may be somewhat louder, but if the set were reduced to such speeds it would make of non-effect the idea of design, viz., a high spark note giving increased range during static or atmospherics.

* * *

V. P., Richmond, Ind.. asks:

Could you kindly inform me how to make a good 2 mfd. condenser for a kick back preventer?

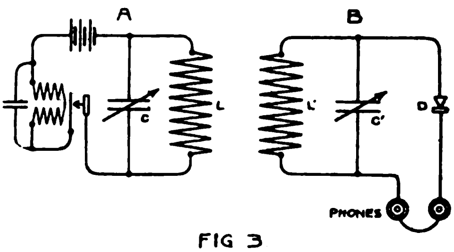


FIG 3

Ans.—These condensers are made by separating two very long sheets of tin foil by a thin strip of paraffine paper. Both pieces of foil are also covered with paraffine paper. The entire arrangement is then wound up in a lump and sealed in a metal can with hot paraffine, connection having been made to both coatings. You will find it much cheaper to purchase one of these condensers than to construct it. They may be secured from any telephone company.

(2) What is the best size of wire to use on your sending apparatus, i. e., on the primary leads and on the secondary leads? I thought high tension cable might be all right for the secondary terminals, but I deemed it best to secure advice.

Ans.—Primary leads of the transformer should be wired up with No. 13, D. B. R. C.; secondary leads (from trnasformer to condenser) use high tension cable. Condensers to spark gap and helix not less than No. 8 R. B. R. C. wire.

* * *

J. E. F., Brooklyn, asks:

Is the Marconi multiple tuner used in transatlantic working? If not, why?

Ans.—Yes, we understand it is.

(2) Is the magnetic detector necessary in the operation of the valve tuner, or can a mineral or valve detector be used with as good results or better than with the magnetic detector?

Ans.—The valve tuner is primarily designed for use in connection with the magnetic detector, but will work equally well with crystal detectors. It will not give such good results with the oscillation valve, as the inductance in the detector circuit is of insufficient value.

(3). Kindly give me the wave length of the following aerial: 112 feet long; 30 feet high at one end, 40 feet at the other; four wires 1½ feet apart; ground lead 15 feet long; aerial wire No. 14 B. S.; aluminum wire; ground lead No. 16; B. S. copper; lead in 50 feet.

Ans.—The wave length of your antenna is approximately 250 meters.

* * *

W. C. M., Bushnell, Ill., says:

My transmitter consists of 1 K. W. Worts-McKisson closed core transformer; secondary voltage of 20,000 Halcun rotary spark gap; oscillation transformer, upright type, of No. 2 aluminum wire; coils 12 inches in diameter, 7 turns in primary and 15 turns in secondary; aerial, four copper wires (No. 12) 2 feet apart, 70 feet long, 50 feet high at one end, 40 feet at lower end; lead in 60 feet long, No. 4 copper, 40 feet long to four No. 12 wires brought down from aerial; ground No. 4 copper, 50 feet long to city water mains; also four copper rods, ¼ inch, 6 feet long in bottom of cellar; instruments located in attic on second floor. Condenser is fifteen 2-quart fruit jars, set in zinc tank surrounded by salt solution, also jars filled with same and boiled linseed oil, 1 inch deep over top.

I have a Murdock condenser unit in aerial circuit to reduce wave length. By using all condenser and all turns in oscillation transformer secondary and one turn in primary close coupled, ground on bottom wire of secondary, I get an ammeter reading of 1.5 amp. ammeter in series with aerial. Why don't I get better reading? To add inductance in aerial lead or take out any, only lowers reading. Taking off one or more jars of condenser only lowers reading and my wave length is too high or apparently so. My leads are of copper ribbon ½ inch wide and doubled, leads from condenser to gap and oscillation transformer only 20 inches long; mv transformer will only draw 600 watts. Please tell me what to do to make this set comply with regulations, also give directions for making what I may need.

Ans.—We have printed this inquiry in full, as it clearly indicates the "haze" existing about the average amateur station with regard to a 200-meter adjustment of their equipment to comply with the United States regulations.

We suggest that you read carefully the article appearing in this issue of THE WIRELESS AGE, entitled "A 200-Meter Amateur Set." We have no doubt but that your circuits are out of proportion, and consequently the reading in the antenna is only 1.5 amps. However, with this set at its most efficient adjustment you should not expect more than 3 amps., roughly. The natural wave length of your aerial is approximately 210 meters. When you add to this fifteen turns of the secondary you probably boost the wave length to 350 meters, which surely does not comply with the law. Not knowing the capacity of your antenna or series condenser, we cannot calculate the latter's effect on the wave length.

You will need to cut down your antenna so that it has a natural period of 160 or 170 meters; then by the addition of a few turns in the secondary of the oscillation transformer you will arrive at a wave length of 200 meters. Your condenser capacity is apparently too large for 200 meters. If we knew the thickness of the glass we could calculate, very roughly, the capacity. Better see the article in this issue of THE WIRELESS AGE; build a condenser this size or reduce the number of jars in your hydro-condenser. Your 1 K. W. transformer is quite correct for the condenser described in the article referred to, provided you connect a reactance coil in series with the primary of the transformer.

At a frequency of 60 cycles, using a condenser the corect size for 200 meters, your transformer will not draw 1 K. W. The limit you can use and still protect the condenser from puncture will be about 4 K. W.

* * *

M. W., Holly, Mich.:

Regarding the spreaders, separate your aerial wires 2 feet. As you are using eight wires you will need spreaders 14 feet in length. Have them made of well-grained spruce, 3 inches in diameter at the center, tapering to 2 inches at the end.

Your receiving hook-up is all right. You should receive up to 100 miles in daylight, and after dark you may hear up to 1,000 miles.

* * *

S. W. T., Beverly, Mass., asks:

Will you kindly tell me where I can purchase a copy of the *Naval Manual of Wireless Telegraphy for* 1911?

Ans.—Write the secretary and treasurer of the Naval Institute, Annapolis, Md.