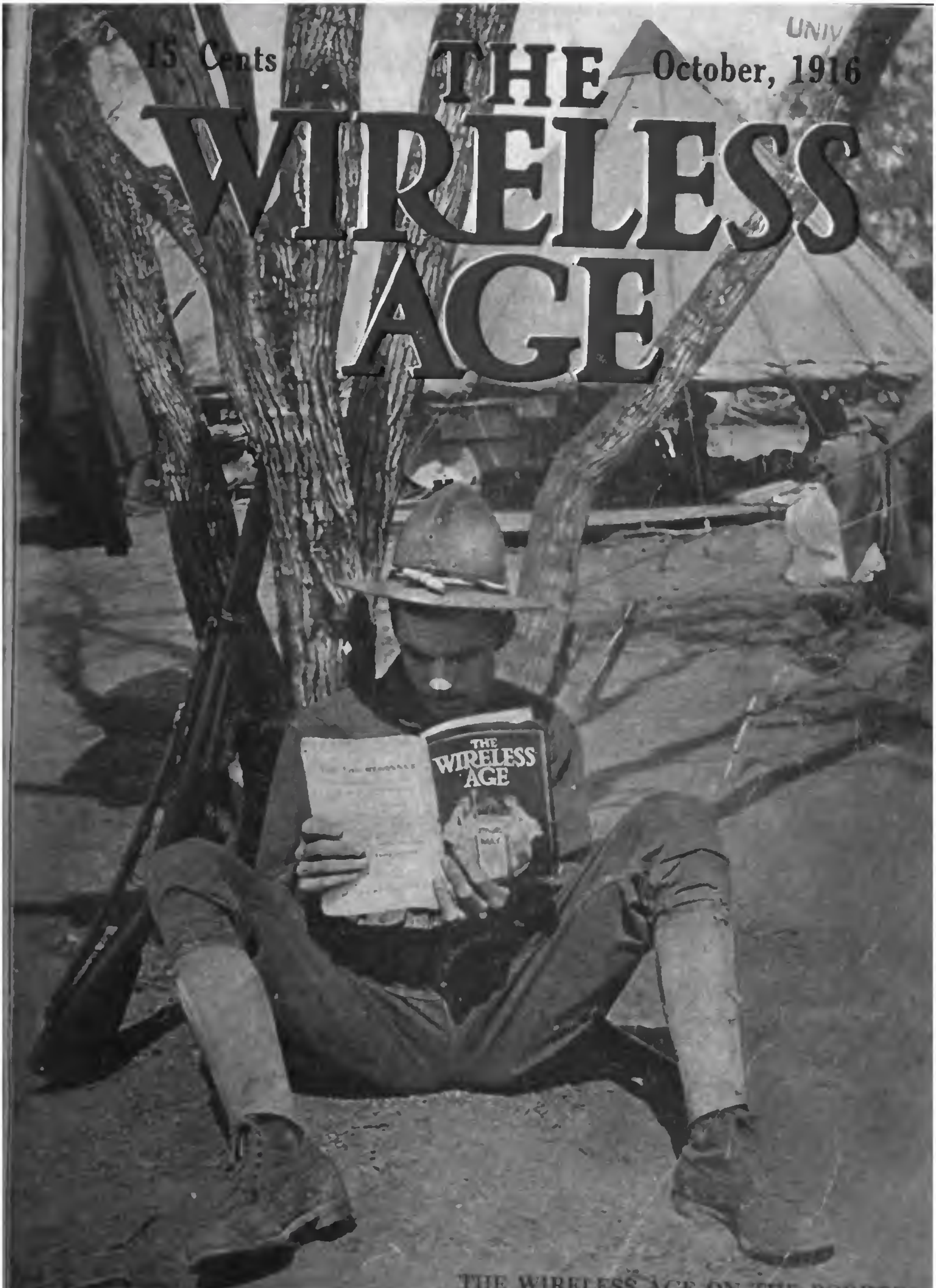
15 Cents

October, 1916

THE WIRELESS AGE



THE WIRELESS AGE ON THE BORDER

THE WIRELESS AGE

OCTOBER, 1916

An Equipment That Marks Progress

The Advantages of the Latest Installation at Siasconset

By J. B. Elenschneider

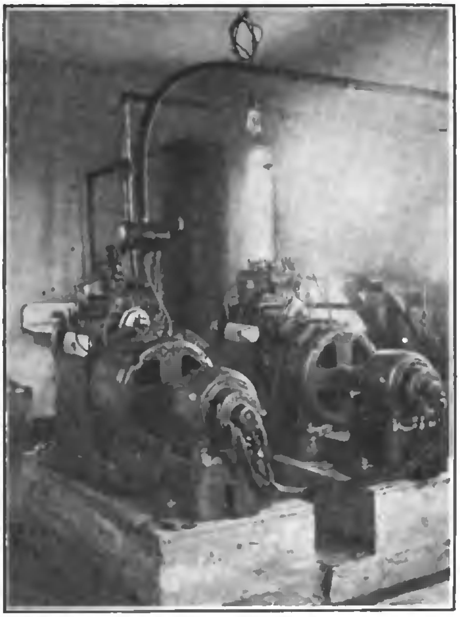
Construction Engineer of the Marconi Wireless Telegraph Company of America

WITH the installation at the Siasconset (Mass.) station of its third distinctive type of wireless apparatus another interesting chapter was added to the history of radio development. Several advantages mark the new equipment, chief among them being a generating plant which reduces energy loss and effects a saving in the cost of operation.

One of the striking features of the new equipment, which is of 2 k.w. power, is the novelty of its design. It differs from the average apparatus in that instead of employing a large storage battery for operating the motor-generator which supplies the energy to the transformer, the 500-cycle generator is coupled to the shaft of the engine by means of a gear, with a ratio of 2 to 1. This plan of construction eliminates practically all losses which, in the ordinary storage battery installation, are caused by the many different transformation of energy necessary to obtain the high frequency oscillations for transmitting.

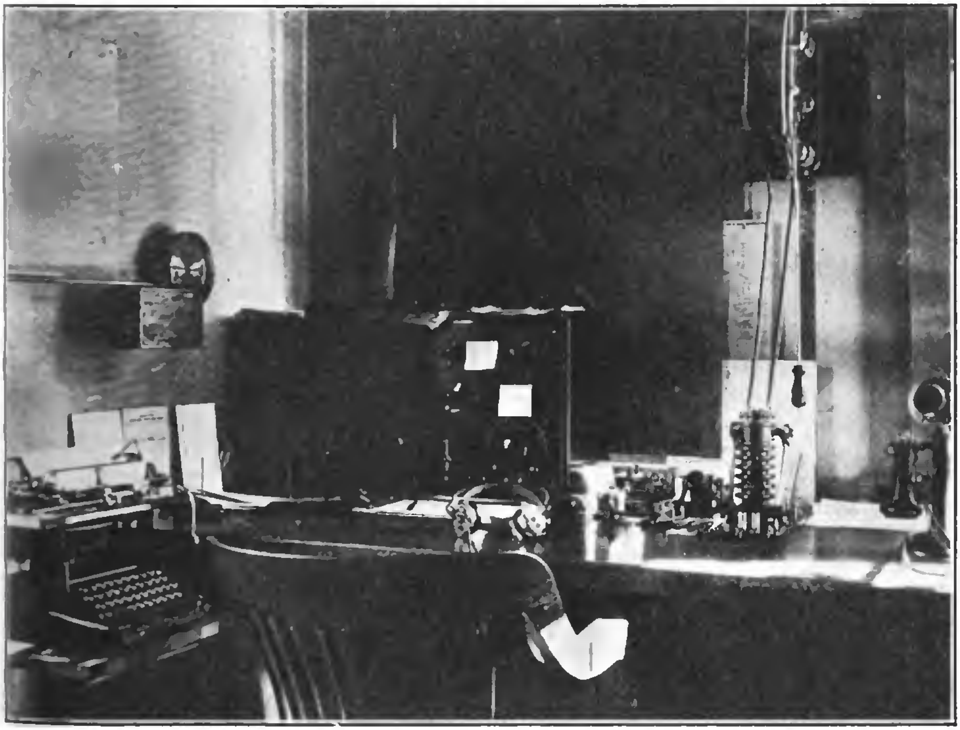
As a rule the energy generated by the engine is transferred through a belt with considerable loss to the dynamo which charges the battery; thence it is conveyed to the batteries at the cost of at least another twenty-five per cent. loss; from the batteries the energy is supplied to the motor which drives the alternating current generator and another loss of at least forty per cent. results. So before the alternating current reaches the transformer a large part of the initial energy generated by the engine is lost through different causes such as belt slip, friction, heat, low efficiency of storage batteries and motor-generators. These losses are eliminated or reduced to an insignificant quantity in the recently-installed apparatus, and the energy generated by the engine is directly applied to the alternator whence it is led in the form of alternating current to the power transformer.

The equipment consists of a ten horsepower, four-cylinder, four-cycle engine, geared to a 2 k.w. 500-cycle



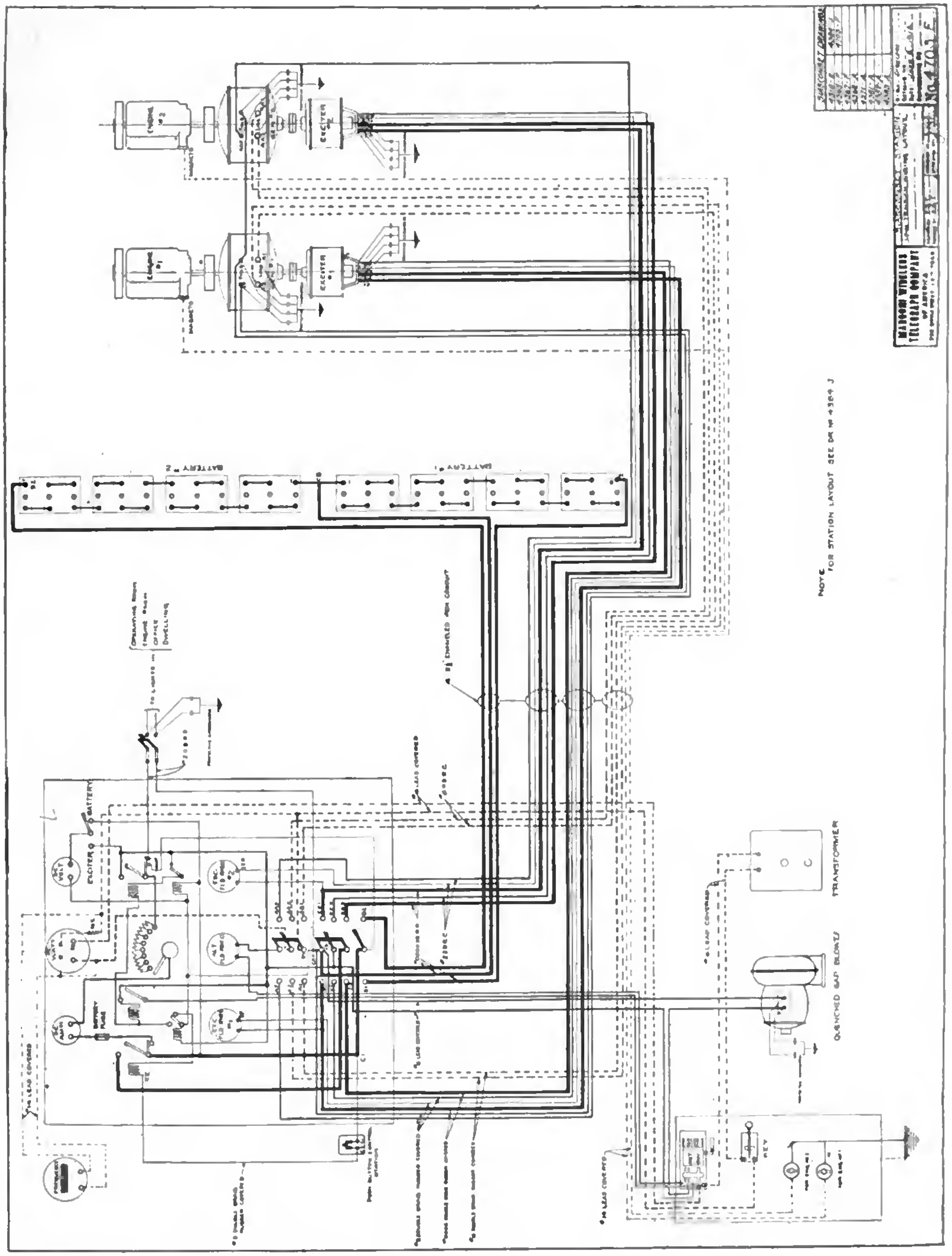
The twin generators of Siasconset, showing, in the rear, the 10 h.p., four-cylinder engines, geared to the 2 k.w., 500-cycle generators. The batteries are also duplicated so that in case of accident the station can be operated from an independent power source generator of the standard Marconi type, the latter being flexibly coupled to a thirty-two-volt direct current exciter, a twenty-four-volt exide starting battery of 160 ampere hours' capacity, an automatic control and charging panel, a 2 k.w. 500-cycle Marconi transmitter of the panel type, and a Marconi type 101 receiver. The engine generating set and batteries are duplicated so that in case of accident the station can be operated from an independent power source while repairs are being made. The engine is of the ten horsepower, four-cylinder, marine type, capable of high speed and possessing high tension magneto ignition. The cooling is effected by a water pump which sends the water from the large cooling tank through the engine and back again. A pump propels the oil from a small tank through an oil sight into the crank case. The amount is regulated by an adjusting screw on the pumps and can be changed to any number of drops necessary to keep the oil in the crank case at the proper level.

A thin wire rope runs over the pulleys from the operating to the engine room, where it is connected to the high tension magneto which, while the engine is at rest, is held in an advanced position by a spring. This enables the operator without moving from his place. by simply pulling the wire rope, to start the engine on a retarded spark so as to prevent back-firing. The engines are run at a speed of 1,000 r.p.m. which, by means of the gear at a ratio of 2 to 1, gives the generator and exciter 2,000 r.p.m., which is the normal speed of the machines.



The operating table is connected with the engine room by a thin wire rope running on pulleys and attached to the high tension magneto, enabling the operator to start the engine on a retarded spark without moving from his place

A fly ball governor maintains the speed of the engine under all conditions, i.e., under all changes of the load on the generator exciter set. The exciter is a twenty-four-volt series wound motor with very heavy windings,

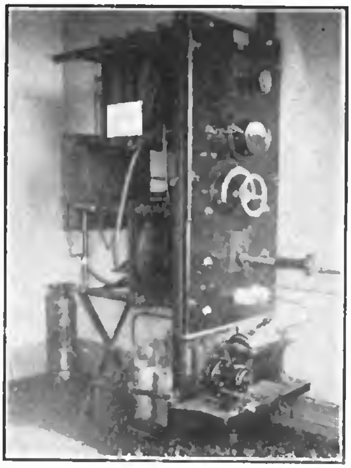

EXCITER
BATTERY No 2
BATTERY No 1
TRANSFORMER
QUENCHED GAP BLOWER
NOTE FOR STATION LAYOUT SEE DR No 4364 J
MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA

which becomes a thirty-two-volt shunt wound generator when the engine attains full speed. The connections effecting this change are made by the magnetic switches on the automatic control panel. The exciter is utilized as a starter for the engine. The starting circuit, which includes the batteries, control panel and starter motor, is closed by means of a solenoid switch of 250 amperes' capacity. A pushbutton near the operator's table, which is about forty feet distant from the engine, closes the solenoid circuit and this in turn closes the starting circuit. It takes over 200 amperes about one second to turn over the armature of the starter motor, the armature of the generator and the engine. This current rapidly falls off to zero and it requires from five to eight seconds for the engine to attain full speed.

When the engine is running at full speed the electromotive force of the exciter closes a solenoid switch of thirty amperes capacity, this switch controlling the generator field circuit and the blower motor circuit. It is mechanically interlocked with the starting switch and as soon as it closes the former opens. Almost at the same time another thirty-ampere magnetic switch closes the battery-charging circuit and, while the engine is running, the starting and lighting batteries are charged at the rate of fifteen amperes and thirty-two volts. The time required for starting the engines and closing all circuits is from five to eight seconds—results which are at least as good as those obtained with any commercial starter for a motor-generator.

The charging panel contains the different magnetic switches and relays, one of which is continually connected across the battery and adjusted so as to automatically cut off the charge when the batteries reach a certain predetermined voltage. It closes the charging circuit again when the battery voltage falls below that for which the relay is adjusted. Thus the batteries are charged automatically, requiring no attention except for replenishing the electrolyte and taking gravity readings from time to time.

The control panel contains a wattmeter which indicates the power used in the transformer of the transmitter, a voltmeter with a changeover switch for reading the battery voltage or the generator voltage, an ampere meter indicating the charging current, a battery charging rheostat of fifteen ampere capacity, a generator field rheostat and two exciter field rheostats; two 3-pole, double throw switches are used for changing from one engine generating set to the other so that if anything should go wrong with one set, the operator can throw the switches to the other side and start the engine of the second set. A single-pole, double-



The transmitter is of the panel type, tuned to four different wave-lengths, 300 meters, 450 meters, 600 meters, and 1,880 meters

throw switch makes it possible to use either one of the two starting and lighting batteries on either of the two engine generating sets. The operator can determine which battery has the lowest voltage by examining the voltmeter. The battery-charging is done while the transmitting set is used. It will not be necessary to operate the engines for charging alone.

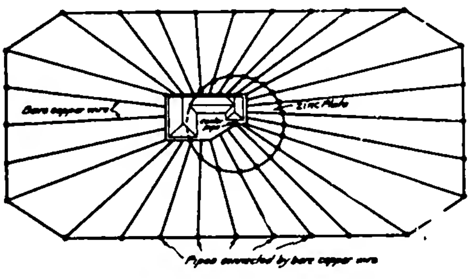
A gasoline tank with a capacity of about twenty-seven gallons supplies the fuel. This tank is connected by means of a galvanized pipe and a gasoline hand pump with a large storage tank holding more than 100 gallons, the larger supply of fuel being buried under the earth several feet away from the station.

The transmitter is of the panel type and has a wave-length range of from 300 to 1,900 meters. It is tuned to four different wave-lengths, 300 meters, 450 meters, 600 meters, and 1,880 meters. The maximum radiation obtained is more than eight amperes.

The aerial is of the four-wire T type and has a natural period of 405 meters and an antenna resistance of approximately 21 ohms, of which the radiation resistance is 14.4 ohms. The aerial is suspended on two wooden masts, each of which has three sections and is 170 feet in height.

The ground system, which is shown in an accompanying drawing, consists of the old zinc circle of 50 feet diameter, to which have now been connected a number of copper wires. These run radially from the station and terminate in galvanized iron pipes, driven into the ground to a considerable depth. This system has reduced the resistance considerably and has made it possible to obtain a decrement on the 600 meter wave of .13. Before this ground system was installed the decrement could not be brought below the .2 mark.

The first set installed at Siasconset was of the type originally invented by Guglielmo Marconi and used in his early experiments. In this apparatus the principal parts consisted of an induction coil, which was employed as a transmitter, and a coherer, which was used as a receiver. There were several drawbacks to the equipments, however, one of them being lack of speed in operation.



SIASCONSET GROUND SYSTEM.

A few years after this equipment had been installed, therefore, it was replaced by the then latest type of "tuned transmitter" and a magnetic detector. The transmitting equipment, which was installed in 1904, was used to transmit for distances of considerable length. It was destroyed by fire in 1907, and the station was operated for about two months with emergency apparatus.

Meanwhile a new station was being built and equipped with new apparatus. The greater part of this equipment was of the same type as that which had been destroyed with the exception that it had a non-synchronous musical spark in place of the plain spark. The non-synchronous spark gap set was in operation until a few weeks ago, when it gave way to the latest type of transmitting apparatus for shore stations.

The first message was received at the original station on August 12, 1901, at ten o'clock in the morning. Sent from the Nantucket lightship, anchored off South Shoals, it was as follows

"Signals clear; am using plain aerial. Good luck."

This message was flashed forty-three miles and at the time its transmission was looked upon as a remarkable accomplishment.

The station, which is owned by the Marconi Wireless Telegraph Company of America, has been in the public eye from time to time, one of the occasions being when it received an S O S from the steamship Republic after that vessel had been rammed in the fog by the Floride south of the Nantucket lightship. The operator at Siasconset broadcasted the news, getting into touch with the Baltic, which turned back from the course she was pursuing and went to the aid of the distressed craft. The Republic sank, but, due to the activities of the men in the Siasconset station in summoning rescuers, no lives were lost.

At the time of the Titanic disaster Siasconset was the first station to communicate with the Carpathia, which was then on her way to New York bearing survivors of the wreck. Hundreds of messages to and from the

The men who made the installation: left to right, J. C. Cowden, manager of WSC; George Schuller; J. B. Elenschneider, designer of the station equipment; Harry Holden, operator; also young Richard Cowden, in front, who hopes some day to become manager of 'Sconset

vessel were handled by the operators at the station.

Among wireless men Siasconset is remembered chiefly because of the fact that it is the last station in the United States that outgoing trans-Atlantic vessels communicate with and the first that incoming vessels get in touch with. It is the oldest commercial station in the United States.

A MOTORCYCLE EQUIPMENT

Captain John B. Christian is in command of a motorcycle wireless outfit that is attracting considerable attention among the troops stationed on the Mexican border.

The apparatus consists of a sending and receiving equipment carried in the side cars of three motor cycles. A motor attachment is provided to be run by the engines of the motor cycles. One of the features of the equipment is an aerial which can be raised to a height of forty feet.

The set has been used to communicate between points thirty-three miles apart, the messages sent and received being highly satisfactory as regards clearness.

THIS MONTH'S COVER

Sergeant Norman R. Hood, Co. I, 1st Iowa Infantry, reading the "magazine that kept me posted in the advance of the radio art," as he expresses it, is the subject of the cover of this issue. The picture was taken in camp at Brownsville, Texas, and is titled, according to the suggestion of its donor, "The Wireless Age of the Border."

Sergeant Hood, a charter member of the N. A. W. A., who wears the association button with pride, arranged to have the magazine sent to him wherever he might be stationed, stating that he could not do without it. "The value of wireless telegraphy," he says, "was brought vividly home while on the Border.

Photograph of a storm cloud snapped by a wireless amateur in the glare of a lightning flash on Mount Monadnock

Receiving on Mt. Monadnock

The Story of an Experimental Trip to the Summit of a New Hampshire Mountain

By Louis G. Barrett

ONE day in August brought such clear weather and a wealth of sunshine that I was seemingly invited by the powers that rule over meteorological conditions to journey with my wireless receiving apparatus from Keene, New Hampshire, to the top of Mount Monadnock in Cheshire County. So, accompanied by a friend, I started early in the afternoon on a motorcycle with a side car attachment.

After we had left Keene in the rear and had passed many small towns, we arrived at a deserted house, which was partly in ruins. Here we left the motorcycle. Then, with our food, aerial wire, and receiving equipment carefully packed on our backs, we started for the summit of Monadnock.

Two hours of climbing over a narrow path brought us to the little house at the top of the mountain. This structure is used by a forest-fire warden as a "look-out" station, the latter being one of the most important posts of its kind in New Hampshire. The house is about sixteen feet square, and has windows on all sides, many maps covering the walls of the interior. From its four windows we were able to glimpse Mt. Washington far up in the north and also the other mountains in the Presidential Range. In the west we could see the little valley in which Keene is situated; beyond, the Green Mountains stretched from north to south.

With the aid of the warden's glass my friend and I were able to view the customhouse tower in Boston—eighty-three miles to the east. In the south the landscape was specked with Massachusetts towns, including Athol and Fitchburg. Many villages in New Hampshire were also brought into view.

Our interest in the view having been satisfied we began the preparations for our wireless work.. We had cut the spreaders on the way up the mountain, and one end of our aerial was attached to the top of the flagstaff on the top-house; the other end we suspended about twenty feet above the ground on a small spruce pole, made fast between the rocks 200 feet down the mountain. We used the regular telephone ground, consisting of earth-sunken plates in a damp spot about a quarter of a mile down the mountain. And so, before the sun had sunk behind the lofty peaks, we had constructed a three-wire aerial, 200 feet in length. This task completed, we connected a Marconi Type "D" tuner to our aerial and earth connections and sat on the door step of the top-house to enjoy our supper and wait for darkness.

The time passed quickly and at about half past eight o'clock we put on our receivers, adjusted the detector carefully and drew up the sliders to seven, eleven and one-half, and seven, respectively. The detector, well designed and of the carborundum type, is hard to jar from adjustment and very desirable for portable work.

With the sliders set as described, we were surprised at the very sharp and clear tone of NAA (Arlington), which was sending the half past eight report. The signals were not much louder than those heard in the valley of Keene, but they were considerably sharper and clearer, and, of course, were easier to read. There was little static. We copied the signals by lantern light for some time, and then rested.

At about fifteen minutes to ten o'clock we again adjusted our headsets and were struck at once by the increase in static. For the next ten minutes we listened on a wave-length of 600 meters. I have some difficulty as a rule in copying ships with the tuner, as it is direct-coupled and its adjustments are rather broad, but on this occasion, no trouble was experienced. In that ten minutes we heard signals from many stations, including those of IZL in Northampton, Mass., which were particularly strong. Later we heard IZR

On top of the mountain shown in this photograph two amateurs spent the night copying signals in Rockland, Me., calling IAT (Arthur H. Lawford) in Bar Harbor, Me.

At quarter past ten a station on the Atlantic Coast began to send, and for a while we listened to its signals. After a time, however, the static increased to such an extent that we were unable to listen for fear of injury to the phones. Therefore, we disconnected the set and went outside.

In the northwest brilliant flashes of lightning were lighting up the sky, and, as we realized that the storm was coming toward us, we began to take down our aerial. When my friend attempted to disconnect the ground lead he dropped the wire, saying he felt a shock. I ridiculed his statement and made my way 200 feet down the mountain side in order to roll up the aerial, while my friend remained above. As I started to roll the wires on the spreaders I received a shock that hurled me off my feet and sent me tumbling down among the rocks. My friend hurried to my assistance, and we spent the remainder of the night in the top house.

From the windows of the structure we obtained an excellent view of the storm. Twice the lightning came in on the telephone line and passed on down the ground lead.

The forest-fire warden's house which provided protection for the author of this article and his companion during a storm

The next morning we returned to Keene well pleased with the results of our trip, and adequately provided with a fund of not uneventful wireless reminiscences.

A MONKEY ARRIVES VIA WIRELESS

The United Fruit Line steamship Almirante arrived in New York recently from West Indian ports flying at the masthead a monkey's tail as a flag. The tail was the balancing pole with which a four-foot monkey had been nonchalantly doing a tightrope act on the wireless aerials for three days, despite the efforts of the crew to make him come down and behave himself.

Naturally the aerials handn't been destined as his quarters when the monkey was put aboard with a large consignment of assorted animals. He was billeted at first in a cage with seventy-nine other monkeys, but he soon broke up their happy household. When his teeth required sharpening this particular ringtail sharpened them on the other monkeys. Likewise he gave his muscles some much needed exercise by clawing the first simian that came handy.

His fellow voyagers gave the crew no peace until the offender was exiled on the third day out and sentenced to be tied up on the after deck. There he was christened by the sailormen "King William" because of the way he had conquered his companions. But the king lost no time in fletcherizing his rope until it broke. Then he shinned up the main mast.

A seaman was sent up after him, and King William promptly skated across the wireless rigging to the foremast, 250 feet away. When another A. B. was despatched to the foremast the simian equilibrist loped to the middle of the aerial, sat down and scratched himself meditatively. He seemed to feel that he had been "saved by wireless."

"I wish the wireless operators would turn on the current full force and burn you to a crisp!" shouted one sorely tried sailor, shaking his fist at the monkey. For which he received an outburst of vitriolic monkey abuse.

When the ship reached port a flanking party was sent up the shrouds on each side of the foremast, the monkey's habitat for the time being, and he was captured and brought to the deck.

With the Naval Expedition in the Congo

Something About the Work of the Field Station Operators

"I AM writing this in a tent on the shores of Lake Tanganyika."

Thus runs a message from William V. Moore of the American Marconi Company's Trans-Oceanic staff, now with the Allies' Naval African Expedition in the Congo region. In it he tells of warfare as he learned it at first hand—the bombardment of German trenches, the sinking of an enemy war craft, the taking of prisoners and field station work.

Moore, who is a senior warrant officer, relates that barrels containing 6,000 gallons of gasoline on the vessel on which he voyaged to Africa, caught fire on June 16th and an S O S was sent out. The appeal was promptly answered by other craft, but several volunteers, among whom was Moore, threw the blazing barrels overboard. For this action his name was favorably mentioned to the Belgian consul at Teneriffe. Another exciting incident of the voyage was the discovery of a German spy, who was placed in the hands of the British authorities and locked up when the vesles arrived off the African coast.

"My journey through the Congo . . . . was interesting," narrates Moore. ". . . Plenty of sport shooting hippos, crocodiles and monkeys. We experienced plenty of storms and tornadoes until the middle of last month (May) when the dry season commenced. . . . We were put under the Belgian army authorities and come under the Navy only for discipline. . . . One of our boats visited the German shore, bombarding the trenches, sinking (a coasting vessel of Arabian origin, common in the Indian Ocean), and capturing five prisoners, ammunition . . . and contraband of war."

In describing the wireless work of the expedition Moore said that there were four operators and one sub-lieutenant to operate the 2 1/5 k. w. field station sets, each station consisting of two wagons and two limbers. One limber contains the seven horsepower water-cooled petrol motor, the dynamo and A. C. generator, the disc discharger, the D. C. board and A. C. board. The wagon contains the receiving and transmitting gear. There is a supply cart for petrol and oil and a mast cart to transport the two seventy-foot masts in thirty sections. The stays and stay adjusters are contained in two trunks, and the aerial and earth nets in one trunk. These are carried in the mast cart.

The operators established their quarters on top of a hill near Lake Tanganyika. The west shore of the lake is owned politically by the Congo Free State, the east shore by German East Africa and the south shore by the British colony of Rhodesia.

The northern end of the lake is 175 miles southwest of Victoria Nyanza lake and its southern end 190 miles northwest of Lake Nyassa. Terrific hurricanes and tornadoes make Tanganyika full of peril for navigators. There are a number of fresh water fish, crocodiles and hippopotami and also several groups of deep water mollusks and crabs, said to be of marine origin. The presence of the crabs and mollusks has given rise to the theory that at one time the lake was an arm of the sea and became separated by upheavals.

"Radioville" is the name given by the wireless men to their camp. However, it is not permanent and they constantly hold themselves in readiness for marching orders, for Moore says: "In a few weeks I shall be departing for the firing lines toward the north of the lake and probably follow up behind the troops as they advance."

How to Conduct a Radio Club

(Especially Prepared for the Members of the National Amateur Wireless Association)

By Elmer E. Bucher

ARTICLE XXVIII

A NUMBER of inquiries regarding amateur and commercial radio telegraphy, some of which have been answered in the Bulletin of the National Amateur Wireless Association, have been received. Many of the questions remain unanswered, however, and, since they are of universal interest to amateurs, it has been decided to publish them in this article of the series on "How To Conduct A Radio Club."

A reader residing in St. Louis asks:

"Can the Fleming oscillation valve be used for the reception of undamped waves in a manner similar to the three-element vacuum valve?"

Several experiments have been conducted along this line, but the results have not been published. We know of no circuit by which this valve can be made to oscillate.

He continues:

"Why are such extremely long coils used in the circuits of the beats receiver described in the book 'How To Conduct A Radio Club'?"

This query has been answered several times in THE WIRELESS AGE. It should be self-evident that to obtain the best results from a vacuum valve the grid must be supplied with a fairly high value of potential and this can only be obtained by the use of large values of inductance in the oscillating circuit and small values of capacity; hence, to obtain wave-length adjustments of 8,000 to 10,000 meters, we use large loading coils in the secondary circuit, also in the antenna circuit.

The correspondent also asks:

"Can the loading coil be eliminated in this set and the inductively-coupled tuner employed for the reception of signals at the lower range of wave-lengths?"

There is no reason why these coils cannot be eliminated, but the complete apparatus will then respond to wave-lengths including 4,000 meters. However, the apparatus will not be efficient at the lower range of wave-lengths in the vicinity of 1,000 meters on account of the "dead end" effect.

Desiring to make this equipment responsive to amateur wave-lengths, the reader inquires:

"Can the tuner be fitted with switches so that the circuits are adjustable to 200 meters?"

This is possible, but it is not recommended. The unused portions of the winding should be broken up by a "dead end" switch to cut down the energy losses occasioned by the unused turns.

In conclusion he writes:

"Can other sizes of wire than those given in the book 'How to Conduct a Radio Club' be substituted in case the experimenter does not have the designated size?"

A small variation from the sizes given may be made without a great sacrifice of efficiency, but the size of wire recommended should, if possible, be used, for it will give the maximum degree of efficiency. If you change the size of the wire the dimensions of the coil must be reduced or increased accordingly. To calculate the inductance of a tuning coil follow the method given in the second edition of the book "How To Conduct A Radio Club." The primary winding for this tuner may vary from No. 22 single silk covered wire to No. 26 and the secondary winding from No. 26 single silk covered wire to No. 34. You are, however, advised to hold to the design given in "How To Conduct A Radio Club."

Constructing a Receiving Set

Constant Reader desires a compact long distance receiving set, but cannot see how such a set is possible with the coils described in the book "How To Conduct A Radio Club." He asks:

"Is it necessary to employ the extremely long loading coils described in the instructions for constructing a long distance receiving set as per the book? Is there no other method by which a required value of inductance can be obtained? For example, I want to mount this apparatus in a cabinet, but after careful reflection I find that the equipment would be exceedingly cumbersome."

Multi-layered coils may be employed provided the precaution is taken to separate the various layers by a space ¼ or ½ inch. If four layers are used, a winding, 4½ inches in diameter by about 7 inches in length, will give practically the same value of inductance as the long coils described in "How To Conduct A Radio Club."

Another subscriber inquires:

"Why do commercial wireless telegraph companies use carborundum crystals in preference to other detector crystals, in the face of the fact that amateurs get far better results with galena, silicon, etc.?"

The answer is simple. Experimental apparatus does not fulfill the requirements of a commercial service. Picture a commercial operator constantly changing his apparatus from a sending to a receiving position and finding himself compelled to "tickle" and "fuss" with a cat whisker adjustment. What would be the effect on the traffic department of a commercial company in these circumstances? Carborundum is without doubt the most stable of all the crystalline detectors and the crystals furnished by the Marconi Wireless Telegraph Company of America are especially selected from a large supply. Remember that it improves the action of a carborundum crystal to mount it with soft metal in a containing cup.

The reader then asks:

"Why is it that I often hear amateur stations with my receiving tuner adjusted to commercial stations whose wave-length I know to be 600 meters or above?"

Either the amateur violates the law in regard to wave-lengths or your receiving aerial has considerable resistance and therefore no distinct time period of vibration. It then responds to all wave-lengths within a certain range, but with no particular degree of efficiency. The energy that you receive under these conditions is due to forced oscillations. Sometimes these effects are due to a badly designed receiving tuner.

He also asks how to account for the long range of small amateur sets operating at the low wave-length of 200 meters during the night hours.

This is probably due to the small absorption of energy, augmented by the use of a very short wave.

Increasing Energy

Several amateurs have sent in a query to this effect:

"Does a receiving detector increase the amount of energy flowing in the receiving aerial during the reception of signals from a distant station?"

Those detectors *not* employing a local battery or other source of local energy do not increase the amount of energy flowing in the antenna circuit, but the three-element vacuum valve, the electrolytic and the carborundum crystal with auxiliary battery current are believed to increase the value of the received energy. Keep in mind that there is still some argument concerning the operation of these detectors.

A member of the National Amateur Wireless Association writes:

"What should be the resistance of a potentiometer for a receiving set, and the potential of the local battery?"

The maximum value of resistance may vary between 300 and 600 ohms. The battery should have a potential of between two and four volts.

An experimenter residing in New York City takes issue with us on the following point. He writes:

"Why do you constantly advise against the use of enameled wire when my receiving set works well with this type of winding?"

We should like to know if actual quantitative tests have been made to assure our inquirer that the results he obtains are equal to those possible with the commoner forms of windings. The fact that he hears signals is no criterion to follow as the mere reception of signals is possible with practically any type of winding. Enameled wire coils generally have excessive distributed capacity, which, at certain wave-lengths, destroys the efficiency of the set.

Another enthusiast writes to ask why we object to the use of No. 32 insulated wire for a loading coil in a receiving aerial circuit.

Experiment proves that a coil of this type has such a value of impedance that it seriously impedes the flow of energy in the antenna circuit.

Receiving Damped or Undamped Oscillations

A member of the National Amateur Wireless Association asks what type of apparatus or circuit is the most sensitive for the reception of either damped or undamped oscillations.

We have found from experience that the type where one vacuum valve is connected up to become an oscillator of variable frequency to supply energy to the antenna circuit for "heterodyning" and a second vacuum valve is coupled to the same antenna for recording the "beats" seems to give the best results. A circuit of this character was fully described in preceding issues of this magazine, also in the February National Amateur Wireless Association Bulletin.

An amateur in Boston who is skeptical concerning the reports of amateur long distance receiving asks:

"Are all the reports we hear regarding the reception of signals by experimenters from Nauen and Hanover, Germany, etc., correct? For example, some report that signals are received on an aerial 100 feet in length and other seemingly impossible performances are now and then recorded."

These reports are for the most part authentic, but in many cases the amateur hears Tuckerton and Sayville, mistaking them for Hanover and Nauen, Germany.

Difficulties of Using Microphonic Amplifiers

A reader who believes that commercial companies in some respects are not up to date in the production of efficient apparatus asks why they do not use microphonic amplifiers for dispatching traffic, particularly in view of the fact that these devices increase the strength of signals considerably.

It has been shown by experiment that the adjustment of microphonic amplifiers is too difficult for the average employee and that they do not possess sufficient stability for commercial service.

An amateur in Milwaukee asks if any type of detector can be used for picking up a wireless telephone conversation excepting, of course, the coherer.

All detectors using a telephone receiver are applicable provided the remainder of the apparatus can be placed in resonance with the transmitting station.

"How far will a three-inch spark coil transmit in daylight?" asks a subscriber. In some localities twenty miles have been covered in daylight, but the actual range of course depends upon the sensitiveness of the receiving detector employed at the receiving station.

A reader who is contemplating the purchase of a high potential transformer says that he cannot decide between the open and a closed type of apparatus.

He should purchase the transformer costing the least, irrespective of type, if constructed by a manufacturer of established reputation.

The same inquirer has had trouble

with an electrolytic interrupter and asks why it functions so badly on sixty-cycle alternating current. He should know that this is due to the fact that the flow of energy in a sixty-cycle circuit is not constant as in the case of a direct current circuit. The electro chemical action necessary in the interrupter can only take place when at least 80 volts flow through the circuit and since the value or the amplitude of the current varies constantly, an actual interruption cannot take place until an alternation of each individual cycle attains the value of eighty volts or over.

A beginner asks concerning the apparatus to be purchased by one who wishes an equipment that will communicate thirty or forty miles. We suggest the purchase of a ½ k.w. transformer of the closed core type with magnetic leakage gap constructed for a secondary potential of 15,000 to 18,000 volts; a non-synchronous rotary spark gap giving 240 breaks per second; a copper plated leyden jar type of condenser of .008 microfarad capacity and a small inductively coupled oscillation transformer.

For the receiving apparatus two receiving tones should be purchased, one having a maximum wave-length adjustment of 600 meters and the second a maximum adjustment of 3,000 meters.

X-Ray Static Machine as Transmitter

A physician interested in wireless writes that he would like to use his X-ray static machine for the transmission of wireless signals and asks for an explanation of how the apparatus may thus be employed.

The writer has never heard of a machine being put to this use, but if there can be designed a special high tension switch by means of which the energy in the condensers can be controlled and the circuit opened and closed to make the dots and dashes of the Continental Morse code, it will be possible for the energy to be transferred to an antenna circuit and radiated in the form of electric waves. The average X-ray static machine generates an excessive voltage for wireless telegraph work, giving a spark discharge of the

Reverting to the subject of receiving apparatus the physician asks if the vacuum valve bulb can be made to oscillate at the wave-length of 600 meters. Experiment shows that the bulbs which are highly exhausted will oscillate at all wave-lengths, but the ordinary bulb cannot be relied upon for this work.

Tikker Experiments

A resident of California says that he is experimenting with the tikker detector, but he has observed that the receiving tuners for this device are wound with Litzendraht wire. He inquires if this winding is positively required and why.

The tikker is a current operated detector and consequently functions best in a secondary circuit of the lowest possible damping. Of course, response can be obtained with ordinary windings, but better results are obtained with Litzendraht wire.

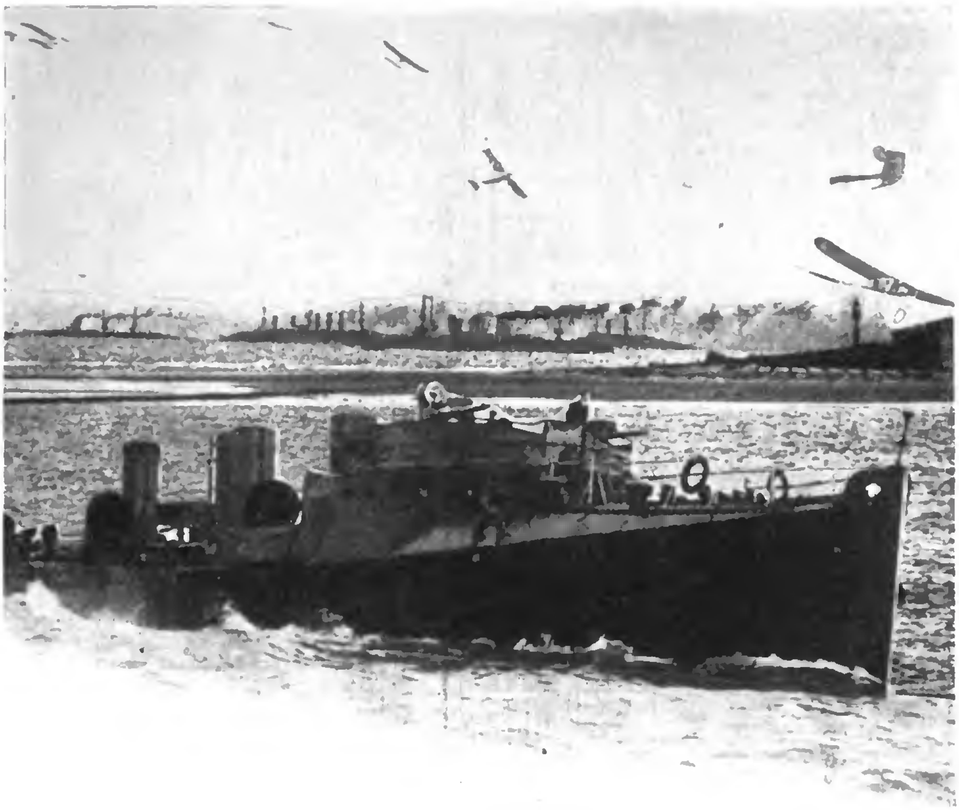
He then asks if the statement is true that during the summer months amateur stations are limited to a few miles' communication, whereas in the winter months a range of several hundred miles can be obtained.

Our experience has been that in some sections of the United States the statement holds true. Generally in the entire northern part the range of amateur stations is decreased considerably during the hot summer months. Foliage and vegetation are said to absorb a considerable amount of energy in the passing wave. The subject is discussed at length in the Proceedings of the Institute of Radio Engineers and also in The Year Book of Wireless Telegraphy and Telephony, 1915. No definite conclusions have been reached, however.

Wireless in Gulf Storm

Wireless was employed to advantage recently when a hurricane swept the coast of the Gulf of Mexico and destroyed all means of communication south of San Antonio, Tex., except those by radio.

A wireless station has been built at Navesink Light station, the West



Flight of the War Birds*

By Patrick Vaux

In a dandy frigate or a well-found brig,
In a sloop or a seventy-four,
In a great First-rate with an Admiral's flag,
And a hundred guns or more,
In a fair light air, in a dead foul wind,
At midnight or midday,
Till the good ship sink, her mids shall drink
To the King and the King's Highway!
—NEWBOLT.

WELL?"

"Still jammed."

"Confoundedly awkward!"

Lieutenant Perwynne made a wry mouth and continued to contemplate the wireless cabin's slip. He did not speak again. The sub-lieutenant, who had brought him the unwelcome news, began to make the best of it.

"Of course, it is an annoyance to Whitehall, but——"

"Just so. It is an annoyance." Perwynne interjected dryly, bending a little closer lest the whistling wind carry away his words. "It cuts both ways."

Deland chuckled grimly.

"It serves us better than them, at any rate, sir. East'ard there'll be a chance of doing something 'stead of hanging on to the Admiralty's wires for the moves."

"Well, yes. But at home they won't know soon enough if—if——"

Lieutenant Perwynne ceased. The two haggard-faced officers looked at each other. Their tired eyes were charged with a meaning which but five weeks ago would have been derided exceedingly.

"This jamming, if it is atmospheric, can't hold much longer," said the sub-lieutenant, cheerfully. "We'll soon know with all this play of fire around."

"There is something else. Don't forget," snapped his superior officer.

The grayness of the air that had hung confusingly along the horizon when first

*From Sea Salt and Cordite. Copyright, George ternoon, had been ordered to extend her scouting area consequent on the breakdown in the wireless communications, was now resolving into murky vapor veiling the farther reaches at sea. As with eyes narrowed against the current of air pouring across the bridge, Deland searched the ever-shifting curtain that merged indistinguishably into the banks of lurid cloud stretching the while length of the north and east horizons, a feeling of desperation took him. But it was only for the moment. Firmly he put from him all thought of home and of those dead to him.

England was suffering slow anguish.

Far astern, the coasts of the Mother of Nations, She—the Mistress of the Seas—were now protected by but submarines and destroyers, two-fifths of which, after the weeks of incessant rip-and-range night and day, were as halt and broken-winded as the heavy vessels stiffening in the flotillas were death-traps in the obsolescence of their strength. Out of the corner of his eye the commanding officer glimpsed the forward lookout suddenly peer into the southeast.

"What d'ye see, Collard?"

The seaman knuckled a leash of brine out of his eyes. Again he strained his tired sight, and shooting out his left arm, pointed to a speck low down in the vague demarcation of sky and water. Deland also switched his glasses on it. But the minute blur was gone already.

"A sea bird, sir," roared the lookout against the wind.

"A sea bird," echoed Perwynne, taking the binoculars from his eyes. But he glanced at Deland as if for corroboration.

"The haze mucks up everything!" said the sub-lieutenant doubtfully. "Sooner thunder clears the air the better for us."

"Something in God's skies that My Lords didn't allow for," he muttered to himself. dodging a gout of spray spurting over the forecastle and weather-screen. "But it's some folks' cocksureness that has brought us to this."

The course of the war had depleted the battle squadrons of Britain as well as those of her adversaries.

On both sides every nerve was being strained to repair disabled vessels and complete those launched. Many British men-of-war detailed at the outbreak for commerce protection had been recalled for the reinforcement of the squadrons now striving to hold the North Sea and of that in command in the Mediterranean.

That which is more poignant than all the horrors and sufferings of invasion was now tearing at England's heart.

Of a sudden Deland touched his C. O. on the left arm, for the thud of a gun, jerky, emphatic, even in its faroffness, rapped through shrouding murk and falling breeze. Almost immediately it was followed by an outburst of firing, irregular, yet fierce and sustained.

"We'll run slap into it, glory be!" the lieutenant jerked out, his gray face stiffening. By G—d, what a flash!"

In a dazzling gleam forked lightning had stabbed the sickly red heavens from north to east. An abrupt, rattling peal shattered the sounds of the guns. Then in the succeeding silence the reports mounted again, fiercer but more puzzling.

"Vessel is makin' nor'nor'east," cried Deland. "More than likely we'll settle what is really interfering with the wireless."

Perwynne, without taking the binoculars off the distance ahead, nodded in reply. There was that in the scattered cannonading which gave grounds for ominous surmise. As, at forty miles an hour, the oil-driven war craft raced down on the engagement the spray hurled white and solid from her bows sheeted to leeward over forecastle and bridge-works, the particles stinging the skin like buckshot and penetrating all clothing. The sub-lieutenant turned to leeward to wipe the salt off his face and cast a look over the deck where the bluejackets had been piped to their posts. He noted that the wind had dropped to a dead calm, and out of the centre of the cloudbanks, traveling westward from north and east, their foremost phalanx almost overhead, steely blue fires were flickering and flashing to the crash and rumble of thunder booming along the desolate waters like the sound of an approaching cataclysm.

"More than us having a hand in this!" he grunted under his breath.

A feeling had come to him of the uncontrollable elemental force sweeping down to fall on them all, just like a vial of wrath on a blind man's helplessness.

From Lieutenant Perwynne burst an exclamation of exasperation and incredulity. His voice rang harsh, his words like expletives.

"Aeroplane—no sea-bird."

"Aeroplane," confirmed the sub-lieutenant, binoculars glued on the speck that had appeared from out of the murk ahead.

At an almost inconceivable velocity it was now heading for the scout.

"The explanation at last of the unaccountable finds in Essex and elsewhere of petrol and bombs," Perwynne rapped out fiercely, scrutinizing the devil machine.

"The move is very plain."

"They are striking before our reinforcements get away to sea," reflected Deland, catching his breath as with a strange sensation at heart he watched the war-bird grow into the outlines of a monoplane.

Thoughts flashed into him of the home aeronautic force depleted to reinforce the Expeditionary Forces—of Shearness and other main bases now to be wrecked and totally devastated. Thoughts, too, of London in flames and horror, and of the country panic-stricken. With terror ravening on their vitals, would the multitude clamor for the cessation of hostilities—and at what price?

It was to hasten the work being affected by hard times and nervous throes that the raid by air had been launched.

"A Taube, sure enough," said Perwynne, harshly. "This confounded calm helps 'em. Hope to G—d a thunderbolt shrivels 'em all up."

That instant a streak of flame ripped athwart the sky ahead, illumining in a horrid glare the ash-colored waters. In the distant rolling that followed the strident hum of the nearing enemy was lost to the ear.

The next second the shrill scream of the monoplane's propeller cut the air—a furious cackling arose from the destroyer's bow-piece.

Tilting steep, the air-craft shot higher then, to evade the shells bursting around under her. She swerved like a bird to port and starboard, escaping the wing fire. Then, with engines throttled, she swooped down, just above the vessel's amidships, and wholly out of the quickfirers' trajectories; for gun-mountings including vertical firing had not yet been fitted on board the older vessels.

Even to the British rifles cracking out, upturned eyes saw the aviator, who sat in a cradle abaft the lifting plane, drop a missile; the devil machine obliquely cleaving upward as he did so.

The Kreutzer projectile missed the port quarter by six feet, and the impact of its explosion jolted the destroyer severely. Another shell almost simultaneously tearing up the depths a few feet away, the combined geyser of spray and water fell like a waterspout across her deck, and men were almost carried off their feet.

"She's hit! she's hit!" Deland shouted, blinking his eyes on a tortuous shaft of lightning searing the vision.

"She's tumbling!" crowed the lieutenant. "Her—" but the terrible crashing and ricochetting peals convulsing the heavens overwhelmed his voice.

His whistle shrilled the "Cease Fire." In maniacal joy he motioned to the gray-winged air machine that was hurtling down tractors first as if her motors had been disabled. When she was within 200 feet of the surface of the water her occupant fell out of the skiff-like structure, some way back from the engines and behind the main planes. With arms and legs outspread as if in vain resistance, the unfortunate aviator whirled down, and disappeared in the scatter of spray on the air-craft hitting the water.

Just then an excited voice hailed the bridge.

"Running into the thick of 'em," boomed the C. O. "A hold-up. How many tackling 'em?"

"London and Britannia," trumpeted the signalman, without taking the glass from his eye. "Cruiser seems to be standing by the flagship, sir."

"She's hit, for'a'd," burst out Deland, a thumbnail blob of flame jetting forth on the nearer vessel's fore deck, to be succeeded by a mushroom-like puff of lightish vapor.

"Yes. London almost done for. Seems to be on fire, too—same as Britannia—somewhere aft. Cruiser trying to draw the attack."

A zigzag of lightning fretted the eastern horizon in a brilliant greenish flash, sharply outlining the sea-line; and, as a solemn hollow, distant peal reverberated, a spitter of rain fell. There was not a breath of wind, and the whack-whacking and spits of flame from the warships came threatening over the darkening sea.

Astern, crimson haze obscured the spoke-like beams from the sun now dipping behind the ridge of dark clouds lining the west horizon; and the wrecked monoplane Deland noted to be already hidden by the distance. To him the air machines looked in the livid gloom like a fantasy of monstrous devil birds hovering and swooping, turning and mounting in a widely scattered formation around and above the two vessels that were steaming slow in line abreast N. N. E., the Britannia drawing most of the enemy's virulence.

Now and again a jump of white water, or a fleck of red, showed when a bomb had missed its blinded prey or had struck her deck or upperworks.

Perwynne replaced the stopper of the wireless cabin's voice-tube. Catching his junior officer's eye, he shook his head.

"God help England this night," said Deland within his heart. "Ninety minutes of their rocketing ahead, and Sheerness'll be in flames—and London in terror."

"They have swept across Holland, keeping out of sight topsides of the dirt we have had all day," cried Perwynne to him. "Between forty and fifty of them. . . . . Yes, I make out forty-five at least. . . . We've to try to stop their rush, somehow."

"Flagship down by the bows, sir. She's been knocking about previously."

Already a subdivision of four monoplanes had stood out of the mazy concentric disposition, and was coming along full tilt. Stridently, with canted muzzle, the destroyer's bow quickfirer spat forth shells.

The leading unit of the racing line pivoted out of the area of bursting projectiles; but the splinters evidently damaged the second craft's left balancing wing. She tilted dangerously as if turning over on that side, then slowly glided seaward to get rest on her pontoons. Under the shock of rifle fire meeting her, the aviator was riddled with the bullets and the frail fabric smashed into tattered wreckage.

Yet the other two had, bird-like, darted up to 4,000 feet, out of the gun's trajectory, and even now were dropping like hawks to inflict the deathblow. The destroyer veered away to enfilade them. From her deck the concentrated small-arms fire killed the bomb-thrower in the third aeroplane, his squirming body half in and half out of the cradle, upsetting the machine in its tumble seaward.

But on the sea craft's forecastle a missile from the rearmost enemy fell with a sickening thud, to roll off into the water to port, unexploded. Another burst in the sea to starboard ere the foe had fled astern.

Then into Perwynne's eye leaped a dim, midget figure on the top of the flagship's after barbette; the destroyer, having hoisted her private number, now making to pass astern and come up to starboard. With unparalleled coolness amid the infernal hubbub of spluttering gun and erupting bomb, the signalman using his arms was swiftly semaphoring her orders. Sheet lightning flashing out beyond, he and the battleship—crumpled and wrecked upperworks and jury-rigged wireless mast—stood outlined, exact and rigid like details of a picture etched in fire.

Upon the impenetrable darkness filling the vision for a moment or two, there gushed a yellow splash that billowed into a dull glow on the London's afterdeck. Amidst the scuffling thunder overhead, Perwynne felt lips touch his ear, and heard his signalman's voice. Its frail, indomitable sound symbolized an infinity of thought, resolution and purpose of duty.

"Flagship signals, sir . . . . Come up . . . port quarter . . . wounded."

When the destroyer swept around the stern of the battleship the top of her after barbette was a flaming pyre; and bluejackets with wet sacks were endeavoring to beat out the blazing fluid flowing over the barbette structure and adjoining deck. Monoplanes swooped down from different points; one succeeding in dashing her fire bomb on to the flagship's forecastle; another in lodging a missile that blew out the face of the forward superstructure.

A projectile, dropped wide, threw up a great cone of spray, washing over the destroyer's bows as she surged abreast of a large jagged gap just above the London's waterline. But, to a signalling arm from a group gathering there, she fell into station alongside.

At a glance her Bridge took in that the London had been severely handled in a very recent engagement. It was noted, too, that the Britannia drew ahead, away to starboard, taking the weight of the attack. The air-craft were seen distinctly, save when electric fluid emblazoned the air, some diving in "volplane" to discharge their shells on the cruiser's sputtering deck, some rising to return and swoop down again, trying to blast the gun positions and small arms fire. A few on being hit exploded in midair into gouts of fire, others plunged headlong waterward.

Obscured by the sultry murk and the fast-falling darkness—glimpsed in the play of lightning which was most intense in the north—the scene was as a nightmare of Hell. Yet, on the destroyer's afterdeck, two bluejackets, as ordered, were making every effort to rescue a half-burnt and blinded aviator, who, groaning heavily, was floating near by, supported by the air-chambers of his disabled machine.

The light of the lanterns, dimly shining in the wrecked bunker behind the gap in the ruptured armor, showed a small cluster of bareheaded, dishevelled men urging a grey-haired flag officer in torn uniform to be seated in the cradle. He, stiff in bandages and splints, was stubbornly resisting the faithful arms supporting him. Indignantly, with his free hand, he indicated the wounded being put down behind him by stretcher-bearers.

Just then a bomb broke on the flagship's upper deck between amidship and forward casements; and down her side seethed a broad cascade of purplish fire; a burning figure leaped screaming into the sea. Singed, half-naked, blackened beings, led by a cursing officer, plied hoses and sodden "gummies" desperately on the fresh conflagration.

Of a sudden, Perwynne hailed the London peremptorily. Even as the hawser was cut, there came the first swirl of wind, a confusing run of sea joggling the small craft, and then hard upon this a terrific flash of pronged fire sheer across the darkness ahead. The stunning effect of the crashing, rolling peal was lost in a vast, quivering white blaze that enveloped sky and sea as if creation had burst on fire.

For that infinitesimal fraction of time everything appeared to stand still in the shadowless glare, to be gulfed instantaneously in inky darkness. Yet with Perwynne—ringing his engines to full-speed ahead, and deafened, blinded by the elemental outbreak—there remained an impression of the gaunt, grey cruiser ahead with bows hove up on a crumbling wall of rushing, white-lipped seas; and of specks overhead—some afar, bursting into flaming atoms in the lightning stroke—some nearer at hand, broken and turned somersault by the tremendous breath of the gale, the shrieking of which now belched on the ear.

It came down with appalling swiftness. The few remnants of the aerial force vainly tried to flee before it, keeping low to escape the danger zone above.

Half an hour later, when the destroyer, tumbling, smashing, cleaving invincibly, drove along the homeward track amid buffeting seas, her C. O. clinging to the rail of his bridge, lifted his eyes from where astern there last had been seen the outlines of cruiser and sinking battleship.

"In touch with Whitehall and running off the news. Good," he exclaimed, mouth close to the ear of Deland who had reported. "It's been touch-and-go for Old England's nerves. Queer how what brought about the wireless jam should save us. Coincidence—of course!"

That was just what Deland did not think.

Marconi Company Asks Million Dollars' Damages From U. S.

ON July 29, the Marconi Wireless Telegraph Company of America filed in the Court of Claims a petition charging that the United States Government, through the Army and Navy and other departments, has constructed or used apparatus in violation of the patent rights of the Marconi Company. A claim for damages to the amount of $1,000,000 has been entered by the wireless company.

The patents named are re-issue No. 11913, granted to Mr. Marconi on June 4, 1901, for transmitting electrical impulses and signals and apparatus therefor; patent No. 609154, dated August 16, 1898, and granted to O. J. Lodge for inventions in electric telegraphy; Mr. Marconi's tuning patent No. 763772 issued on June 28, 1904; and No. 803864 granted to J. A. Fleming on November 7, 1905, for an instrument for converting alternating electrical currents into continuous currents, (the valve detector).

The Marconi Company alleges that in violation of its rights and privileges under these patents the United States, through its officers and agents, has, since June 25, 1910, entered into agreements with various persons and corporations for wireless apparatus which constituted an infringement of the Marconi patents, and that the Government has used, and is still using, the apparatus so obtained. Those specifically mentioned in the petition are Fritz Lowenstein, Emil J. Simon, Telefunken Wireless Telegraph Company, Atlantic Communication Company, Kilbourne & Clark Company and Wireless Specialty Apparatus Company.

The Marconi Company will substantiate its claim for damages with evidence that it has at all times been ready, able and willing to furnish and supply to the United States any of the inventions set forth in the patents mentioned, together with apparatus embodying these inventions and to charge the United States only reasonable prices therefor.

The petition to the court also states that upon learning of the infringement, the Marconi Company notified and warned the Government to desist, but that the United States "neglected and refused so to do, and still continues to make and use the inventions set forth and claimed in said letters patent."

The petition, over the signature of E. J. Nally, vice-president and general manager of the Marconi Company, states that the Government "well knowing that the validity of said letters patent had been adjudicated in favor of your petitioner by several of the courts of the United States, has, since the twenty-fifth day of June, 1910, and before the filing of this petition, without license of your petitioners, and without lawful right, made and constructed, and used, a very large amount of apparatus containing and embodying in use the inventions covered." The Marconi Company claims that the infringement "has resulted in great injury, damage, and loss to your petitioner, in the aggregate sum of $1,000,000, which sum is justly due to your petitioner and which sum, or such other reasonable compensation as this honorable court may find to be due your petitioner, your petitioner avers it is justly entitled to recover, after allowing all just credits and offsets."

The outcome of this action will be watched with interest throughout the technical world, as the decision of the Court of Claims will indicate the degree of protection afforded inventors whose patented apparatus is useful to the Government. The statute which permits patent holders to appeal for redress is a comparatively new one, the Court of Claims having been established to determine the validity of claims against the Government, which cannot be sued in court as is the case of private corporations or individuals.

Views of the Summer

The double-page photograph across the top shows the company streets from the senior end, also the 250-foot aerial suspended from trees. The center photograph gives a view of Birchwood Lake, the club house and mess tent showing in right of background

Assembly for retreat at sundown, showing some of the 250 juniors who attended

Military Camp of N. A. W. A.

The small illustration to the right is a view of the reservation upon which the International Order of Military Women were camped. There were more than 100 enthusiasts of the gentler sex who received instruction. The group shows Major White and staff at morning tent inspection.

Interior of the wireless station, Lieut. Hotchkiss at key of the 2 k.w. Marconi set

Views of the Summer

Above, the military headquarters' wireless station, giving a glimpse of the condenser rack and the 8 h. p. Fairbanks-Morse engine used for generating power for the 2 k.w. set loaned by the Marconi Company. Both engine and wireless apparatus were donated by the respective makers in the interests of patriotism. In center, Officer of the Day on inspection rounds

The bathing hour, a daily frolic for the embryo soldiers

Military Camp of N. A. W. A.

Just left of the center, in the photograph above, may be seen the counterpoise erected under the headquarters' station aerial. Newspapers seldom reached the camp and the press bulletins posted were practically the sole means of keeping in touch with the outside world. The illustration on the right shows the water supply at the head of the company streets, separate pipes being installed for washing and drinking water

Setting-up exercises, part of the healthful daily routine

MY TRIP TO THE BORDER

By C. S. Gould

Marconi Operator and Member of the New Jersey Signal Corps

In these warlike days all that pertains to things martial is of interest, and wireless is not the smallest feature in the picture of preparedness and battle. This in brief is my reason for setting down on paper the story of the trip of the New Jersey Signal Corps to the Mexican Border.

The afternoon of June 30 found all of the members of the Corps in the New Jersey State military camp filled with excitement due to the orders they had received to make ready to go to the Border. At the noon mess word had come to break camp and entrain the next morning at seven o'clock. Delay followed delay, however, and it was not until late the next day that the Corps marched to the railroad station at Manasquan. Here the roll was called and those who had been rejected by the doctors fell out of the ranks, the remainder finding seats in the cars. Two of our number—one a private and the other a sergeant—were so much absorbed in saying good-bye that they were left behind. Our train waited at a point fifty miles from Manasquan, however, until the missing ones arrived on the express that followed.

Making only one stop—Fairmount Park, Philadelphia—the troop train thundered straight through to Harrisburgh, where we were transferred from the day coaches to Pullmans. At Pittsburgh the Women's Preparedness Association served us with coffee and sandwiches and at Trafford, Pa., other members of the Association distributed stamped postal cards and pencils. Not the least interesting feature of the trip were the receptions accorded us at the various stations by girls who stood on the platforms cheering and waving flags. At Little Rock we visited the Y. M. C. A. and then again resumed our journey, speeding across the hot levels of Oklahoma and Texas, into the deserts of New Mexico.

When we reached El Paso I was given ten cartridges for my revolver and ordered to allow no one to leave the train until instructions to that effect were issued. These came an hour afterwards and the troops marched out of the cars. Instead of remaining at El Paso, however, we were ordered to Douglas, Ariz., 200 miles away. On the way we passed through Columbus where a large tent surrounded by a high wire fence heavily charged with electricity and patrolled by a strong guard was pointed out to us as a military prison for Mexicans.

Arriving in Douglas at noon on July 7th, we at once set about pitching tents. The thermometer registered 112°, but at night the weather was so cool that we were compelled to sleep under blankets. The routine of camp life occupied our time during the next two days and then came a heavy rain storm which developed into a cloudburst accompanied by brilliant flashes of lightning. This meant additional work—digging sinks, grubbing roots and extra attention devoted to the care of the horses. And so passed our days on the Border, one being very much like the other.

MILITARY MEN PRAISE CAMP EQUIPMENT

Major A. F. Kilbourne, U. S. A., who has charge of mediums of communication between the camps along the Mexican border, recently made an inspection of the methods in practice at Camps McAllen, Pharr and Mission. After an examination of the wireless plant which is taking care of all official business of the three camps, he said that the New York division's wireless communication was the best he had yet found along the border.

The wireless system at McAllen has a radius of more than 100 miles. Although Major General O'Ryan and Squadron A were "somewhere in Texas" a few weeks ago on a tour of inspection, communication with headquarters was maintained by means of the wireless.

It is understood that General O'Ryan has been much impressed by the fine showing made by the wireless, and although he personally has refrained from expressing his opinion, other officers have predicted that, should trouble come, the wireless would play an important part in concentrating the widely separated units. Many of the telegraph and telephone wires have been cut repeatedly.

The Problems of Interference*

By Percy W. Harris

THE ever increasing popular interest in wireless telegraphy and the fact that in practically every school at least the elements of this modern application of electricity are included in the course of instruction may, perhaps, account for the large number of specifications relating to radiotelegraphic apparatus which find their way to the Patent Office.

Most of these, unfortunately, prove to be of little value, mainly because the inventors are unacquainted with practical work. It might be said that had they known of certain difficulties connected with the transmission and reception of wireless waves, the greater proportion of the specifications would never have been filed. Particularly is this case with regard to patents for eliminating interference with the reception of wireless signals.

When Senatore Marconi first erected a pair of stations for intercommuication over short distances, there was, of course, no interference from other stations, as these did not exist; but directly the stations were multiplied a difficulty arose. This will be understood when we consider that the transmitting aerials radiated electric waves equaly in all direcions, and these were recorded on paper tape as dots and dashes. We thus see that if one station were working to another at a distance of, say, fifty miles, any other receiving station within that radius from the transmitter would be affected equally. The disadvantage of this is obvious, as no two pairs of stations close to one another could work at the same time. Wireless telegraphy being of the greatest use on board ship, working in congested shipping zones, such as the English Channel, would have been practically impossible had no remedy been found.

* From The Year Book of Wireless Telegraphy and Telephony, 1916.

With the invention of the tuned transmitter in 1900 some of the disadvantages were removed. The early transmitter to which we have just referred radiated strongly damped waves, which excited the receiving aerial by impact. The tuned transmitter, on the other hand, radiates a train of more or less feebly damped waves, no one of which is sufficiently strong to create an effect in a reeciver (except at close range); whereas the cumulative effect of the whole train on a suitably adjusted instrument within range is very appreciable. By having various pairs of stations, each pair on a different adjustment, many can work at the same time within a comparatively small zone. Were it not for tuning, the giant stations at Poldhu, Clifden and other places would interfere with all ship stations for a great distance; whereas in reality vessels almost in sight of these stations are unaware of their working unless the operators make special adjustments.

Under present conditions, however, and owing to international agreement, it is impossible to make full use of the principle of tuning to avoid interference between stations. The most stringent rules have been framed and need to be enforced to avoid interference, and it must not be imagined that because all transmitters and receivers have apparatus to enable them to be adjusted to particular wave lengths, they are by any means immune from disturbance. The reason for this is as follows: First, the most important application of wireless telegraphy is to communicate with ships at sea and between ships and coast stations. In cases such as distress calls it is necessary that as many ship and shore stations as possible should hear the signals. Again, at the present time special warnings may be issued from the Admiralty by wireless regarding alterations in light vessels, calling at certain places, the presence of submarines, and such matters. Operators, therefore, have their apparatus adjusted in such a way that they can hear any call from any station within range. Were it not for this international agreement, distress calls would often go unheard. For some years all mercantile ships and commercial shore stations have had their apparatus normally adjusted to transmit and receive signals on a wave-length of either 300 or 600 meters. The case of naval stations we shall refer to later.

Quite apart from warnings and special calls, the handling of ordinary radiotelegraphic traffic requires to be carried out upon a common wave-length, so that every ship may be ready to receive its traffic. Thus a liner may have had a message for another vessel, which the latter is not expecting. The operator of the second ship, listening on the standard wave-length, is bound to hear the call of any ship within range, and thus will not miss the message. If, however, he were listening on some other wave-length he would probably miss the call.

Mercantile Ship Wave-Lengths

Three wave-lengths only are allowed to be used by mercantile ships—namely, 300, 600 and 1,800 meters. This last is only permitted in certain circumstances and is seldom used; whilst for reasons into which we cannot enter here the first-mentioned wave is but rarely utilized. To all intents and purposes we can say that commercial messages between ships and coast stations are practically all transmitted upon a wave-length of 600 meters. As the range of the average ship is some 200 to 250 miles, it will be understood that great care is needed to prevent interference.

Naval stations, both ship and shore, have very great latitude in the use of wave-lengths, working on numerous adjustments between 600 to 1,600 meters, the whole of this range of wave-length being reserved for official use. Warships are thus immune from interference by vessels of the Mercantile Marine and by coast stations handling commercial traffic; whilst the mercantile vessels, on their part, are not "jammed" by the installations of war vessels—incidentally often of very high power and considerable range. The giant stations used for trans-ocean communication, the distribution of news, time signals, etc., invariably work on wave-lengths considerably longer than those normally used by ships, and cannot be heard on ordinary adjustments.

The reader will now understand why it is that under present conditions the advantage of tuning cannot be fully utilized, particularly by vessels of the Mercantile Marine.

Modern receivers which give audible signals in a telephone headpiece enable the operator to distinguish the signals of one station through the signals of many others operating at the same time, owing to individual differences in sound. Although to the layman this may seem by no means easy, in practice reading through interference does not always present difficulties, particularly where the station it is desired to read has a pure musical note of a pitch appreciably different from that of the other stations. The position is somewhat analogous to that of a man in a railway carriage who unconsciously picks out the voice of a friend who is talking to him above the noise of the train and the voices of other people who are conversing in the same compartment. The coherer and similar receivers in use in the early days did not allow of this kind of reception, and therefore were useless in all cases where interference occurred on the same wave-length.

Defects of Call Signal Inventions

The reader who has followed us so far will now realize why so many of the call signal inventions are useless in practical work. Most of them depend for their working upon the coherer, which, as is well known, will readily actuate a relay controlling a strong current. Whilst many of the devices would work excellently with a pair of stations free from any interference, they are useless on the ocean, where many vessels are working upon the *same wave-length,* for the bell or other indicator would act whenever any ship happened to call any other, as well as when a call was made for the particular ship. Later we shall get other reasons for the non-success of many such devices due to atmospheric troubles.

In recent years a number of improvements have been devised in wireless transmitters and receivers for the purpose of facilitating the reading of one set of signals over interference of one or more other sets. The main advance has been in the direction of making the sound heard in the receiving telephones of a musical nature and of a clearly defined pitch. All early transmitters gave a rough, low and totally unmusical note, whereas those of modern design cause a sound similar to that of a flute or whistle. This has been effected by substituting for a fairly large fixed gap smaller gaps between electrodes rotating at a high speed or between a number of flat electrodes with very small space between them. To give an analogy between the old and the new notes, we may compare the sounds given by ordinary carpenters' saws and machine-driven circular saws. The ordinary saw gives a rough, coarse sound very little distinguishable from that of other saws being used at the same time; whilst the circular saw gives a hum of a more or less clearly defined pitch, and it is comparatively easy to pick out by ear the sound of one circular saw from that of others working in the vicinity.

Utilizing Note Tuning

In aural reception the frequency of the spark is of the greatest importance, whereas in reception by coherer and similar detectors this counts for very little. A number of devices have been invented within recent years to utilize *note* tuning. Amongst these we may instance a telephone receiver in which the diaphragm was made to resonate to a particular note, but was unaffected by others. It would seem on first consideration that such a device would overcome many of the difficulties of interference on the same wavelength, for, if we imagine a pair of stations to work on a note of high pitch, their telephones would not be actuated by signals of lower pitch. However, it has been found that this telephone does not give sharp signals, there being no rapid cut-off at the end of the dots and dashes. Such lack of sharpness interferes with reception at anything but a slow speed. Another device tunes the telephone circuit, by means of large capacities and inductances, to the particular musical note which it is desired to receive; but no extensive use has been made of the idea, as it has not been found

Some years ago a series of investigations were made for the purpose of finding the best frequency to use with ordinary telephone receivers, and it is now recognized that frequencies from 500 to 1,000 per second are the best. Wireless operators find that very high notes, although clearly audible above interference from atmospheric noises and sounds from installations giving a lower note, are very tiring to the ear; and the writer's experience, in common with that of many others, is that after working for an hour or two with a note of 1,000 per second a form of mental strain is created, a kind of nervous irritation sets in, and one seems to hear the sound long after it has ceased. On the other hand, a frequency of about 600 per second is pleasing to the ear, easily readable, and has not the effect above referred to.

The most successful call-signal devices are those which have a time-lag, not being actuated by short signals, such as dots and dashes at ordinary speed, but only by prolonged signals of several seconds. Such devices are not affected by occasional jamming from other installations, neither do atmospheric disturbances, except when very strong, give unwanted signals.

So far we have dealt mostly with interference by signals of the same wavelength, assuming that the reader is fairly well acquainted with the principle of tuning and the usual methods of selecting, by resonance, the wave-length required. Most modern tuners will easily differentiate between waves differing by as little as 5 per cent. in length, provided the stations are not too near. To effect this sharp selection, however, there is usually considerable sacrifice in strength, and means have now been devised by which the selection can be made without much loss. Several pairs of very high power stations have recently been erected for working "duplex"—that is to say, sending and receiving taking place at the same time.

Duplex Operation

To explain this method of working we may instance the giant stations at Clifden and Glace Bay. The transmitting station at Clifden is situated some miles from the receiver, separate aerials being used. A

Transmission across the Atlantic takes place in both directions at once, the receiving station in Ireland not being jammed by the transmitter a few miles off, although the difference in wavelength is by no means large. Without some special arrangement the received signals in Ireland ad Nova Scotia would be hopelessly jammed by the enormous power being radiated from the adjacent transmitters, as, tuning or no tuning, any individual wave of the train being radiated would be sufficiently strong at that distance to force the receiver into strong electrical vibration. In this case interference is eliminated by what is known as a "balancing aerial" at the receiving station, this aerial being placed at right angles to the aerial which is taking signals from across the ocean. Both receiving aerials are led to a specially designed receiver, where they act in opposition to one another. The aerials used by the Marconi Trans-Ocean Stations are directional in the properties, receiving stronger signals in the plane of their length and weakest in the plane at right angles to this. We have mentioned that the balancing aerial is erected at right angles to the ordinary receiving aerial, and in this case it receives practically nothing from across the ocean, although both aerials are affected about equally by the strong signals from the adjacent transmitter. The signals in the receiving and balancing aerials from the adjacent transmitter are made to neutralize one another, all that is left being the weaker signals from across the ocean. Here we have a case of interference successfully overcome, not by ordinary tuning or note selectivity, but by balancing.

The Balancing Principle

The balancing principle has also been applied to signals of different wavelength received on the *same* aerial. The method is to tune the aerial to two wavelengths, one of which is the same as it is desired to receive. The aerial is coupled to two receivers tuned to each of the wave-lengths respectively, and the resulting rectified oscillations are opposed in a common telephone transformer.

Powerful waves differing from both the tunes of the aerial will excite both wave-lengths, and by carefully adjusting both receivers a good balance can be obtained.

The desired signals excite only one wave in the aerial, and so come through, as both receivers are not affected. This method has been worked at Letterfrack, but does not give results equal to the balancing aerial method.

Hindrance to Sharp Tuning

We have so far omitted reference to one trouble arising in connection with the emission of damped waves from a transmitter, and which may prevent sharp tuning. When a closed oscillating circuit is coupled to an open radiating circuit, there is an interaction between the two circuits, which in case of tight coupling causes waves of two frequencies to be radiated. The weaker the coupling, the closer these waves become in frequency; and when the coupling is very loose practically a pure wave is given off. In the case of a very weak coupling, however, there is some diminution in strength, and in most cases where very sharp tuning is not required the coupling is made sufficiently strong to utilize most of the energy of the close circuit, but not strong enough to give waves which differ to any great degree.

If the arrangement of the discharger in the closed circuit is such that the spark can be fairly rapidly quenched and the circuit opened after a few oscillations, the energy which has already passed into the antenna oscillates freely. As there can now be no interaction, the wave emitted is very pure, and a minimum of interference is caused. The quenching should not be too rapid, as, if the first oscillations in the aerial increase very rapidly, interference will be caused on other receivers by impact excitation.

The Marconi high power stations, with their high speed discs and rotating side electrodes, are adjusted so that their sparks are quenched as soon as the energy of the primary circuit has been delivered to the aerial. Another method of quenching extensively utilized consists in passing the spark between a number of flat metal plates separated by a distance of not more than 1-100th inch, the small gaps being in series. The large metal surface rapidly conducts the heat away; this being one of the chief causes of the quick quenching. When any considerable power is used the metal plates need to be artificially cooled by an air blast, and the power required for driving the blower may be considerable. A good quenched gap enables a tight coupling to be used without causing the emission of a double wave, thus yielding higher efficiency. Such discharges need to be very carefully designed, or there may be losses which more than outweigh the advantages gained in other directions.

The growing use of continuous waves has recently brought into prominence a number of receiving devices which overcome many difficulties caused by interference. Many people with a slight acquaintance with wireless telegraphy believe that continuous waves must be vastly superior to damped waves for purposes of tuning; but as most modern transmitters are but feebly damped, the superiority is by no means so great as would be thought—in fact, the Marconi Company has found that there is very little difference in the sharpness of tuning between continuous wave signals and signals from their very feebly damped high power transmitters.

A Continuous Wave-Receiving Device

A highly ingenious continuous wave receiving device is known as the "Goldschmidt Tone Wheel," really a commutator run at a speed closely approaching that required to commute the oscillations received into a continuous current. As, however, the speed is purposely not exactly that required to commute the current, a low frequency alternating current is produced, having a frequency equal to the difference between the received wave frequency and that of the commutations of the tone wheel. For a description of the working of this instrument we would refer our readers to the "Wireless Telegraphist's Pocket Book," by Dr. J. A. Fleming. Its great advantage is that interference from a continuous wave of only slightly different frequency will give a greatly different note in the telephones. The Heterodyne receiver, another ingenious device, gives a note the tone of which depends on the difference in frequency between the received waves and that of a continuous oscillating current generated in the receiver. This is also described in the book above referred to.

The Poulson "Ticker," another continuous wave detector, is useless in jamming, as the note given depends for its frequency upon the rate at which a circuit is opened and closed, and is quite independent of wave frequency, all signals, including atmospherics, therefore being of the same tone.

Atmospheric Interference

Having dealt at some length with interference caused by other wireless stations, we must now turn to the problems arising through interference from atmospherics and other troubles. How to eliminate atmospheric disturbances has long been a serious problem for the wireless expert, and, although we may reasonably expect a complete solution of the problem before many years have passed, it must be confessed that at present much needs to be done. Directly Senatore Marconi came to communicate over an appreciable distance he found that all kinds of irregular signals recorded themselves upon the tape machine. It soon became evident that these irregular signs were not produced by wireless stations, but originated from lightning discharges and electrical disturbances in the ground or atmosphere. From a fancied resemblance of many of the signs to the Morse character for the letter X, and from the fact that they were an "unknown quantity," these signals came to be known as "X's"; they are also termed "atmospherics," "strays," and in the United States "static." Whenever these signals were frequent they made the reception of real signals most difficult and frequently impossible. Some of the trouble vanished when the coherer was taken from the aerial and placed in a separate tuned circuit, as it had been found that Xs partially arose from accumulation of electricity in the aerial, which when the pressure had reached a sufficiently high figure suddenly discharged through the coherer. With the tuned apparatus direct metallic connection of the aerial with the ground prevented such an accumulation. The trouble, however, still continued, and, as voyages to various parts of the world were soon made with wireless installations, investigators discovered that in the tropics and some other parts atmospheric trouble existed almost continuously throughout the day and night.

With the introduction of detectors which permitted aural reception a further improvement was manifest, as the skilled operator could often distinguish the sound of the transmitting station from that given by atmospheric and similar discharges, and the provision of musical notes marked still a further step. In regions where atmospherics are very prevalent, such as Equatorial Africa, the Amazon region, and tropical waters, the power required for effective communication over a given distance needs to be considerably in excess of that needed for the same distance in regions comparatively free from such trouble. It has been observed in many instances that atmospherics are more troublesome on a long wave than on a short one, but this is not always the case. Large and high aerials, presenting as they do a very great surface to the atmosphere, are affected far more than small ones; and recent experiments have shown that a long, low aerial is not affected to anything like the same extent as a tall aerial containng the same amount of wire, even when the received signals from a particular station are of the same strength on each.

Sounds Due to Atmospheric

The operator listening with the telephones on his head when atmospherics are prevalent hears a variety of sounds. Some "X's" seem to give a low, rumbling noise, others have a sound resembling the tearing of calico; others, again, sound like escaping air, and still others give a frying noise. One peculiar variety well known to experienced operators almost invariably precedes a squall of sleet, and the writer has on more than one occasion created a sense of wonderment by telephoning from the wireless cabin to the bridge to say that such a squall would arrive within five minutes. There may be no visible signs of any such squall, but invariably it arrives within the time stated, to the great astonishment of those who do not know how its arrival is foretold.

Much that we have written with regard to the elimination of interference from other wireless stations applies equally to the elimination of atmospherics, although not so much has been done with regard to this last. The Marconi Balanced or Opposed Crystal Receiver, which is described in the "Handbook of Technical Instructions for Wireless Telegraphists," has so far proved the best device for the elimination of this form of disturbance, although many experiments are now being carried out in other directions.

Instances of Freaks

It is a remarkable fact that in the case of two stations separated by a distance of a few hundred miles a particular atmospheric trouble will sometimes affect both equally, and at other times disturbs one and not the other. A land station will oftentimes find it practically impossible to read signals from a ship at a much smaller distance than this, whilst the ship has not the slightest difficulty in reading the coast station. This is occasionally acounted for by the fact that the coast station aerial is much higher, but such an explanation does not often satisfy.

Land stations are sometimes subject to interference by induction from power transmission lines, tramway systems, electrified railways, and current leakages generally. The elimination of such troubles as this, however, gives little trouble to the practical engineer, and need not concern us here.

In this consideration of the problems of interference we cannot, of course, offer anything like complete information on the subject. Our endeavor has been rather to indicate to the student who has acquired some knowledge of the theory of wireless telegraphy, and also to the theoretical worker unacquainted with practical conditions, some of the troubles which arise and which need to be taken into account when designing apparatus and thinking out improvements. If we have been able to point out new paths of investigation to even a few of our readers, this article, incomplete as it is, will be more than justified.

Long Distance Transmission on Low Power and Short Wave-lengths

The Aerial Current

By A. S. Blatterman, B.Sc.

Part. II

THE writer has presented in another publication a formula for calculating the current in the base of a transmitting aerial. That formula can easily be thrown into the form:

$$i_2 = 54400 \sqrt{\frac{W_1 C_2}{\delta_2 \lambda} k} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where:

W_1 = watts in the condenser circuit.
k = per cent of W_1 transferred to aerial.
C_2 = capacity of aerial in farads.
λ = wavelength in meters.
δ_2 = decrement per semiperiod.

Now the aerial decrement δ_2 is the sum of the decrements due to the equivalent resistance of radiation, the resistance of the earth connection and the ohmic resistance of the antenna wires.* That is: $\delta_2 = \delta R_1 + \delta R_2 + \delta R_3$

R_1 = decrement due to radiation resist.
R_2 = decrement due to antenna ohmic resist.
R_3 = decrement due to earth resistance.

Thus:

$$\delta_2 = \frac{R_1 + R_2 + R_3}{4 n L_2}$$

$$= \frac{3 W \pi 2 (R_1 + R_2 + R_3) C_2}{\lambda} 10^8 \quad (6)$$

R_1 = radiation resistance.
R_2 = ohmic resistance of wires.
R_3 = earth plate resistance.

If the value of the antenna decrement as given by this last equation be substituted in the original equation for i_2 we obtain a very important result, namely,

$$i_2 = \sqrt{\frac{k W_1}{R_1 + R_2 + R_3}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

This means that *when the power W_1 in the condenser circuit is invariable the aerial current is affected only by the total equivalent resistance of the given aerial circuit, but is independent of an added self-inductance, altered wave length or capacity, and hence the addition of any foreign element into the circuit must be judged solely by the change it occasions in the total aerial resistance.*

Thus, while a power of 1 k.w. may produce six amperes in one aerial it may only produce three or four amperes in an aerial of higher equivalent resistance.

It is interesting to note that equation (7) could have been derived another way. It is plain that the total power supplied to the aerial, W_2, is dissipated in three ways, namely, as heat at the surface of the aerial conductors and at the earth plate, and in electromagnetic radiation.

The power radiated is $P = i_2^2 R_1$.

The power lost in heat at the earth plate and in the aerial conductors = $(R_2 + R_3)\ i_2$.

Therefore, the total antenna power W_2 is:

$$W_2 = k W_1 = i\ (R_1 + R_2 + R_3)$$

and

* There is another component of aerial resistance due to the effective series resistance of the aerial acting as an absorbing condenser. This is negligible at wave-lengths near the fundamental.

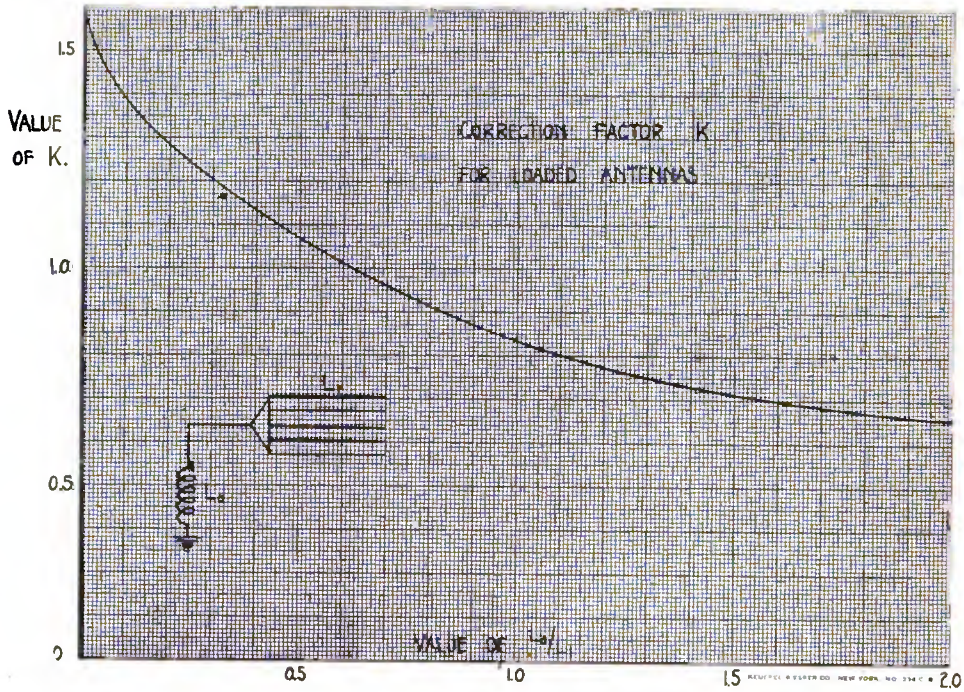


Fig. 8

$$i_2 = \sqrt{\frac{kW_1}{R_1 + R_2 + R_3}}$$

which is the same as equation (7).

The factor, k, involves the losses in the condenser, brushing and dielectric hysteresis losses, the losses in the conductors of the condenser circuit, the losses at the spark gap and the losses at the oscillation transformer. In ordinary spark sets and those using the nonsynchronous rotary gap, k may be in the neighborhood of 0.3 or 0.5.

Apart from the importance of selecting the proper wave length for a given distance, as discussed above, the proper proportioning of the aerial to the wave length used is so influential in its effect on the power radiated that it is remarkable that so little attention has been given to this feature in the construction of amateur stations. One frequently hears the amateur's query, "How many amperes do you radiate?" and the answer, "four amperes on 1 k.w.," or perhaps "three amperes on ½ k.w."; and these figures are then accepted *per se* as indicative of whether or not the station in question is an efficient one. *The antenna current mentioned by itself is absolutely no criterion of the effectiveness of one station as compared with another.* The writer knows of one station which radiates thirty-five amperes with 1 k.w., and yet has a range of less than 100 miles, while numerous other stations radiating only four or five amperes with the same power have a range of at least twice this. What is desired from a wireless station is the conversion of as much as possible of the primary transformer power into electromagnetic waves, that is into power radiated from the aerial.

Now the power radiated in this way is:

$$P = i^2 R_1 \text{ watts}$$

and the radiation resistance R_1, as has been shown, depends on the height of the aerial, the wave length, and on the shape of the current distribution along it; that is, the form factor. Moreover, as shown by equation (7), and stated in italics, the antenna current itself is limited by the effective resistance (including that due to radiation) of the antenna. Thus, in speaking of the radiation efficiency of a station it is not sufficient to give only the current in the aerial, but the radiation resistance must also be stated if a complete criterion is desired.

Substituting the value of i_2 given by equation (7) in the equation for the power radiated we find:

$$P = \frac{k\, W_1\, R_1}{R_2 + R_3 + R_1} \quad \ldots\ldots\ldots\ldots (8)$$

From this it appears that the radiation resistance R_1 should be as large as possible while the resistance of the earth connection and the wires R_2 and R_3 should be kept very small. If R_2 and R_3 could be made negligibly small then all wave length that can be effectively radiated corresponds to the fundamental of the given aerial. For the particular case of the amateur station, where the wave length must be very short, it is therefore obvious that a wave length very close to the fundamental should be used, since this means maximum antenna dimensions and hence maximum radiation. For these reasons it is of the utmost importance to be able to determine very exactly the maximum dimensions of the antenna which will permit the use of the given short wave.

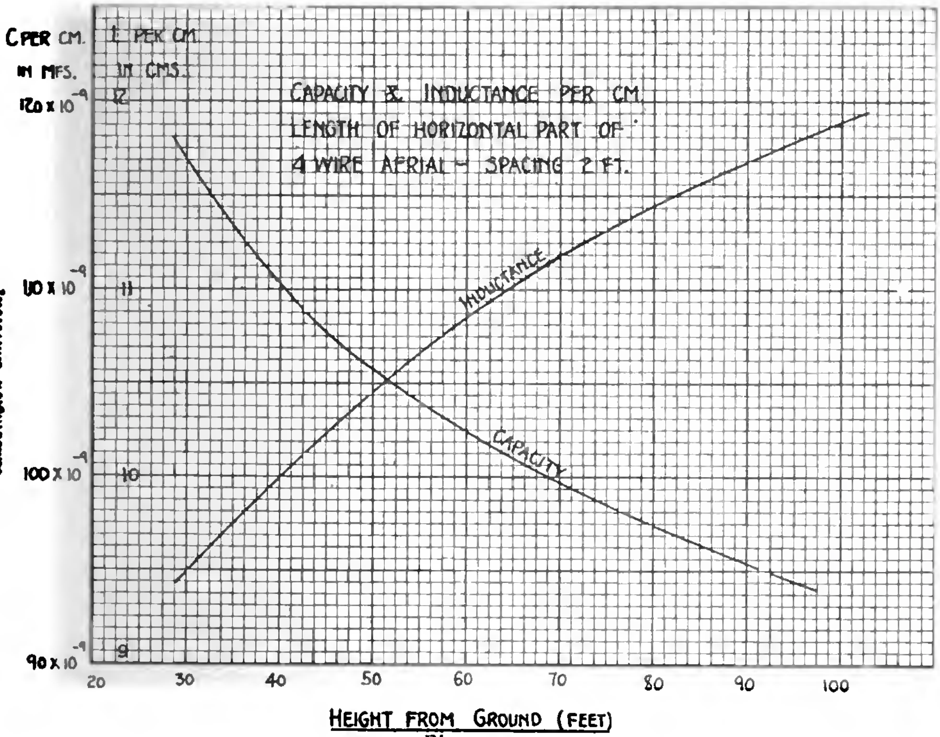


Fig. 9

the power supplied to the aerial would be radiated and the efficiency would be maximum.

Natural Wave Lengths of Aerials—From the above considerations it will now be evident that the wave length is a most important factor affecting the range of a station. It is also clear that in a superficial way it is desirable to use high aerials with high form factors, and short wave lengths, since all these make for a large value of power radiated. Of course, for a given aerial the shortest

The writer has already presented* curves and tables based on the formulae of Dr. Louis Cohen, which give the approximate values of capacity and inductance and natural wave lengths of amateur antennas. These were not highly satisfactory, for while they furnished an indication of the magnitude of the quantities involved, yet the average accuracy was not greater than some 20 per cent. Within the past three years, however, additional data and formulae have ap-

* A. S. Blatterman, Electrician and Mechanic, Sept., 1913.

peared* through which it is possible to calculate very accurately the natural wave length of a given aerial, and thus predetermine to a nicety the maximum possible dimensions thereof.

It is well known that when inductance and capacity in a circuit are lumped, or localized, respectively in a coil and in a condenser, the circuit can be put in oscillation, and the frequency of the oscillations is:

$$n = \frac{1}{2\pi\sqrt{LC}}$$

The wave-length

$$\lambda = 2\pi \times 3 \times 10^8 \sqrt{LC}$$

where L and C represent the total inductance and capacity, in henries and farads respectively.

In an antenna, however, the inductance and capacity are not concentrated, but are distributed throughout the system, and the total inductance and capacity of the system cannot, in general, be used in the above formula to compute the frequency. In this simple case the formula becomes:

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

The wave-length:

$$\lambda = 4 \times 3 \times 10^8 \sqrt{LC}$$

Now in an actual antenna we have a loading coil or at least the secondary of an oscillation transformer at the base. This constitutes a considerable localized inductance which must be combined with the distributed antenna inductance in determining the frequency of the system. Under these conditions the frequency lies somewhere between the values given by the above two formulas being $\frac{1}{4}\sqrt{LC}$ when the loading inductance is zero and approaching $\frac{1}{2}\pi\sqrt{LC}$ when this inductance is so large that the antenna inductance is negligible in comparison.

We can therefore write the equation for the frequency of such a system as follows:

$$n = \frac{K}{2\pi\sqrt{LC}} \quad \ldots\ldots\ldots\ldots\ldots (9)$$

The wave-length:

$$\lambda = \frac{2\pi}{K} \times 3 \times 10^8 \sqrt{LC} \quad \ldots\ldots (10)$$

where K varies from 0 to $\pi/2$ and depends on the ratio of the coil inductance L_0 to the antenna inductance L.

The curve (Figure 8) gives the values of K for different values of the ratio L_0/L from 0 to 20.

Let the inductance of the loading coil have the same value as that of the antenna. Then $L_0/L = 1$, and from Figure 8 the value of K is 0.82. Using this value

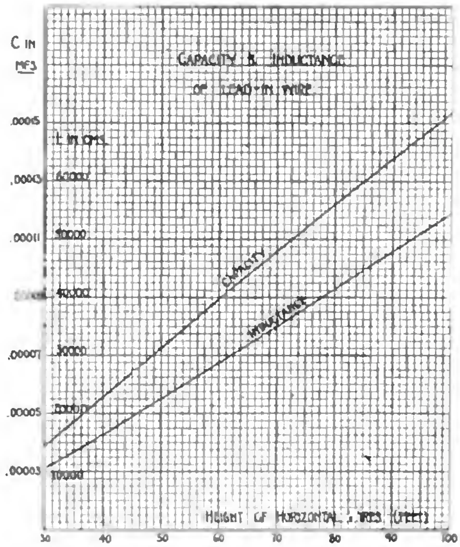


Fig. 10

of K in equation (9), there is obtained for the free frequency of the system

$$n = \frac{0.82}{2\pi\sqrt{LC}}$$

and for the natural wave-length:

$$\lambda = \frac{2\pi}{0.82}\sqrt{LC} \times 3 \times 10^8$$

Assume the following values for the inductance and capacity of the antenna.

$L = 20{,}000$ cms. $= 20{,}000/10^9$ henries.

$C = 0.0005$ mf. $= 0.0005/10^6$ farads.

Then

$$\lambda = \frac{2\pi}{0.82} \times \frac{3 - 10^8}{10^7} \sqrt{2000 \times 0.0005}$$

$= 230$ meters.

If the inductance and capacity of the system had been considered localized, the wave-length would have been:

$$\lambda = 2\pi \times 3 \times 10^8 \sqrt{(L_0 + L)\,C}$$

= 260 meters

* G. W. Howe, Electrician, August and September, 1914.

As a check on the results obtained by the use of the curve (Figure 8), consider the extreme cast $L_0/L = O$; that is, no loading coil, a simple antenna. In this case $K = \pi/2 = 1.57$.
Then

$$n = \frac{\frac{\pi}{2}}{2\pi\sqrt{LC}} = \frac{1}{4\sqrt{LC}}$$

which is the formula to be expected when the capacity and inductance are distributed.

We are thus forcibly impressed with the necessity of being able to calculate the inductance and capacity of the aerial, as well as the inductance of the coil at the base of it.

Figure 9 gives the capacity and inductance per cm. length of the horizontal part of four wire aerials at different heights. The wires are assumed to be No. 14 gauge and spaced 2 feet apart. Thus, for an aerial of four wires spaced 2 feet part, which is 80 feet long and a certain height above ground, the capacity and inductance of the horizontal part would be determined by reading from Figure 9 the values of C and L per cm. length corresponding to the given height and then multiplying each of these by the length of wires in cms., in this case, $80 \times 30.5 = 2240$ cms.

To these resulting values must be added the capacity and inductance of the lead-in, in order to determine the total inductance and capacity of the system.

The two curves of Figure 10 enable one to determine the inductance and capacity of the lead-in wire. These curves are plotted for a lead-in composed of four No. 14 wires twisted together, leading down from the aerial and terminating 10 feet from the ground. Abscissas are not the length of the lead-in but are the heights from earth to the horizontal wires forming the antenna top.

If the antenna is of the inverted L type the foregoing statements need no modification. However, when the antenna is of the T type with lead-in at the center, then from the point where the lead-in joins the flat-top there are two inductances and two capacities in parallel, these being the two halves of the flat-top is, by this process, reduced ductance of the flat-top is half that of either of its two branches, or, in other words, it is ¼ the inductance of the total length of flat-top; the equivalent capacity is equal to the actual capacity of the whole flat-top.

Roughly, therefore, the wave-length of an inverted L aerial is not materially changed by adding another piece to that already existing and extending in the opposite direction so as to form a T. This is because the inductance of the flat-top. Thus, the equivalent inone-half while the capacity is doubled, leaving the product LC unchanged. This is only approximately realized, however, since the capacity and inductance of the lead-in, especially in small aerials, is a considerable fraction of the total inductance and capacity and therefore doubling the capacity and halving the inductance of the flat-top does not exactly result in the same value of the total product LC.

Editor's Note—In the November issue will be published a complete set of curves indicating the fundamental wave-lengths of 4-wire aerials of various dimensions, supplemented by an additional set showing the wave-length of aerials with a given amount of inductance inserted at the base.

To be continued

REWARD FOR OPERATOR OF SAN MELITO

Owen Chick, Marconi operator on the tanker San Melito, which was attacked by a German submarine while en route from Great Britain to Mexico, and escaped by means of the skill and bravery of the ship's company, was among those who were accorded recognition for heroism. Chick said in a report to the English Marconi Company:

"I was very agreeably surprised when asked to accept, in addition to a check, a beautifully executed model in silver of an early type of U boat mounted on an ebony base, bearing the inscription: 'Mr. O. Chick, wireless operator, presented by the Eagle Oil Transport Co. and the Anglo-Mexican Petroleum Products Co. as a memento of the escape of the s. s. San Melito from a German submarine after being shelled for forty minutes August 21, 1913.'"

The Korea's Last Trans-Pacific Voyage

By David Mann Taylor

Marconi Operator

The shore is gone! O'er restless sea,
One last look far away;
We meet, dear friends, where joy ne'er ends,
Good-bye! 'Tis Sailing Day.

AMID screeching salutes and a hearty God-speed from five hundred throats, the Pacific Mail steamship Korea, greyhound of the Pacific, with the veteran Captain, A. W. Nelson, on the bridge, left San Francisco, at noon on July 3, 1915, on her 20,000 mile journey.

The scene will long be remembered. It was such a day as only California can give us; not too warm; just golden. As the ship swung away from the dock, bedecked from stem to stern with bunting, confetti and vari-colored paper ribbons her deck-rails crowded with passengers waving handkerchiefs and wafting good-bye kisses to dear ones ashore, the Constabulary Band was playing alternately with our own Filipino stringed orchestra. A program of all the snappy American music of the day ended with the "Star Spangled Banner" and "America," at which time we all gravely saluted the flag, which was then dipped with a salute from our siren. All our officers were in full dress uniforms and the sight was inspiring. Many a tear dimmed eye I saw as I looked down upon the scene.

We steamed slowly from the dock to the main channel, thence across the beautiful bay toward the Golden Gate, passing the greatest Exposition ever held in the world. Off the Marina were anchored the battleships Maryland, Colorado and West Virginia, the Torpedo Flotilla, with the tenders Cheyenne and Iris and supply ship Jason, all of which dipped their flags in salute and ran up the signal "bon-voyage, safe return," which was answered from our bridge with "thank you." Many of the passengers lining the deck-rails at the time stood at attention, with bared heads as the salutes were exchanged.

We proceeded to sea, after exchanging salutes with the lightship and pilot boat. The big Pacific was calm and the beautiful clear blue sky, dotted here and there with fleecy little clouds, made it possible for us all to watch the fast disappearing land for quite some time.

After passing the Farallones, the last bit of America we were to see for sixty-five days, one and all retired to their rooms to dress for dinner, for the first evening meal on board is not unlike a debutante's "coming out" dinner, when everyone's curiosity is aroused and all strive to look their prettiest and best, especially the gentler sex, which was well represented.

At this time in the Marconi cabin we were keeping a close watch upon the doings upon the atmospherical stage, and it was the scene of great activity. Many messages were transmitted and many replies received. After clearing our own traffic to San Francisco, we watched patiently and assisted other ships that had traffic but at the time were out of range of the coast station. Constant communication was maintained throughout the entire voyage. Press dispatches were received from San Francisco, Honolulu, Choshi, Japan, and Shanghai, China, and our newspaper was published twice daily. Our average communication was 3,000 miles.

After steaming six days across the beautiful sunshine belt of the Pacific during which time there was nothing to break up the serenity of the fleecy little clouds that accompanied us, we picked up Diamond Head, the first point of land sighted by vessels bound to Honolulu. Those whose destination was Honolulu were loath to leave. For those glorious days had been a succession of deck games, dances, card parties, musicales and theatricals.

As we left the quarantine and proceeded to the Honolulu docks, we were besieged by dark-skinned native swimmers, diving for coins. These boys proved to be quite adept in the art and rarely missed any coins thrown to them. The rivalry was intense and their efforts energetic, each dive being accompanied by shrieks of laughter, the successful swimmer rising to the surface with the coin in his hand, immediately transferring it to his mouth for safe keeping. All the way up the channel and until the vessel was made fast to the pier, we were accompanied by the amusing divers.

We arrived at Honolulu at eight in the morning of July 9, and left at five o'clock that afternoon for Yokohama, Japan, our next port of call.

After leaving Honolulu our big swimming tank was placed in position on the forward deck, to the delight of our many passengers. The tank, promptly christened the "Korea's Bathing Beach," was crowded with a happy throng each dav of the remainder of the voyage.

The trip of ten days from Honolulu to Yokohama passed altogether too quickly. The weather continued delightful. The Pacific was as peaceful as a small inland lake.

We arrived at Yokohama, Japan, at 9:30 in the morning of July 20th. Here, many tourists' parties left us for their tours of the land of the Rising Sun. The supreme pinnacle of Japan, the peak of Fujiyama, the Sacred Mountain, rises in full view as the steamer enters Yokohama. In a moment the spirit of Japan is made manifest; you have the feeling of being carried from one world to another. Though Yokohama is quite a progressive and cosmopolitan city, one in which can be found all the modern luxuries and comforts of the present day, they are enjoyed among people who live in exquisite paper houses, who wear neither hats nor leather shoes, and who dress in kimonos unchanged in fashion for centuries—people who seem to go at life back end forwards, yet withal have evolved an artistic culture that has influenced the West.

We had been, a few days before our arrival at Yokohama, happily surprised to learn by wireless that the Oriental Palace Hotel management had made arrangements to give a dinner-dansant in our honor. By wireless also came the information that a company of Russian artists had been engaged to give a varied programme of entertainment immediately after dinner.

The dinner took place at eight in the evening of our arrival. Through the courtesy of Captain Nelson, our Filipino stringed orchestra was in attendance, and played with fine animation a selection of the latest American music, much to the delight of the guests. For the first time, public rendition was made of the new Korea waltz, "Yankee Swanson," written on shipboard by Dr. Tietze, in honor of our Commander, author of the story "Yankee Swanson," which is in reality a sketch of his own life.

At ten o'clock the following morning

The supreme pinnacle of Japan, the peak of Fujiyama, the Sacred Mountain, rises in full view as the steamer enters Yokohama we left for Kobe, Japan, our next port of call, arriving there at noon on July 22nd. We spent three days amid this city's great industrial activities.

A few hours after we left Kobe, we passed into the world-famed Inland Sea of Japan, one of the most beautiful bodies of water in the world, linking the Pacific Ocean with the Yellow Sea. The opportunity of passing through this wonderful stretch of water should never be missed. Here the greatness of Nature's handicraft is supplemented on all sides by the expert horticultural and gardening activities of the little Japanese. The opal-hued sea is dotted here and there with pretty little islands, thousands of them. The ship passed through the narrow channels, at times so close that one could almost step across from the deck to the fairyland islands, on which men and women hard at work occasionally stopped and waved to us. The surface of the magic sea reflected all the delicate colors of an Oriental opal, and it seemed to be set in a framework of brilliant emeralds formed of the dainty green covering of the mountainous mainland and the myriad of mystic islands, between which we passed the whole day.

After passing through the Inland Sea of Japan, we entered the Straits of Shimonoseki and passed into the Yellow Sea, skirting the coast of Kyushu, the southern island of Japan, southward to Nagasaki. We arrived at Nagasaki at 3 P. M., on July 26th. At this port is located the largest coaling station in Japan, and here also may be found the largest tortoise shell factories in the world, and the famous Tategami dry dock, carved out of solid rock at a cost of a million dollars.

Upon entering Nagasaki, the ship was piloted through a maze of narrow passages; up a crooked path, as it were, to our anchorage. In passing through this channel a striking panoramic view of the famed handicraft of the Japanese farmer is unfolded; upon the sloping hillsides are to be seen the finely cultivated truck gardens, so arranged as to make use of every possible bit of land for cultivation. These gardens are laid out in terraces, and graphically illustrate the ingenuity of the Japanese farmer, who has so little ground to cultivate in this section.

Upon arrival here steamers are met by a fleet of coal *sampans* (barges), each manned by a crew of Japanese men and women, some with little babies tied upon their backs, much like the papoose of the American Indian. The women and children work just the same as the men. They are very sturdy and never seem to be discouraged no matter what the weather conditions may be; at times they work all day and night, with only a short stop to take a little nourishment of rice and fish.

Almost before the ship was made fast to the coal buoy, the *sampans* were alongside our vessel and the agile little Japanese had begun the work of rigging the scaffolding around the ship, using ropes, poles and planks, in such a manner that they provided substantial stairways, just like so many little flights of stairs, all around the sides of the ship. Upon each step stood two workers passing the small baskets up, hand over hand, until they reached the deck, from whence they were emptied into the bunker hatches.

Each basket will average from thirty to forty pounds in weight, but these little people not only handle them with astonishing rapidity, but are quite happy in their work. On one occasion, as the baskets were being passed up very rapidly, one little woman caught a basket carrying a lump of coal that was heavier than her strength could manage and she dropped it back into the *sampan*. She began to giggle—they invariably giggle when anything happens—and the giggle rippled all the way down the line. No angry protest was heard from the foreman; it was just a joke on her and the work continued merrily on.

On this trip we spent some twelve hours taking on our supply of coal and left on July 27th, for Manila. We were right in the midst of the Typhoon Zone at the height of the typhoon season. The typhoon is the bugbear of seamen and travelers whose business calls them to this part of the globe during July and August, and the weather signals, reports and storm warnings sent out from the various observatories were watched by all with keen interest and anxiety.

A typhoon is the worst kind of a storm; it comes in the form of extreme heavy gales of wind, ranging from eighty-five to 125 miles per hour, accompanied by heavy rains and high mountainous seas.

After leaving Japan, we received daily weather reports, sent broadcast by wireless to ships at sea. This weather service, rendered free by most of the Government wireless stations throughout the Orient, is practically the same as that maintained by the United States Government radio stations.

For several days previous to our arrival in the Typhoon Zone, typhoons had been reported and observed from various weather observatories and warnings broadcasted to all ships at sea.

Less than four hours after leaving Nagasaki, south bound, our first storm warning was received, reporting a typhoon moving in a northwesterly direction. We were then steaming southwest The following morning I received a long report, containing explicit information as to the whereabouts of the storm. Captain Nelson, our commander, immediately ordered our course changed, more to the southeastward and away from the coast of Formosa. According to our position and course, and

An illustration of the writer's observation that, though Yokohama is quite a progressive city, one in which can be found all the modern luxuries and comforts of the present day, they are enjoyed among people who live in exquisite paper houses, who wear neither hats nor leather shoes, and who dress in kimonos unchanged in fashion for centuries

the typhoon, we were bound to meet and clash if we continued, and we were only saved the unpleasantness of passing through a typhoon, accompanied by its probabilities of and dangers of the encounter through the timely reception of explicit information, conveyed by wireless.

The change in our course was approximately 220 miles, which was overcome, to some extent, by steaming behind the typhoon and cutting across to Northern Luzon, thence southward to Manila. The distance covered by our ship was approximately the same, but we steamed 220 miles away from the Formosan Coast, in which direction the typhoon was directly headed, escaping its fury and experiencing nothing but a heavy sea, aftermath of the cyclonic storm which had just passed.

This typhoon, which was one of the most severe storms experienced in many years, swept over Shanghai, July 28, and continued up the China coast, doing heavy damage The North China Daily News reported the wind velocity the greatest recorded since 1870. Shanghai suffered the most; the Bund and Public Gardens were seriously damaged and many deaths were reported. The value of Marconi wireless equipment aboard all vessels was again demonstrated; without the aid of the wireless storm warnings our ship would have continued on, in its regular course, unmindful of the approaching dangers and would have clashed with the typhoon between nine and ten in the evening of July 28th. The consensus of opinion among the officers of the ship was that we had escaped a situation that may have been disastrous to the ship and the lives of those on board. Many voluntary expressions showed it was also a great relief to the passengers, many of whom had traveled through the Typhoon Zone at this time of the year before, to know that with the aid of Marconi wireless we were able to keep in constant communication and at all times were aware of the progress of the storm, enabling the commander and his officers to navigate the vessel in a safe manner. A feeling of perfect security was evidenced by the passengers upon receipt of the news that we had escaped the wrath of the heaviest typhoon of the season, in fact, the heaviest in thirty-five years.

After four days' steaming time we arrived at Manila. Here we discharged our remaining passengers and cargo, and immediately began to load a general cargo for Shanghai and America.

We left promptly at 10 A. M., on August 2, for the fifty run over to Hong Kong, at which port we arrived at five in the morning of August 4.

Hong Kong, as many of us suppose, is not a city; but an island lying off the coast of Kwang-Tung Province, South China. It stands on the fringe of the vast Chinese Empire, a gathering place of all sorts and conditions of men. Victoria, the city, is located upon the slopes of the island, and in general it is spoken of as Hong Kong. It is the clearing house of the world's commerce to and from the Far East, therefore one of the busiest harbors in the world. Ships of various nations are continually coming and going to all quarters of the globe. The island of Hong Kong belongs to Great Britain, having been ceded by China in the early 40's; here is located one of the largest naval stations in the Far East. Owing to the war, our Marconi cabin was sealed and the aerials lowered under the supervision of a British naval officer, leaving us free to indulge in sightseeing. We were glad of the opportunity, even though we had been here before, and for eight days we enjoyed many little jaunts around this quaint, picturesque island.

On August 11, we steamed from Hong Kong for Shanghai, beginning the first leg of our homeward bound voyage. During the entire outward bound voyage we had heard many rumors that the Pacific Mail Steamship Company was to discontinue the trans-Pacific service. Not much credit was given to these rumors, however, as we had heard similar reports for quite some time. When we arrived at Woosung, three days later, we heard that our ships were sold, but we were unable to obtain any definite confirmation until our arrival at Nagasaki at 6 P. M., on August 16th. Here we learned our fate. A cablegram was received by the commander, giving explicit information and details regarding the future movements of the ship and its crew. It was then learned that the Big Four, the steamers Mongolia, Manchuria, Siberia, Korea and the China had been sold to the Atlantic Transport Company and that these ships were to be turned over to their new owners at San Francisco and sent back to England, thereafter to be engaged in the trans-Atlantic trade.

When this news reached officers and crew they were very glum. Much speculation was indulged in and many "pleasantries" were exchanged. Dr. Jackson, our ship's surgeon, portrayed our feelings very well that night at Nagasaki in a poem which he composed and titled: "Korean Lament."

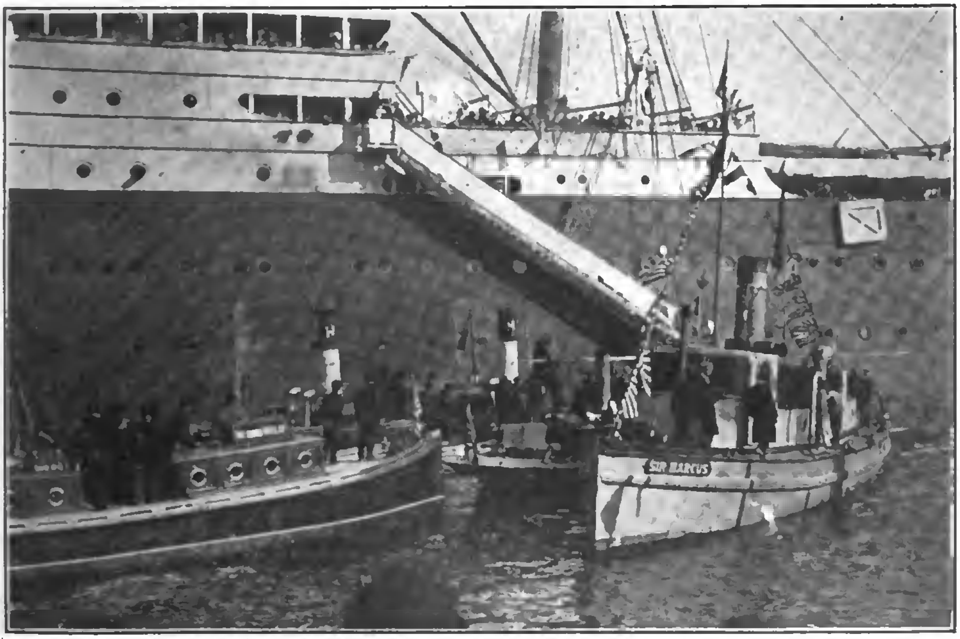
From thence onward our trip home through Japan was one long good-bye—"Sayonara," as they say in Japanese. Rumors of the removal of the American flag from the Pacific had filtered through Japan; but the catastrophe had been unbelievable. The Korea was the first steamer to have authentic information. We learned then that, commercially, the withdrawal of the Pacific Mail fleet from the Orient would be a heavy blow to Japan, as much money had been spent by American travelers and Yankee officers and seamen passing through the Island Empire. It was with a feeling of deep regret that Japan said farewell to the American flag.

The day of our departure dawned bright and sunshiny. Hours before our sailing time the beautiful harbor of Yokohama presented a fair and busy scene. Activity was everywhere. The barbor was crowded with many ships of various nations. *Sampans* propelled by one long oar, darted hither and thither, carrying Japanese sightseers aboard our ship for a last "Look see" and to say good-bye to their American friends. Merchants and their families, bringing with them small tokens of friendship—the little "Cumshaw" so affectionately remembered by us all—showed us with convincing sincerity how loath they were to see us go.

The hour of our departure drew near all too soon. Finally all our passengers were aboard and our visitors were beginning to leave the ship; the crowded decks were lined with returning tourists, intermingled with many Japanese in quaint costumes, their many-hued kimonos contrasting vividly with the more sombre American dress.

Promptly at 3:30 P. M. we were clear of the buoy. As the ship turned around and headed for the breakwater, there began the noisiest and most heartrending blowing of whistles I have ever heard; the steam salutes were forced until they sounded like shrieks and moanings. It was Yokohama's good-bye to the American flag, and it seemed to wail, "Come back, come back." Many a tear stained face I saw as I looked down upon the crowded decks, and through the glasses I could see that our friends and associates in the small boats felt as we did; it seemed to be the breaking of strong ties of friendship, that may or may not be renewed at some later time.

Several of the steam launches accompanied us out into the bay and two of the Pacific Mail Company's launches, crowded to the rails with officials and members of the Yokohama staff, ran alongside for five miles. With our siren



The harbor of Yokohama will still continue to present a fair and busy scene no doubt, but it was with a feeling of deep regret that Japan said farewell to the American flag. When the Korea left, hundreds of Japanese merchants came aboard for a last "look see" and to say good-bye to their American friends and steam whistles continuously blowing in answer to the salutes of the launches, we steamed slowly out to sea, dipping our flag in farewell as the launches turned around for their return run to the harbor.

In the Marconi cabin we were kept very busy with good-bye messages. All the way to Honolulu, the Japanese operators on various liners and at the coastal stations of Choshi and Otchishi, saluted us every night with: "Good wishes and hurry back."

* * * *

In the four years during which I had frequently visited Japan I had formed many friendships among the telegraph fraternity of the Island Empire. Many a happy hour I had spent in Japanese telegraph offices and radio-telegraph stations, and these reminiscences came crowding upon me. So much was I affected at severing my ties with the sons of Nippon that I wrote the following poem, as my "Good-bye" to Japan:

"SAYONARA"—GOOD-BYE

I can see the cherry blossoms,
  As they bloom in Old Japan,
Falling pink and white about her;
  Little maid of Yoko-San.
I can see the gold of sunrise
  And the silver of the moon;
And the twinkling lights of sampans,
  On the dusk of the lagoon.
I can feel the warmth of summer,
  And the drowsy stir of air;
And the slender little fingers,
  Strumming softly to me there;
And the world's a flood of sweetness,
  When you play your samisen.
  Sayonara—O my Hana!
  I will dream of you again.

I can see you as I used to,
  With the lotus in your hair,
Piled up smooth and dark and shining;
  And the robes you used to wear,
Gay like wings of birds and beetles,
  Sweet perfumed and flowing free;
And the long, light, sliding windows,
  Where we leaned and watched the sea.
I can feel your soft caresses,
  Blossoms of the East they seemed,
Fluttering down so warm and gentle,
  Like dream kisses I have dreamed.
Oh! The world's a flood of sweetness,
  When you play your samisen.
  Sayonara—O my Hana!
  I will come to you again.

From and For those who help themselves

Experimenters' Experiences.

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

FIRST PRIZE, TEN DOLLARS
Supplying the Current for a Vacuum Valve

ASK any amateur who is not using a vacuum valve detector what the chief difficulty is and in nine cases out of ten he replies it is lack of funds. He feels that he cannot afford to buy a vacuum valve and keep it supplied with electricity.

Being in the same boat with the majority of amateurs, I decided the best thing for me to do was to buy a separate valve, which several concerns are now selling, and make the storage battery and the high voltage battery myself.

I shall try to describe briefly the results of my work.

The low voltage filament battery consists of two cells for a four-volt battery and three cells for a six-volt battery. The unit I constructed was of six volts capacity, but any number of cells can be made to deliver any value of voltage. The important thing to remember is that a storage battery of the lead type delivers two volts on closed circuit.

The capacity of the small battery such as I constructed was about twenty ampere hours, and I think that this is sufficient for the requirements of the average amateur station.

There are two negative and one positive plate per cell. These plates have the same dimensions, but, of course, the negatives differ in construction from the positives.

From the drawings (Fig. 1) the size of the plates is given as 5 inches by 6 inches. This gives a capacity of twenty ampere hours for each positive plate in each cell. It is permissible to put in, say, two positive and three negative plates of this size, thus obtaining a capacity of forty ampere hours, but I think for the best service the smaller one will suit best because it is easier to charge.

The material from which the plates are made is ¼-inch lead. Each plate is 5 inches by 6 inches with a lug, ½ inch by 2 inches. The plates are drilled with ½-inch holes, as shown in the drawing, and each hole is countersunk on each side. These holes are to hold the active material.

After three plates have been made for each cell the positive plate of each is placed on a piece of heavy glass and the holes are filled up with a mixture of red lead (lead oxide, which may be obtained from most drug stores), and sulphuric acid. Dilute the acid to about 1 — 10 or 1 — 15 with water. Mix with a copper or iron spoon. Copper is best because it does not react with sulphuric acid.

Do not be sparing with the red lead, but fill the whole plate, or grid, up full.

The next thing to do is to fill up the negative plate with litharge, which is a spongy variety of metallic lead. Then the litharge is mixed in the same way as the red lead was, that is, with sulphuric acid.

When all the plates are filled up, either litharge or oxide, they should be piled up on one another, with several thicknesses of cardboard between and subjected to great pressure, such as is obtained from a vise. The cardboard is used to separate the plates so they won't stick together when taken out. The pressure will pack the active material better and prolong the life of the battery very much. They should be kept in the vise or under pressure of some great weight until they dry considerably.

After two negative plates and one positive plate have been made for each cell, they are ready to be assembled in the battery.

The two negative plates of each cell are connected as shown in the drawing. The separate cells are connected in series, that is, a positive plate to a negative plate, etc. They should be connected by heavy lead strips, as the wire will burn out quickly if the cell is shorted, which, by the way, is the worst thing you can do to make its life short.

When the cells are all connected, fill each jar with a solution of sulphuric acid by bulk four parts of water to one of acid, and whose final specific gravity is 1260° by hydrometer. Never

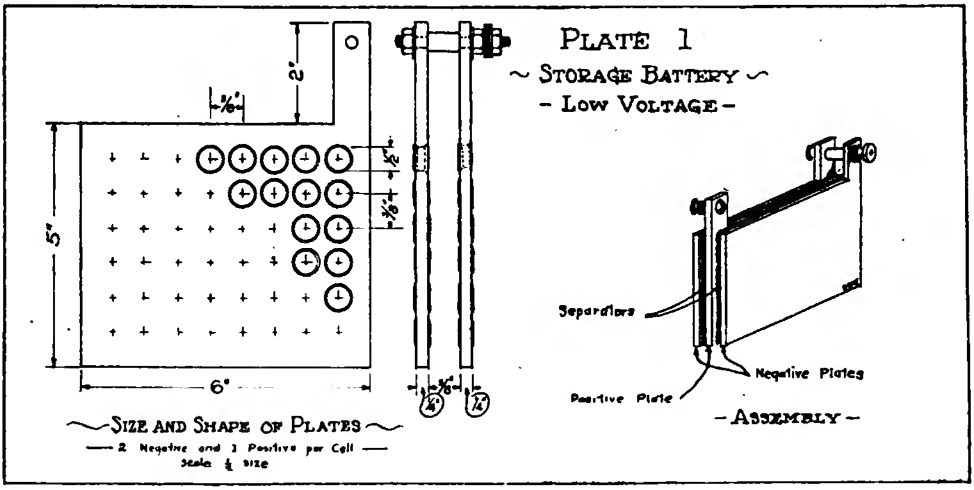


Fig. 1, First Prize Article

Glass jars are best suited to the use of the amateur as they cost less than rubber and never leak. Glass jars, measuring inside 6 inches by 6 inches by 1 inch, are just the right size.

Assemble the battery by putting two negatives around a positive plate, as shown in the drawing, and separated by wooden separators, which can be obtained from the Electric Storage Battery Company, Philadelphia, Pa. (Catalogue number 1420, cost per separator 4c.). These separators are just the right size and are specially treated wood. In the three element cell two are necessary so if you wish to make a six-volt battery, with two negatives and one positive plate, six separators will be necessary.

mix the solution by adding water to acid as the acid will be scattered all over and is liable to cause serious burns, but add acid to water. The mixture will get quite warm and should be allowed to cool before adding to cell. Always mix in a glass or earthen bowl.

A hydrometer is not absolutely necessary, but I certainly advise the purchasing of one, as it tells accurately the condition of each cell.

When the acid has been cooled, pour into the cells until about ½ inch over tops of plates.

The cell is now ready to charge, and the method used will be described later.

This battery should never be

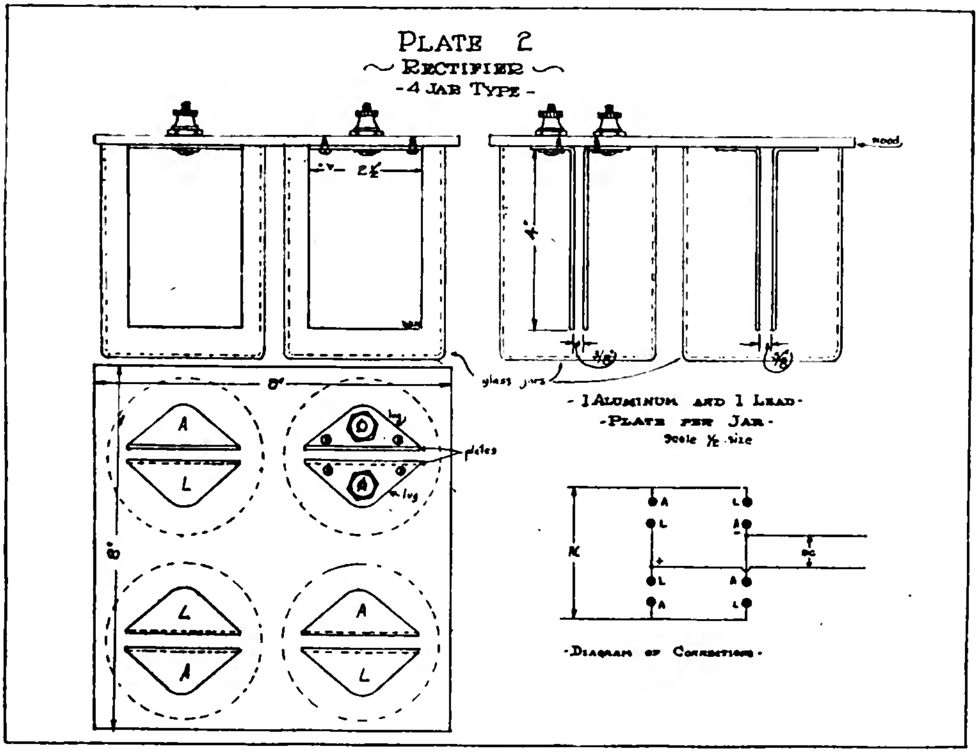


Fig. 2, First Prize Article

charged with more then 2-3 of an ampere and ten volts of the six-volt size. Too great a charging current will cause the active material to drop out of the plates and cause trouble.

Since the capacity is twenty ampere hours, current of two amperes for ten hours will charge the battery nicely. From my experience, I advise charging with two amperes until cells begin to gas, which will be in about eight hours; finish charging at one ampere for four hours. This gives a total of twenty ampere hours.

Always connect the positive pole of the charging current to the positive pole of the battery. To find the positive pole immerse the wires in a solution of salt water The most bubbles will come from the positive pole when the current is turned on. Few will come from the negative. Also the negative, after a few minutes' immersion, will become dirty in color, while the positive will be bright copper, if copper wires are used.

The specific gravity of the liquid when fully charged should be somewhere between 1280° and 1300°. One storage battery manufacturer says 1300°, and another says 1280°, so to be safe I shall call it 1290°.

Never add acid to the cell to make the specific gravity come up. If the gravity is right in the beginning it will be right at the end of the charge. Always use distilled or rain water to mix the electrolyte and only add pure water to jars when liquid evaporates, as the acid always remains unless spilled.

Always charge the battery once every six weeks whether it has been used or not. This will always keep it in good condition. Never allow the voltage of a single cell to drop below 1.8 volts. This corresponds to a specific gravity reading of 1,150° and the battery should be immediately recharged when found to be weak.

Never discharge a battery at more than 5 amperes. Although the battery will deliver about seventy-five amperes on short circuit, it is very harmful and five amperes is a safe discharge rate.

Never test the battery with an ammeter. This is a dead short circuit and will not only burn out the ammeter, but cause damage to the plates. Always test with a voltmeter and never test on open circuit. The voltage on open circuit is about 2.5 volts and is no indication whatever. Test the battery with a voltmeter when the battery is working, say, when it is connected to the filament of a vacuum valve. The voltage if in charged condition is near 2.2. .

It is well to clean the jar of sediment that will collect in the bottom after the battery has been in use, in order to prevent short circuiting of the plates internally. This should be done every six or eight months.

Never allow any foreign substance to get into the jars as metals cause rapid deterioration of the plates.

Last but not least, use good judgment about the battery and you will get good service from it but always keep it well fed (charged). As a horse can do more work when fed well, so can a storage battery, and either must be fed whether working or not.

After I had completed my battery, my next thought was, how can I keep the battery charged without financial backing? True enough I had alternating current in the house, but I required direct current to charge a storage battery, so I made up my mind to make a rectifier. The description of the one I made follows:

As a single-jar electrolytic type uses only one-half of every cycle, it is very wasteful. The four-jar type is more efficient as it uses both sides of the cycle, and I decided on this type. Although no electrolytic rectifier is very efficient, it may be expected that this rectifier will deliver about 50 per cent. of the current put in. I have seen demonstrated a rectifier giving 60 per cent. efficiency, but I don't believe I have ever heard of one giving more.

The first thing to do is to procure four jars, such as the kind used in a crow-

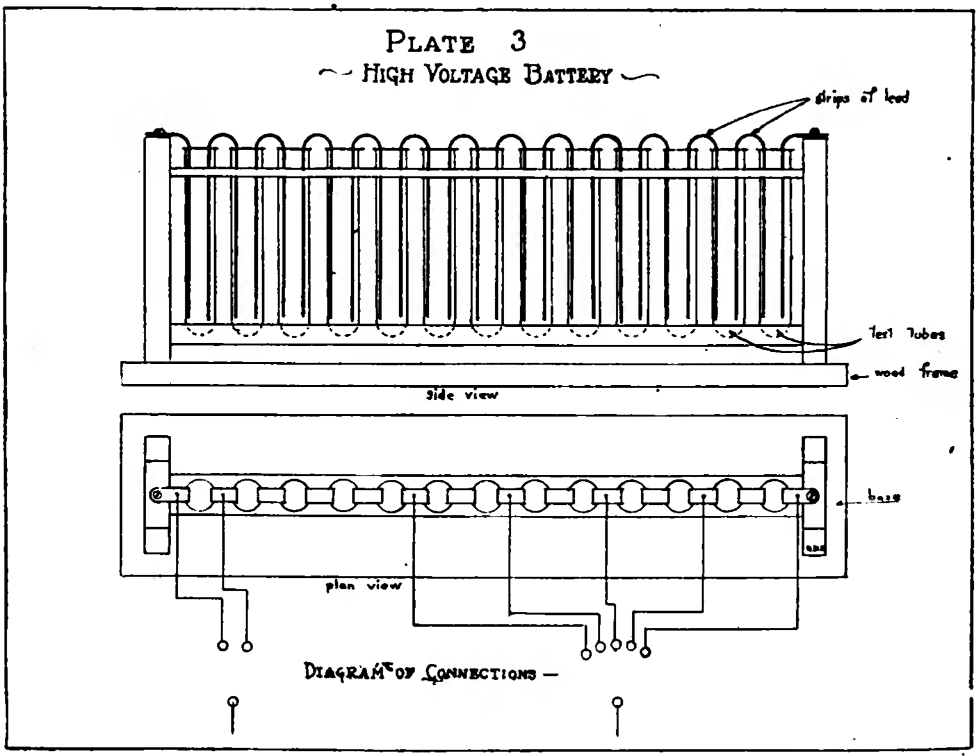


Fig. 3, First Prize Article

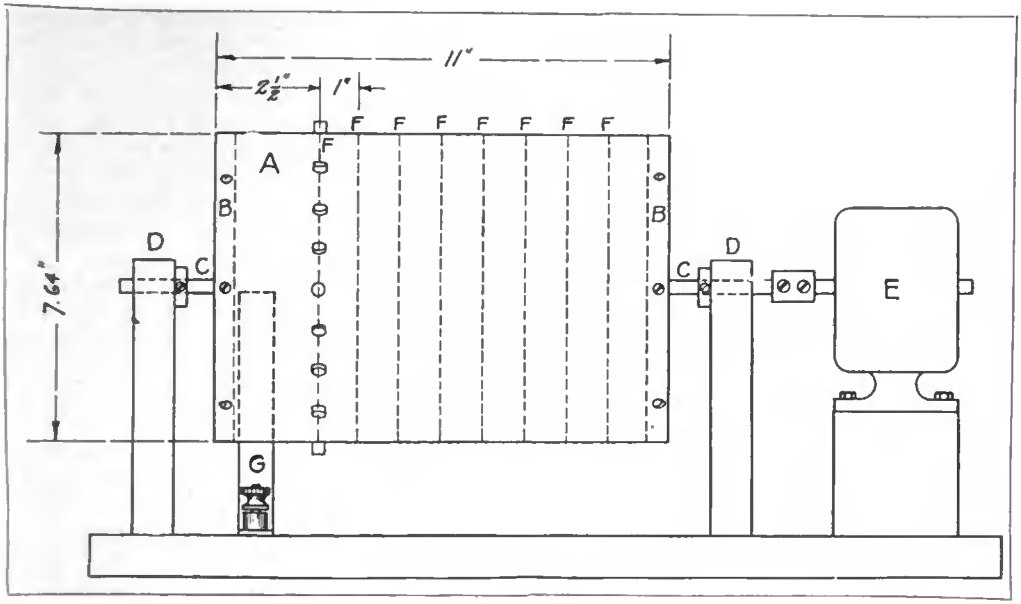


Fig. 1, Second Prize Article

foot battery. Four fruit jars may be used by cutting off the tops. This is best done by wrapping a string around the jar where it is desired to cut, soaking the string in gasoline and igniting. When the gasoline is burned up, plunge in cold water and a smooth cut is left.

I shall not give any dimensions as there is no definite capacity required as there was in the storage battery. However, I will give the size of the plates, etc., used in the rectifier I made.

A wooden top is made as shown in the drawing, to which all the plates were screwed. The size of the top was 8 inches square by ¼ of an inch thick. The plates attached were of ⅛-inch material, 2½ inches wide and 4 inches long, with a large lug as shown. There is a lead plate and an aluminum plate in each jar, both identical as far as size is concerned. The plates are spaced ⅜ of an inch apart for best results. A binding post is put through each plate to allow for connecting on top.

The diagram of these connections is given. Of course the supply of alternating current must be cut down. The best way is to use a step-down transformer, but in case none is to be had, a lamp bank will prove second best. In order to charge the storage cell at two amperes, two amperes must be taken from the rectifier, and since the rectifier will be about 50 per cent. efficient four amperes must be given to it on the A. C. side. Therefor four 32-candle-power carbon filament lamps will be necessary, all connected in multiple and the bank in series with the rectifier and the mains.

I have found that this arrangement only increases the cost in current for the whole house about 20c or 25c. each month, which is very reasonable, especially in the West, where the charging plants charge you 50c for just such a battery as I have described.

In order to use the rectifier the jars must be filled with a saturated solution of ammonium phosphate. Sodium phosphate will work, but the ammonium is cheaper.

When the rectifier is delivering current a film of gas collects on the aluminum plates and prevents passage of the current when the alternation is flowing into the aluminum plate. This acts as a valve and sends the current in one direction only.

It will be well to drill a hole in the wooden top over each jar to enable easier filling of solution. The rectifier will deliver more current with different levels of solution in each cell, and while the rectifier is working, a syringe may be inserted to either take out or put in the solution. With an ammeter in series with the battery the right amount of solution may be found.

A wooden tray should be made to hold the jars. If convenient a metal tray can be made into which cold water may be run to keep the jars cool, as under a current of four amperes the jars will heat up and the efficiency will drop considerably.

There is now but one missing piece of equipment to operate the vacuum valve, and that is the high voltage battery. There are several different types of batteries: the ordinary flash light variety, the voltaic pile, and the storage type that I will describe and which proved highly satisfactory.

To operate the valve the operator should have a source of E. M. F. up to fifty or sixty volts. Bearing in mind that the storage cell can be relied upon to give two volts, it is evident that from twenty-five to thirty cells are required.

Buy from a chemical supply house the required number of small test tubes, about ¾ of an inch in diameter by 6 inches long. These will cost about 4c apiece. Make a wooden frame to hold the tubes as shown in the drawing (Fig. 3). Put strips of lead into each tube as shown and fill the tubes with sulphuric acid, the same as was put in the low voltage battery. The battery is now ready to charge.

It won't make any difference which is the negative or positive terminal the first time the battery is charged. Only at subsequent chargings be sure to charge the same way as at first. As a reminder, the positive pole may be painted red, the customary way of distinguishing it.

Since it is necessary to use a charging voltage of greater E. M. F. than that of the combined voltage of the battery, it will be necessary to divide the battery into groups of five or six cells each.

When the battery is first made, the plates must be formed into active material by the charging method, as it would be impractical to fill the plates in the way which was done in the case of the low voltage battery. But the method of forming the plates is easy, as the capacity is so low that with a charing current of two amperes, the charge is complete in fifteen minutes or less. The capacity is about ¼ ampere hour, and it is possible to take about ½ ampere from such a cell, but for only six or seven minutes, depending upon the size of the plates.

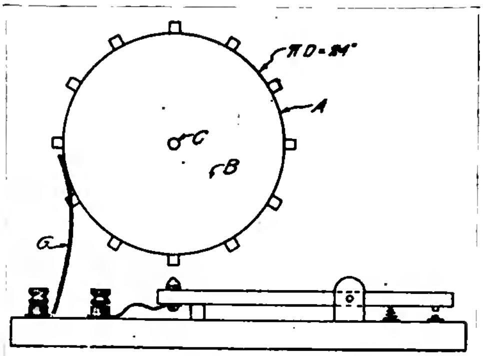
The low capacity of this battery is not a disadvantage, as the current drawn from a high voltage battery is rather low when connected to a valve.

The same care should be taken of this battery as of the low voltage, but of course the plates are not as easily ruined by neglect.

Walter N. Maynes, *California.*

SECOND PRIZE, FIVE DOLLARS
A Simple Method for Constructing a Wireless Organ

From time to time articles have appeared on the design of experimental radio apparatus capable of producing music, but practically all of these de-



End supports omitted for clearness.

Fig. 2, Second Prize Article

signs involved the use of spark-coil sets so that their range was limited to a few miles, or the apparatus was so complicated as to be beyond the mechanical ability of the average experimenter. This is an interesting field for experimentation, and although the application of such apparatus is necessarily limited, the experimenter will be well repaid for his efforts in constructing a set in accordance with the instructions to follow. The writer has called his apparatus a wireless organ rather than a wireless piano for the reason that the notes are sustained as long as the keys are depressed.

Apparatus involving tuned interrupt-

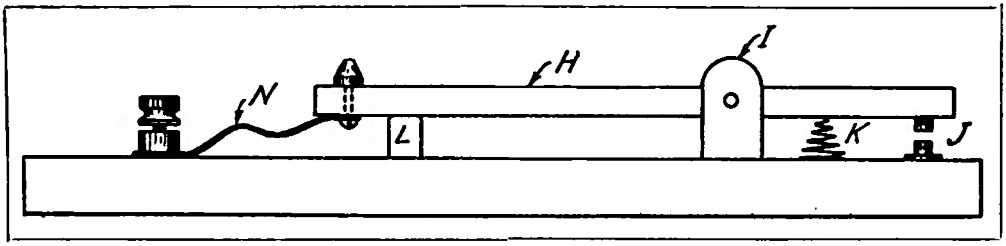


Fig. 3, Second Prize Article

ers, condensers of various capacity, or a collection of various sized rotaries is extremely complicated both in construction and operation. After considerable experimenting with systems using duplicate rotary gaps driven by counter-shafting at various speeds, also multiple gaps with a varying number of electrodes driven from a common shaft, the writer hit upon the simple method herein described. Many of the dimensions are purposely eliminated and the experimenter can fix them to suit his convenience. For the purpose of simplicity, only eight notes, comprising the major scale of C, are described. If the constructor desires he can enlarge upon this to any desired extent, providing an increased number of notes, and by reference to a physics textbook can figure out the required frequency for the various chromatics, which will be found quite an asset.

Figures 1 and 2 illustrate side and end views of the apparatus, respectively, the keys being omitted from Figure 1 and the end supports from Figure 2, for the sake of clearness. The eight notes are produced by a series of eight rotary spark gaps, mounted on a common drum. This drum, A, is made of heavy sheet zinc, 11 inches long, and exactly 24 inches in circumference. What is familiarly known as a "tin-can joint" is employed, as shown in Figure 6, after which the seam should be soldered. Two heads, B, are turned from ½-inch Bakelite, to which the drum is secured with small screws. These heads provide good insulation between the shaft and drum, and the former therefore may be directly coupled to the motor E. Suitable bearings for the drum-shaft are provided, as shown at D. The gaps themselves are formed by screwing brass switch-points to the zinc drum, as shown. The number of points varies for each note. These points may be procured cheaply in various sizes, but this design contemplates the use of points ¼ of an inch in diameter, 5/16 of an inch high, fitted with a threaded shank and nut. Eight circles are inscribed on the zinc drum, 1 inch apart, the first circle being 2½ inches from one end. It is on these circles that the points are to be mounted. These circles are indicated by the dotted lines, F, in Figure 1.

Now as to the required number of points to produce the various notes. It will readily be apparent that it is of no consequence what the lowest or highest note may be, but it is essential to obtain the proper intervals. The rest may be left to adjustment of the motor speed. "Middle C" on the piano vibrates at the rate of 256 vibrations per second, and we may take this as our starting point.

TABLE I

If C is 256 vibrations per second, then D is 288 vibrations per second, E 320 vibrations per second, F 341.3 vibrations per second, G 384 vibrations per second, A 426.7 vibrations per second, B 480 vibrations per second, and high C 512 vibrations per second.

TABLE II

If we call middle C (256) 1, and express the other figures in terms of improper fractions and find the least common denominator, we find that at any given speed, twenty-four points will be required for C, twenty-seven points for D, thirty points for E, thirty-two points for F, thirty-six points for G, 40 points for A, forty-five points for B, and forty-eight points for high C.

The required number of points for each note, as shown in Table II, are now fixed on the various circles, F, inscribed on the drum, A. Holes in the zinc should be drilled, not punched, as accuracy is necessary here, and the points fastened with a nut screwed on from inside. One head should be left off until this operation is completed.

G, in Figures 1 and 2, designates a phosphor-brone spring which conducts the high-frequency current to the drum. No detailed explanation is necessary.

We will now turn our attention to the keys, which are eight in number 7/8 of an inch wide, 1 inch thick, 10 inches long, of good dry hardwood. The purpose of these keys is twofold—to present a stationary electrode to the proper set of rotating points, and to make the primary circuit at the same time. The builder will note that unlike most rotary gap practice, but one sparking place is provided, the phosphor-bronze spring, G, making constant contact with the drum. In Figures 3 and 4, H represents the keys, pivoted on the common shaft, I, at a point 6½ inches from one end. One-half inch from the short end a series of contacts, J, are provided to make the primary transformer circuit. The stationary contacts are mounted on a copper strip fixed to the base, and the contacts on the keys are connected in series by short lengths of flexible conductor. The contacts are so adjusted as to provide a movement of ¼ inch. Small spiral springs, K, serve to keep the rear of the keys down on the strip L when not depressed. One-half inch from the rear end of the keys, and 6 inches from the pivot, stationary electrodes are provided.

It is between these points and the rotary points that sparking takes place. These points may conveniently be made from the same type of switchpoints as the rotary points, but filed to a wedge shape as shown. Three inches behind the keys, a strap of copper, M, is run; and from this leads of thin flexible sheet copper ½ inch wide, N, are run to the electrodes on the rear of each key.

A sparking length of about 1/8 inch will probably be found most suitable. The zinc drum should therefore be mounted at such a height that the outside ends of the sparking points clear the ends of the stationary electrodes, when in normal position, by 5/8 of an inch. The operation will not be self-evident. When any particular key is depressed (which takes the front end of key through an arc of ¼ of an inch), the rear end rises, carrying its stationary electrode through an arc of ½ inch and presenting it at a distance of 1/8 inch from the proper circle of gap points at the same instant that the circuit into the transformer primary is made. Thus it will be seen that no sparking will take place except from the particular gap desired, and the primary circuit will be interrupted whenever a stationary electrode is not elevated to the proper sparking distance.

The hookup is as shown in Figure 5. The regular transformer, condenser and oscillation transformer may be used, and the design therefore permits the use of a full blower if desired. A rheostat, R in

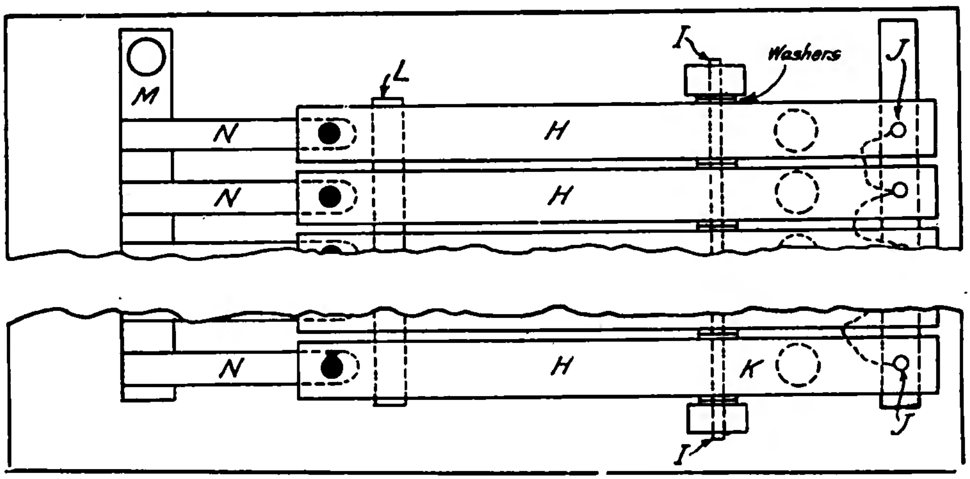


Fig. 4, Second Prize Article

Figure 5, arranged to be operated by the foot or knee, will be found quite serviceable as a "swell," as used in organ playing. If over ½ kw. is employed, it may be found desirable to use light contacts at J and make use of a

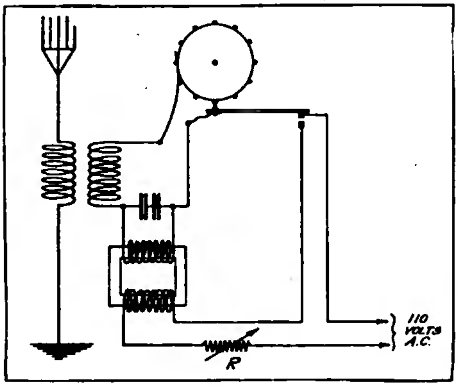


Fig. 5, Second Prize Article

magnetic key to break the primary current.

There are several familiar melodies which may be played on this one octave, among them being "Home, Sweet Home," "River Shannon," "Good Night, Ladies," "Lightly Row," etc. With a few additional notes at each end of this scale, and a few chromatics, its "repertoire" may be greatly increased. It will be found interesting and instructive, and the constructor will find a deal of pleasure when, after his friend signs off with a commonplace "GN," he can "turn on the music" and give him "Home, Sweet Home."

The wireless piano provides a large and interesting field for amateur experimentation. Three octaves are available between the spark frequencies of 200 and 1600 but the mechanical difficulties increase rapidly. Two drums similar to the one herein described, each carrying an octave, could be made to provide an uninterrupted run of two octaves by gearing one up to exactly twice the speed of the other. However, on a given condenser, a transformer draws its maximum current over a narrow band of discharge frequencies only, and if this plan were utilized for two or three octaves, it is likely there would be considerable difference in the strength of the notes at the extremes of the scales, so that separate circuits for each octave, operating on the most suitable voltage, would probably be desirable.

K. B. Warner, *Illinois.*

THIRD PRIZE, THREE DOLLARS

A New Type of Panel Receiving Set

The set about to be described is of a type little used by amateurs but one which I have found far superior to the usual receiving transformer type. Two of its notable advantages are the absence of all sliding contacts and the capacity for indefinitely fine and sharp tuning.

The set consists of two variometers, two rotary variable condensers, a stopping condenser, a horizontal ball and socket detector and aerial, ground and receiver binding posts. The variometers and condensers are mounted in the panel (Figure 1) and are operated by the knobs on the front of the panel. The variometers are mounted in opposite corners to cut out mutual inductance between them as far as possible and the fixed condenser is mounted against the

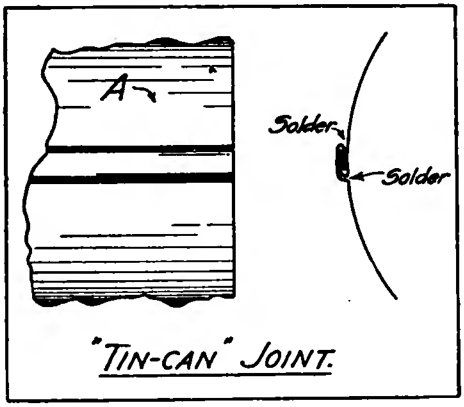


Fig. 6, Second Prize Article

right hand side of the panel. The detector is at the right of the panel.

The front of the panel is of ¼ inch fibre, one foot square; the manipulating knobs are ¼ inch fibre or hard rubber, 2 inches in diameter. They are tapped nearly through for 8-32 and the 8-32 rods are locked in place by nuts. The pointers work over aluminum protractors 4 inches in diameter. The sides and back of the panel and the detector base are made of 3/8 inch quartered oak, that on the sides and on the detector base being 6 inches wide, and also a piece running up and down midway between the two sides. This piece will have to be gouged out to take the variometers. The back pieces should be set flush with the sides.

The variometers are alike and are constructed as is shown in Figure 2. Two thin pasteboard cylinders 1½ inches wide, one 5½ inches in diameter, the other 5 inches in diameter, are wound closely with No. 26 B. & S. Gauge S. C. C. copper wire except for a space of ¼ inch left in the middle.

Care should be taken to have the same length of wire on each coil. The coils should then be thoroughly shellaced. The 5½-inch coil should then be fastened in place with the winding horizontal so that the middle of the nearest part is directly behind a hole in the front, 3⅛ inches from the nearest sides. The coil should be fastened by small screws through ¼-inch middle space to the front, side and middle partition. A brass rod is passed through the hole in the front of the panel and then through holes in the ¼-inch middle strip of both cylinders and is passed through them again on the opposite side, so that they turn symmetrically on the rod as is shown in Figure 2.

A knob and pointer are attached to the front end of the knob and the inner winding is locked to the rod by nuts as shown. Fibre washers are used to keep the correct distance between the coils. Four pieces of tire tape should be put on each coil to hold the windings and connections. Connection between the coils should be made by a flexible connection as shown in A. The variometer should be so adjusted that when the pointer reads 0° the movable coil is inside the fixed coil with its winding in the opposite direction; at 180° the windings should be in the same direction.

The variometer is continuously variable, for its magnetic opposition and attraction, which determines its wave-length, is continuously variable. (Note: The book, "How to Conduct a Radio Club," shows several other types of variometers which may be used equally well.)

The parts of the condensers, which are also alike, may be bought and put together or they may be made. Twenty-five stationary plates of No. 24 aluminum are needed. They should be cut in the form of a right triangle, 3 inches on each leg, and a semicircle ¾ of an inch in diameter, should be cut out in the middle of the hypotenuse; a hole should be bored in each angle 3⅝ inches from the middle point of the hypotenuse, as shown in Figure 3 B. The twenty-four movable plates are of No. 24 aluminum in the form of a semicircle 2¾ inches in diameter with a lug projecting from its center with a diameter of ½ inch. The plates are fastened to the front and to a

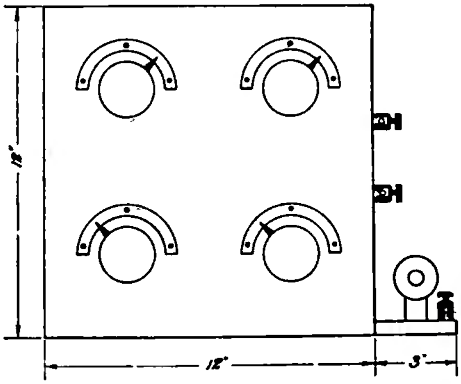


Fig. 1, Third Prize Article

fibre block, the movable plates being attached to the knob on front. The plates are separated by ⅛ inch brass washers, as shown in Figure 3 A.

The detector consists of a ½-inch octagonal brass pillar, 1⅝ inches high, on which is mounted the mineral cup and an 8-32 brass rod with a spring on one end so as to touch the mineral. This is accomplished by a ball and socket device with a tension spring and a knob to adjust it as shown in Figure 4. Note that both knobs extend in front of the base which is ¼ of an inch back from the front of the panel; this allows easy manipulation. This detector is intended for use with ferron, silicon, galena or perikon. I have found ferron the best, the only good kind being that which comes in very large crystals and has some surfaces that look like tin foil when broken. That from Colorado is probably the best. Three binding posts should be placed beside the detector so that the "phones" may be connected either across the detector or the condenser. The aerial and ground binding posts are on the right side of the panel.

The hook-up is shown in Figure 5. The first variometer is the primary of the receiving transformer, the second variometer is the secondary, and they are statically coupled by the variable condenser between them. This set can be made for about five dollars and is superior to many much higher priced sets.

Carlisle M. Ashley,
District of Columbia.

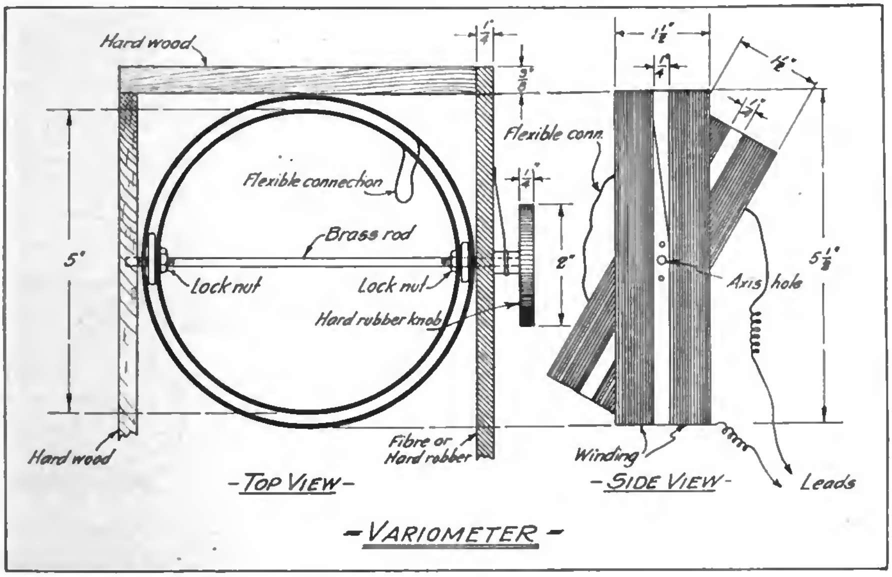


Fig. 2, Third Prize Article.

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Shock Absorbing Base for the Rotary Spark Gap

The operator who has experienced the annoying vibration arising from a rotary spark gap motor that does not run true in its bearings, will appreciate this simple arrangement for the absorption of the shock from the motor. For efficient radiation on a short wave it is essential to group the transmitting instruments closely together and thus reduce the total length of connections in the primary circuit. The rotary spark is usually placed somewhat apart from the other apparatus, particularly the receiving tuner, to prevent vibration from being transmitted through the wireless table. This is a weak point in the transmitting unit. The use of such a shock absorber as is described here permits the rotary gap to be grouped with the other apparatus and absorbs the noise and vibration.

Figure 1 is a cross section of the absorbing base, showing the motor secured thereto, and Figure 2 is a top view. Figure 3 is a detail of the spring element.

Referring to Figure 1: A designates the main base, preferably of yellow poplar 1 inch thick. It is cut out about 3½ inches each way larger than the spark gap base. The supplemental base, B, is 5/16 of an inch thick and 2½ inches larger each way than the spark gap base. Base B is positioned parallel to base A by means of bolts, D, rigidly secured to base A by lock nuts, E and F, and is spaced therefrom by springs, C, disposed on the bolts between the bases. The holes, M, drilled in the corners of each base are 5/16 of an inch in diameter, as indicated in Figure 2. They are drilled ⅝ of an inch from each edge of base B and ⅞ of an inch from each edge of base A, in the respective corners.

The bolts, D, are ¼ of an inch in diameter and 3 inches long, so that base B is capable of reciprocating upon them. The springs, C, are formed from No. 18

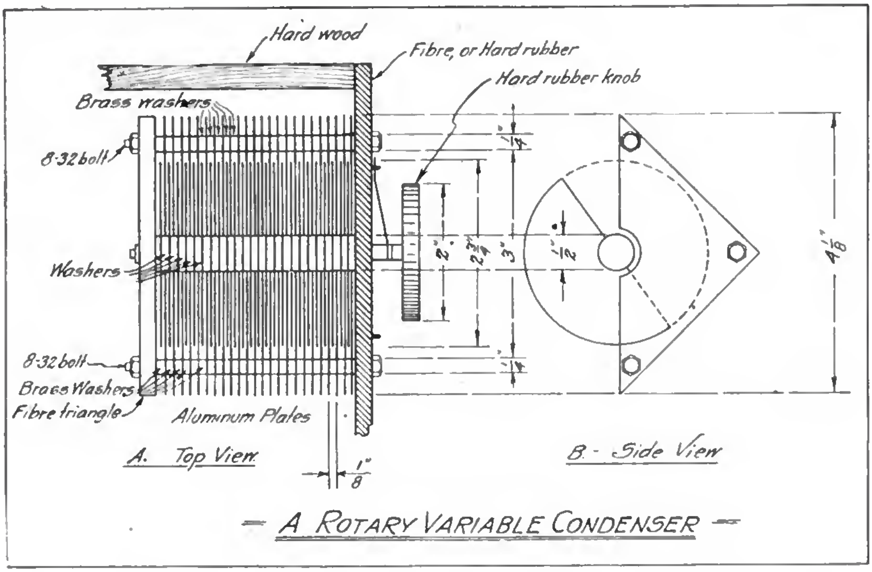


Fig. 3, Third Prize Article

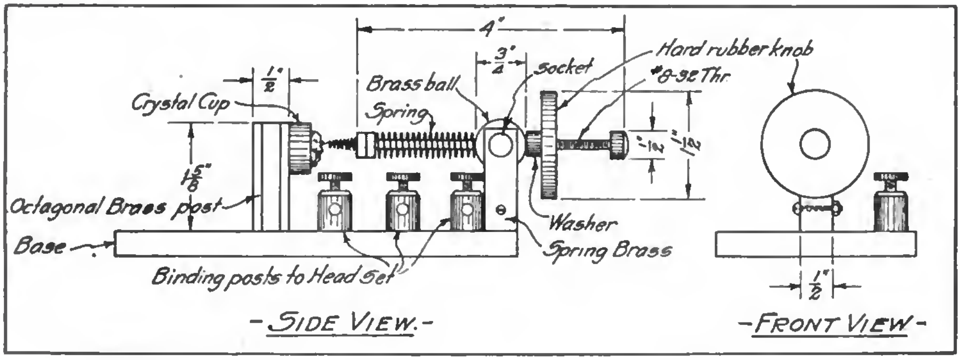


Fig. 4, Third Prize Article

or 16 spring wire, according to the weight of the motor they must support. They are 3 inches long and ½ inch in diameter. The springs positioned on the bolts between the nuts E and washers H resist the weight of the spark gap secured to base B.

Such arrangement will effectively prevent any shocks from motor, K, being transmitted to the apparatus mounted on the same table with the spark gap. The absorber, which is neither expensive nor bulky, is recommended for this and similar purposes.

J. B. Brady, *District of Columbia.*

HONORARY MENTION

Long Distance Communication and the Work of 5BV

I have read the articles by Messrs Weiss, Mathews and West and Chandler on long distance amateur communication. The work that these amateurs are and have been doing for the past winter is not at all out of the ordinary, to judge by what is being done by a great number of amateurs all over the country. I have conclusive information at hand that the amateur "PWR" at Cresco, Iowa, is being copied from Denver to Vineland, N. J., and south to the Gulf.

I copied 9EE last year nearly every time he sent. He is located in Indianapolis, and at the time I wrote him he was using ¾ k.w. and radiating 2 and ½ amperes. 9UC at Somerset, Ky., has been copied at Niagara Falls and also at Springfield, Mass. I have heard him talking to 4AA at Athens, Ga., who has a ¼ k.w. set and who has ben copied at Lima at 8AEZ. Also 9UC has worked with 9HQ at Stoughton, Wis. 5BJ has worked with North Dakota Agricultural School and I could read him, when he was using 200 meters, with the telephones two feet from the table.

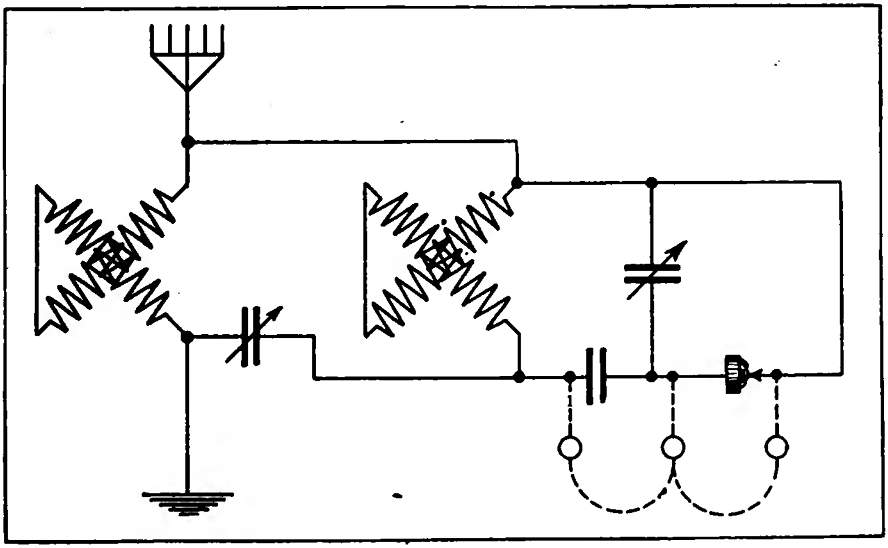


Fig. 5, Third Prize Article

With moderate interference I have heard the following amateurs nearly every time that they have worked for the last two years: 9XK, 9IT, 9ABD, 4AT, 4AA, 9LT, 5AD, 8DZ, 4AF, 4CL, 5DU, 9BW, 5AA, 9IC, 9EE, 8PP, 9JF, 9FY, 8TI, 9JB, PWR, 9IO, 9LM, 5ZA, 5ZC, 5ZI, 9YD, 9XT, 9XE, 9ZA, 8CX, 8XA, 9YK, 5ZB, 5ZQ and a number of others. I use only a single vacuum valve with a poor pair of 2,000-ohm phones and an aerial 38 feet high and 90 feet long. In conclusion I will say that I have never heard a single station in the daytime earlier than five o'clock in the afternoon, although I am able at night quite often to hear them two and three feet from the phones. In summer practically all the fellows down here have to close down on account of QRN. I have not heard a single commercial station on 600 meters nor anyone below that for the last month as the QRN simply kills all the short wave stations with a single vacuum valve as a detector.

John M. Clayton, *Arkansas.*

HONORARY MENTION

The Manufacture of Insulated Copper Wire

Let me advise the readers of The Wireless Age that double braid No. 14 wire is no longer manufactured. Under the most recent edition of the National Code of Electrical Instructors, double braid wire in sizes smaller than No. 6 is not manufactured and single braid wire, in sizes larger than No. 7 has been discontinued. Of course this wire can be run off at special order, but as the entire matter is one of mechanical protection while pulling the wire through conduit, in order to prevent the carrying of double stock by contractors at considerable cost, duplication of jobbers' stocks of sizes, and to reduce the manufacturing cost, the Electrical Committee voted to change as above at the Revision Meeting in

New York City, March, 1915, and it became effective last autumn. Perhaps some readers believe that there is a necessity for double braid wire, but they should know that they cannot obtain it

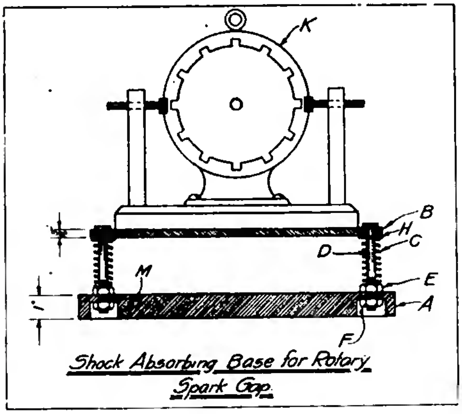


Fig. 1, Fourth Prize Article

in small sizes unless a bit of it happens to be left over in a dealer's stock.

Your readers should also understand that the rules of the National Electrical code are far broader in scope than those of the Underwriters' Association. Of course municipal regulations are always

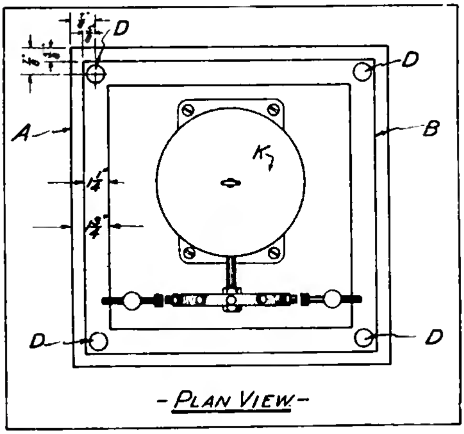


Fig. 2, Fourth Prize Article

paramount and they should be followed in radio installations.

William Lincoln Smith,
Massachusetts.

HONORARY MENTION

Perhaps there is no surer method of stopping a rotary gap quickly, after the current has been broken, than by hand. But there is a certain amount of danger when one does that. For instance, he might catch his fingers between the stationary and movable electrodes, or re-

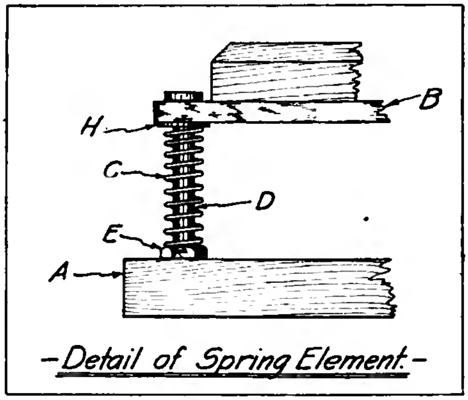
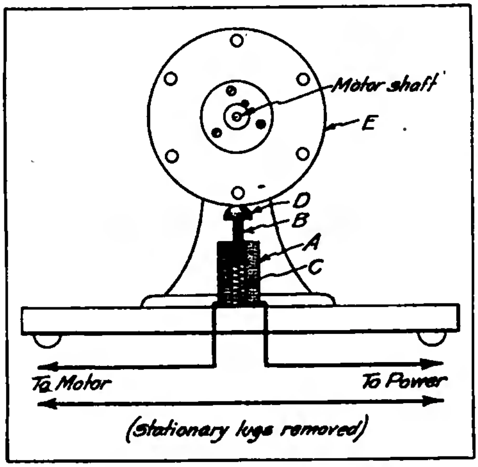


Fig. 3, Fourth Prize Article

ceive several thousand volts from the secondary of his step-up transformer.



Drawing, Honorary Mention Article, R. A. Wilkins

The auto-magnetic clutch that I am about to describe, does away with these dangers, and therefore is invaluable to the amateurs.

The first thing to take into consideration is the magnet, A, shown in the accompanying drawing, which is obtained from any four-ohm telegraph sounder. The core is removed and an iron core, B, one-half the length of the magnet, and a trifle smaller in diameter, so it can slide with freedom in and out of the coil, is made. One end of this core or armature is fitted with a soft-rubber tip, D, to act as a brake against the rotor, E. The spring, C, is made of phosphor-bronze, the tension depending, of course, upon

(Continued on page 74)

Emergency Repairs At Sea

Overcoming Remarkable Conditions on the Pennsylvania in a Typhoon

THE ingenuity and resourcefulness of wireless men in the face of apparently hopeless difficulty, is sometimes severely tested. Deep-sea service in winter usually provides at least one opportunity for the man at the key to demonstrate his ability to make a cabin full of waterlogged apparatus awake and talk over a thousand miles of gale swept ocean, my experience on the steamship Pennsylvania being an example of the difficulties in which an operator sometimes finds himself.

The Pennsylvania is neither new nor large, so when we were hit by a terrific typhoon some 700 miles out of Yokohama, the seas began to smash our deckworks in an alarming manner. Usually when a ship runs into bad weather, some one of the passengers or crew will say he has known worse before, but in this storm no one on board had seen anything to compare with it. At times the whole after part of the vessel, including the wheel house on deck, was buried under green water; a huge wave came on board, broke every door in its path, ripped off the cover of No. 1 hatch and wrenched the funnel loose from its stays. Both the bridge pilot-house and the wireless room were stove in. Below, the cargo of liquid asphaltum broke loose, and, running into the engine room, threatened to put the motive power of the ship completely out of commission.

In the midst of this tumult, all hands were puzzled by the smell of acid and the entry of large streams of oil into the saloon. I guessed the source of the trouble as we had a glass plate condenser on deck, and the planking was anything but watertight. The oil on the floor, together with the heavy roll, made navigation in the saloon almost impossible, but presently when we heard the motor in the wireless cabin running, I managed to crawl up on my hands and knees, fearing that someone had gone crazy and was trying to operate the set. When I finally arrived, it was impossible to open the door against the wind till a momentary lull enabled me to force my way inside.

The place was full of water, the set a wreck. On the floor the transformer coil, two pairs of phones, accumulators, the condenser and all the cells were adrift in a slush of broken glass. Although the service switch was up and the starter "off," the motor was running slowly with the salt water making the connections. I had to think for a little how to stop it, and finally decided to wrench off the wiring. Meanwhile, with all the heavy equipment and the broken glass smashing about the cabin with the heavy roll, I had to look sharp to keep out of the way. As the rolling became wilder, I fled the place and reported the conditions to the Captain, who had squeezed between the stove-in bridge and the pilot house to keep from being blown overboard.

"Leave everything and go below," he ordered. "We can do nothing now but save the ship."

Next day the weather was fine though the sea was terrific. The Captain took a look at wreckage in the radio room. It seemed hopeless, he thought, but he urged me to make a big effort to get through to Chosi—the Japanese station at Hondo—as he expected important orders from the owners. Everything and everybody on the ship were at my disposal. Assisted by the ship's carpenter I went to work at nine in the morning, but the floor was so slippery that we made very little progress till the thoughtful mate sent up a bucket full of sand. We then got the transformer into its case and made fast, removed the auxiliary and accumulators entirely, and set the condenser upright. The spare plates kept on the floor were intact, but so soaked with acid that the tinfoil was peeling off most of them. The container was cracked and we tried to repair it with asbestos paste donated by the engineers.

By one o'clock we had rigged up some sort of a condenser with twenty-four plates and set out to dry the rest of the equipment.

The rheostats had to be taken down, dried and oiled with insulative oil. The starter and transformer also had to be oiled. We spent two solid hours on the motor. First the brushes came off, then we oiled the inside as well as possible without taking out the armature, which would have required too much time. At eight o'clock (no time for dinner), I tried it out. The first thing to go was the generator rheostat. We repaired it, but it went again. I made a resistance by winding some twenty feet of iron wire on a pencil and after a good deal of experimenting managed to make it work, although the motor ran unsteadily and sparked furiously.

I started again at nine o'clock, and called Chosi. No answer. When I tried again the starter burned out in two places. Again the asbestos paste proved invaluable, but the release magnet now refused to hold. We hooked it up with wire hooks. Once more we tried to start the motor, but this time the field rheostat went on a strike. After we had mended that the apparatus operated, but the generator rings were arcing across the dividing rings while the brush holders were leaking into the frame. We remedied these defects and tried again. It was now midnight. I called CQ for a long time but received no answer—I had forgotten that the phones had been in acid and water all day before. Although I dried them out in the steam oven they were as wet as ever again in ten minutes, so I tried cleaning them while warm with gasoline. Still I could hear nothing. The aerial was intact—I tried the tuner with the battery but found it dead. By two in the morning I succeeded in getting it dry and listened. I heard NNG and my spirits rose. When I tried to call him, however, away went the condenser, shot to pieces. We rigged it up again, but the motor brushes were shorting through the frame.

I turned in for a nap at half past four and went at the task again at six. Every seam in the cabin was open, the roof sprung and the set as wet as ever. By noon we thought everything was in working order, but when I started up again all the current went to ground through the soaked insulation. All that day we worked on the motor and wiring, and about eight at night picked up NNG, the U. S. S. Proteus, bound for Nagasaki, to which I gave my MSG. Chosi got us however, and I worked with him direct.

When I began operating next day the condenser let go again. As my patience was now exhausted, I discarded it for a tentative air condenser of sixteen plates in series multiple, separated by chips or broken glass and braced by two supports from the floor. This kept us going till our arrival in Yokohama, where we bought a few necessities and steamed to Hong Kong. The carpenter made a serviceable frame for the condenser plates and everything went well till our arrival at San Francisco. We had worked 1,200 miles with the Empress of Japan, 850 miles with Chosi, 1,400 with San Francisco at night, and 247 miles with the same station at ten in the morning.

Such difficulties are, fortunately, unusual, but they demonstrate the surprising endurance of good wireless equipment, and the necessity of a thorough training in the theory as well as the practice of radio telegraphy to enable an operator, without technical assistance, to patch up a jury set when the seas have worked havoc with the regular equipment.

A wireless station is being built at the refinery of the Magnolia Petroleum Company at Beaumont, Texas. Construction of the tower was completed about June 1. The wireless instruments will be installed in the company's telegraph office at the refinery and three radio operators will be employed each working eight hours a day. The purpose of the station, General Manager Plumly states, is to keep in touch with vessels coming to and leaving the port of Beaumont.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Sunoil	Sun Company	KWP
J. W. Van Dyke	Atlantic Refining Co.	KHR
H. C. Folger	Atlantic Refining Co.	KHS
Henry R. Mallory	Mallory Steamship Co.	(Not assigned)

WORK OF THE WAVE-LENGTH COMMITTEE

It is likely that the recommendations of the Committee on Wave-Length Regulation of the Institute of Radio Engineers will be submitted to the next International Radio Telegraph Convention. This is among the most important activities of the Institute, the Committee having been appointed to carefully study the existing conditions and suggest such improvements as are deemed advisable. The members of the Committee are as follows: R. F. W. Alexanderson, Edwin H. Armstrong, Louis W. Austin, H. Boehme, William H. G. Bullard, George S. Davis, Leo deForest, Melville Eastham, Lloyd Espenchied, Leonard Fuller, Alfred N. Goldsmith, John L. Hogan, Jr., Frederick A. Kolster, Ralph H. Langley, Fritz Lowenstein, Emil E. Mayer, Greenleaf W. Pickard, Samuel Reber, David Sarnoff, Frederick Simpson, T. Lincoln Townsend, Roy A. Weagant, Arthur C. Webster and Leonard D. Wildman.

NAVAL SERVICE ANNOUNCEMENT

The following is from a circular from the United States Director of Naval Communications:

Hereafter the Naval Radio Service will be known as the "Naval Communication Service." Charges on all traffic exchanged between other systems (radio, telegraph, and cable) and radio stations (ship and shore) operated by the Navy will be accounted for by the Naval Communication Service. In addition to his other duties, the Director, Naval Communications, will perform the duties formerly assigned to the Superintendent, Naval Radio Service. Correspondence relating to the Naval Communication Service should be addressed to Director, Naval Communications, Radio, Va.

Remittances should be made payable to Naval Communication Service. If used, money orders should be drawn on Postmaster, Washington, D. C.

THE INSTITUTE CHANGES ITS MEETING PLACE

The first meeting of the Institute of Radio Engineers after the summer vacation season was held on the evening of September 6th in the Engineering Societies building, New York City. Two papers, one entitled "A Brief Technical Description of the New San Diego, Pearl Harbor and Cavite High-Power Naval Stations," and the other "A Few Experiments with Ground Antennas" were presented by Leonard F. Fuller. Professor Charles A. Culver presented a paper on "Notes on Radiation from Horizontal Antennas."

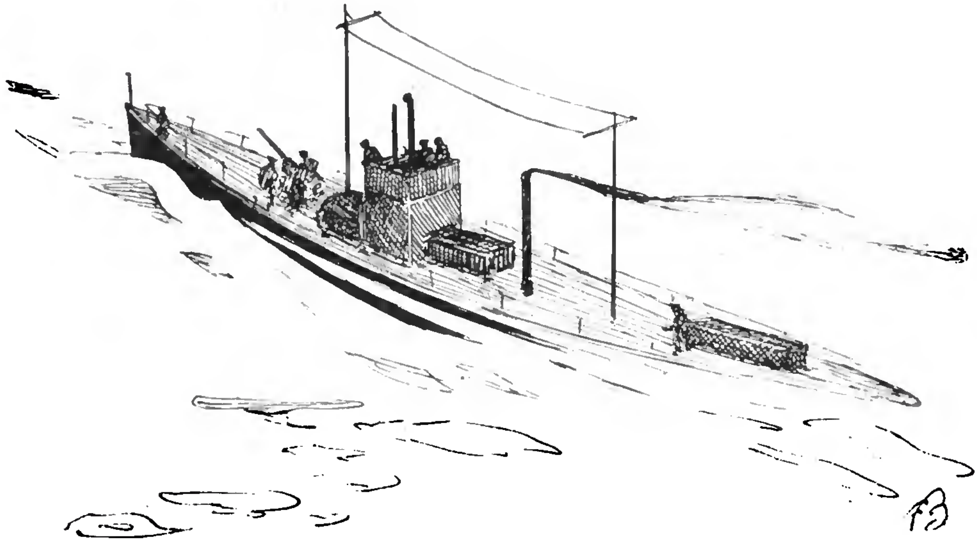
Meetings of the Institute will be held in the future in the Engineering Societies building instead of at Fayerweather Hall, Columbia University, where they have been held in the past. This change was due to the increased interest shown in the art by electrical engineers and the fact that the Engineering Societies building is more centrally located than Fayerweather Hall.

THE SHARE MARKET

NEW YORK, September 8.

The market has been dull because of the vacation season, and there has been comparatively little dealing in Marconi shares, but traders look for activity in the near future. Bid and asked quotations today:

American, 3¼-3⅝; Canadian, 2-2⅜; English, common, 14-17½; English, preferred, 13-16½.



U-Boat Attacks and Wireless Calls

Some Exploits of Marconi Men in the War Zone

ONE of the most remarkable instances of a fight on the part of a skipper, whose steamship was being shelled by a U-boat, was recorded in the experiences of the Anglo-Californian. The reliance of those on board the escaping craft was placed on their wireless apparatus, and the sequel showed that their faith in the Marconi service was not misplaced. The story came out when the British steamship Anglo-Californian steamed into Queenstown Harbor on the morning of July 5th, after having withstood an attack from a German submarine for four hours. The vessel had left Montreal for the British Isles on June 24th. The U-boat was sighted at eight o'clock in the morning of July 4th. Captain Parslow ordered full steam ahead, and wireless calls for aid were sent out. The U-boat on the surface proved to be far speedier than the steamer and rapidly overhauled her, meanwhile deluging her with shells.

One shot put the wireless apparatus on the Anglo-Californian out of action. Finding that he could not escape by running for it, Captain Parslow devoted his attention to maneuvering his ship so as to prevent the submarine from using her torpedoes effectively. He kept at his post on the bridge, coolly giving orders as the submarine circled around his craft. Finally Captain Parslow was killed by a shell. Just before that he had given orders to launch the boats, but this proved difficult while the vessel was under shell fire. Several men on board were struck down while working at the davits. Ultimately four boats were got overboard and were rowed away until they were picked up. The son of Captain Parslow, who was serving on board the ship as second mate, was standing by his father's side when the latter was killed. He seized the wheel and continued dodging the submarine. Meanwhile the wireless S O S call that had been sent out at the first alarm, brought British destroyers to the scene, whereupon the U-boat abandoned its attack and submerged.

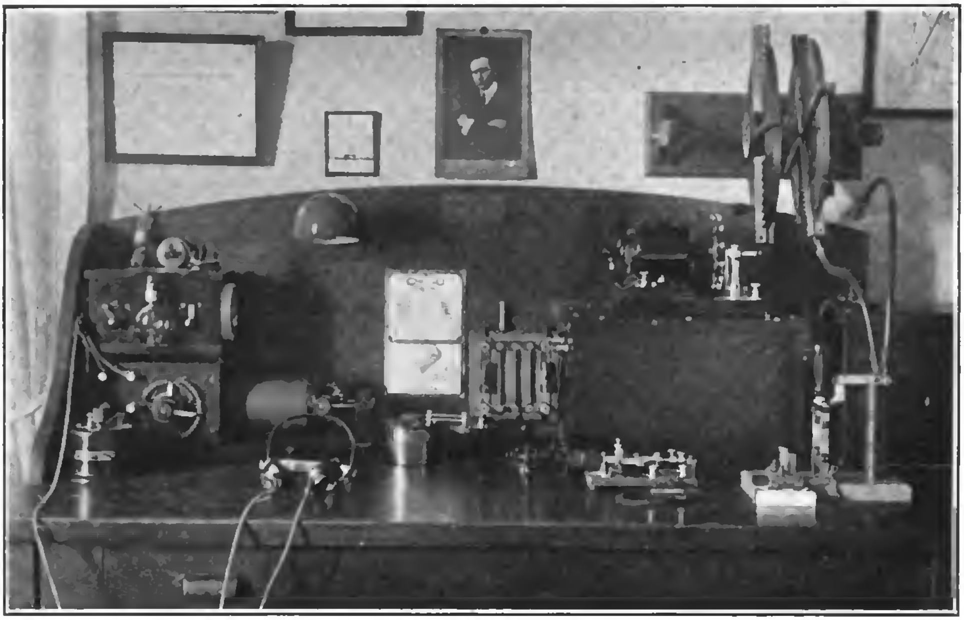
Not long ago, in the waters of the Mediterranean, the steamship Den of Crombie was sunk by a submarine. A time such as this, when the vessel in which you are journeying is about to be torpedoed, is not one which the average person would select in which to make sketches. This, however, suited the humor of Percival Denison, the Marconi operator on the Den of Crombie. So soon as the vessel had been held up by the enemy submarine, Denison noticed that the U-boat had a wireless equipment, and he forthwith made a rough sketch of it. When making away from the sinking vessel, the operator also sketched the scene behind him. In this wise afterward the Marconi man was enabled to give a detailed presentation of the aerial equipment. This, as he had observed it, consisted of a single telescopic steel mast, erected amidships, carrying at the top a permanently fixed spreader, the wires being secured to the deck. The most ingenious feature of the installation was the means for rapidly erecting and dismantling the aerial structure. The whole of the operation, he calculated, could be carried out after the order to submerge had been given and before the upper portions of the deck were awash.

In one of the first great tragedies involved in the torpedoing of an ocean liner, the saving of 140 lives was due solely to the promptitude of the Marconi wireless operator in sending out the S O S. The large African liner Falaba, bound outward, carrying a cargo and specie, with a crew of ninety and passengers to the number of 160, was in St. George's Channel at noon on Sunday, March 28, 1915, when those on board became aware that the vessel was being pursued by a submarine. The captain put forth all speed and tried to escape. The undersea boat, however, was one of the large and speedy types, and followed in the liner's wake with the swiftness of a greyhound. Within three-quarters of an hour after she had been sighted, she was within hailing distance of the ship. The first act of the commander of the submarine was to send up a rocket, and, following this signal, he ordered the captain of the Falaba to get his passengers into the boats, as he intended to sink the vessel.

In the meantime, when the undersea craft was first observed making after the vessel, the wireless operator on board was instructed by the chief officer to send out the S O S signal. In relating his experiences afterwards, the Marconi man said: "I sent the signal, giving our position, and it was answered from Land's End. In order to emphasize the urgency of the call, and anticipating what might happen, I added that our ship had been torpedoed and was sinking. I remained in the cabin for about six or seven minutes, and then the chief officer came to me and said that nothing further could be done, as the submarine had overhauled us. I managed to get into one of the boats, but almost as soon as it touched the water it began to sink, part of the side having been burst through. A passenger with a piece of rope held the crack together as well as he could, but the water poured in and soon we were up to our waists in water. Only the buoyancy of the lifeboat kept us from going under. There were sixteen of us, and two, a passenger and a member of the crew, were washed away."

The submarine had fired a torpedo before the work of removing passengers and crew into the lifeboats had been accomplished. The shot struck the vessel amidships and she immediately gave list to starboard and went down twenty-three minutes afterward. Of the 250 persons on board, only 140 were rescued, and of these eight died later from exposure.

In the meantime the S O S call had sped across the waters. The White Star liner Cymric, bound out from Liverpool, was only twenty miles away from the Falaba at the time. Captain F. E. Beadnell said that the wireless operator on his vessel picked up one of the distress calls sent out by the Falaba which read: "Submarine alongside. Am putting off passengers in boats." The captain was eager to steam full speed to the rescue of the African liner, but the British Admiralty instructions to all shipmasters forbade them to enter into the danger zone when the enemy's warships were near, so he was compelled to continue on his course. A little later the operator heard the answering calls to the S O S from British warships, and it was felt on board the Cymric that the passengers and crew of the Falaba would be rescued. As a matter of fact, however, the fishing boat Eileen Emma was the first to arrive on the scene and picked up nearly all of the 140 persons saved.



The equipment of Harry R. Lord at Cambridge Springs, Pa.

With the Amateurs

THE Radio Club of Westchester was recently organized at its headquarters, 2320 Newbold avenue, Bronx, New York City. The club meets weekly on Tuesday evenings. The more advanced members give lectures on radio subjects and code practice is held.

The transmitting set consists of a Packard ½ k.w. transformer, a sectional Murdock condenser, a rotary spark gap and an oscillation transformer. The receiving apparatus is of the loose coupled type.

The club would like to communicate with all amateurs and clubs within a fifty-mile radius. The call letters are 2EW.

The San Francisco Radio Club has undertaken the task of publishing an official account of the proceedings of the organization, under the title, "1916 Year-Book of the San Francisco Radio Club." It contains a record of what the club has accomplished, together with a list of members, notes on meetings, lectures, initiation fee and dues, and similar matter.

The booklet was made ready for distribution on September 7, copies to be supplied free of charge to those asking for them. A two cent postage stamp to cover mailing charges will be appreciated from all those who are anxious to obtain a copy of this publication.

The membership of the club is rapidly increasing; thirty-six members at present hold membership cards.

Names of newly elected officers are: president, H. W. Dickow; vice-president, D. B. McGown; secretary-treasurer, H. R. Lee; sergeant at arms, T. J. Ryan. The board of examining officers contains the names of L. O. Fassett and C. M. Heaney.

All correspondence should be addressed to the secretary-treasurer, 1580 Grove street, San Francisco, Cal.

Howard S. Pyle, 3329 37th avenue, Seattle, Wash., invites correspondence or personal calls from amateurs desiring to co-operate with him and the Puget Sound Radio Association to form an organization to cover the Northwest territory. Mr. Pyle makes a strong appeal to the fraternity of his vicinity, saying: "We want to affiliate with the N. A. W. A. and show the country that there are live amateurs away up here in the Puget Sound country, as well as around New York and the Middle West."

On June 12, a number of the amateur operators of South Jersey, headed by C. Waldo Batchelor, Wm. G. Phillips, Geo. E. Haldeman and Harry W. Densham, met and organized The South Jersey Radio Association, with headquarters at Collingswood, N. J.

The officers report that the association is already well under way and is affiliating with all the smaller clubs throughout the State with the object of forming a strong organization.

All organizations wishing to affiliate or become members of the South Jersey Radio Association, are invited to communicate with Harry W. Densham, secretary, Collingswood, N. J.

The radio station at the State University of Iowa (9-YA) will send general items of interest as QST press every Wednesday and Saturday night at 8:15 P. M., central time, during the school year. A wave-length of 500 meters and a rotary spark of medium tone will be used. R. C. Giese, operator, says to all amateurs: "Please drop us a note if you get our signature."

Deep regret has been expressed by the amateurs of Western New York over the death by drowning, on July 22, of R. H. Lilley, secretary of the Grape Belt Radio Association. Mr. Lilley was bathing in Lake Erie when the accident occurred and his body was brought to his late home in Westfield, N. Y. The vacancy occasioned by his untimely end has not been filled, Herbert A. Hiller, president, of Silver Creek, N. Y., having temporarily assumed the extra duties. It is expected that the position will be filled by election at the next meeting of the association.

Clayton S. Hunt, R. R. No. 12, Urbana, Ill., has recently been appointed district manager of the Central Radio Association, in place of Lauron A. Kern, of Mattoon, Ill., who resigned. Mr. Hunt trusts that he will hear from all interested amateurs at an early date.

The Port Morris Radio Club of New York, which was organized in June, 1916, would like to hear from amateurs in New York City. William K. Storrs is secretary and all amateurs interested are requested to communicate with him at 513 East 144th street, Bronx, N. Y.

Twenty-two young men possessed of a desire to assist one another in furthering their knowledge of wireless telegraphy, met at Fenske's Hall, Twenty-ninth and Clybourn streets, Milwaukee, recently to perfect a permanent organization.

Martin Hartman was named temporary chairman and Robert Mirgeler, temporary secretary. A committee, composed of Roman Engel, Clarence Bates, LeRoy Cleveland and Charles Seymour, was named to draft a constitution and by-laws to be presented at the next meeting in two weeks. Leonard Niessen and Robert Mirgeler were named on a committee to seek permanent quarters for the new club.

The society will be the first of its kind in Milwaukee and will have for its members all amateur operators who desire to join. There will be junior and senior classes, the latter offering assistance to the former. The club will have a permanent station at its headquarters.

Those at the meeting were: Frank Jutrash, Leonard P. Niessen, Louis Prahl, Winifred Zimmerman, Karl Frendenberg, Roman Engel, Clarence Bates, LeRoy Cleveland, Charles Seymour, R. E. DeLand, George Koresh, Reginald Hardy, Eugene Tuhtar, Charles Bishop, Stanley F. Poser, Moy B. Quong, Herbert Holz, Thomas A. Towle, George Stumpf, Elmer Kaufmann, Martin Hartman and Robert Mirgeler.

MARCONI IN NAVY

A Rome dispatch says that Guglielmo Marconi has been transferred from the engineer corps and appointed temporary captain of the navy.

Artillery Fire Directed From Aeroplanes By Wireless—Marconi

This Has Been Made Possible, Inventor Says, By Improvements in Aircraft

"ON the whole, there have been no great war inventions that occur to me. Most of them have been minor ones, or applications of knowledge previously at our disposal, as in the case of poison gases, if these may be named at all. In my own field there has been some advance in practical wireless, by which we are now able to direct the artillery fire of a ship by signals from an aeroplane. This has been made possible largely through big improvements in aircraft."

This was the statement made recently in Rome by Guglielmo Marconi in an interview regarding the European war.

"The big lesson in Europe has been one of organization, of the physical handling of big material problems by the armies. I doubt if any one before this war ever realized the meaning and value of railroad transportation on a large scale, as it is practised in the United States. Europe, too, has learned how to do big industrial jobs overnight, to assemble raw materials and turn out needed factory products.

"I refuse to play the prophet rôle, so I would rather not say how many of these war products will be of use to us when peace comes."

Since the beginning of the war Mr. Marconi has had unusual opportunities for observing the practical side of the war, having early put his scientific knowledge at the service of his country. As a Senator of the kingdom he has visited England, Belgium, France and other countries and introduced industrial and shipping reforms. In his capacity as military officer he has come into close relation with the army and the navy and given the benefit of his science and business organization knowledge to munition factories.

He has also perfected the army and navy wireless systems, and is at present working on a signal system which, it is expected, will render far more difficult submarine warfare through the readier location and signalling of the presence of such craft. The details of this he was unable to furnish because of its immediate military importance. Incidentally the inventor referred to the position of the United States.

"I don't think the United States should ever fear any fatal, disastrous invasion," he said. "Her seas protect her too well. She is too mighty a country in population and force ever to be conquered. I doubt if, with reasonable precaution, even her coasts could be injured or landed upon. The experience of this war has shown how easy it is to protect a coast by submarine, even when the invader is a near neighbor. It is a rule that will work both ways. The United States would have vast difficulties in landing forces on foreign territory, say that of Europe. Neither England nor Germany has been able to get at each other, though relatively close."

As to the prospects of peace in Europe, Mr. Marconi said there are many people who believe the war—that is, actual hostilities—will be over by winter.

"To me," he said, "the saddest fact about this war is that so much energy has been used up which might have gone to a better purpose."

GERMAN STATIONS JAMMING

Since the beginning of the great allied offensive daily wireless battles have been occurring between rival radio stations in belligerent countries. A despatch from Lugano says that the Italians complain that their wireless messages are being blocked by the German stations, which fill the air with flashes to prevent the Italians from getting their news to the world.

Queries Answered

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

Positively no Questions Answered by Mail.

F. S. L., New Rochelle, N. Y., inquires:

Ques.—(1) Referring to the receiver described on page 82 of the book "How to Conduct a Radio Club," over what range of wave-lengths will a transformer secondary winding respond with the secondary loading coil eliminated? What is the longest and shortest possible wave-length adjustment?

Ans.—(1) With the loading coil out of the circuit the secondary winding will respond to wave-lengths inclusive of 3,700 meters and of course the minimum wave-length can be the lowest value desired; but unless the precaution is taken to fit the secondary winding with dead-end switches there will be considerable energy losses at the shorter range of wave-lengths at values lying between 200 and 1 000 meters.

Ques.—(2) Could variometers take the place of these two coils as efficiently? If so, what should be the dimensions?

Ans.—(2) Variometers of the rotary ball type by all means could not be used as it is not possible to construct one possessing sufficiently values of inductance for a circuit of this type. It would be possible to construct a variometer of the sliding tube type for this circuit, but the energy lost in the windings would be detrimental to the efficiency of the set.

Ques.—(3) What would be the dimensions for a receiving transformer if the secondary loading coil were eliminated and the remainder of the circuit given the same dimensions as is the book "How to Conduct a Radio Club"? Would the entire apparatus be adjustable to the same range of wave-lengths?

Ans.—(3) The dimensions of the secondary winding may remain as given provided a condenser of much larger capacity, say .001 microfarad, is used in shunt to the secondary winding. but the apparatus will not be as efficient as that constructed according to instructions given in "How to Conduct a Radio Club."

We note by your last query that you desire to construct a compact receiving set that will be responsive to wave-lengths up to 10,000 meters. This is possible by the use of multi-layered loading coils. Coils of this type are not feasible when the layers are wound closely together, but when they are separated by an air space of ¼ or ½ inch, they are practical and will work as efficiently as single-layer windings. Multi-layered coils can be purchased from the Manhattan Electrical Supply Company, Park Place, New York City. They are conveniently fitted with multi-point switches for variation of the inductance values and are exceedingly compact for the value of inductance given.

* * *

E. R., Trinidad, Colo.:

We are not familiar with the circuits nor the possible wave-length adjustment of the time signal receiving set sold by a manufacturer referred to. An inquiry of this kind should be sent to the manufacturer direct who will undoubtedly be glad to give you the necessary information. In the book "How to Conduct a Radio Club" the dimensions and circuits of a receiving set particularly suitable for the reception of the Arlington time signals, are fully described.

Your aerial of the T type, 120 feet in length with a vertical height of 50 feet, has a fundamental wave-length of about 210 meters which is slightly in excess of the United States restrictions.

No. 4 enameled wire may be used for the windings of an inductively coupled receiving tuner and will give fair results, but owing to the thinness of the insulation there is considerable electrostatic capacity between adjacent turns; therefore coils wound with wire of this type may have a defined natural time period of vibration which, at certain wave-lengths, may occasion considerable energy losses. It is customary in commercial receiving tuners to use single or double silk covered wire.

It is not necessary to make contact with each individual turn of the secondary winding of the receiving tuner, provided it is fitted with a shunt variable condenser to give the necessary closeness of adjustment between the tops of the usual winding. If, however, a variable condenser is not supplied, it is of advantage to have the secondary winding closely adjustable.

* * *

D. P. D., Limon, Colo., asks concerning the dimensions of an aerial suitable for the reception of amateur signals, as well as the wave-lengths used at the larger commercial stations.

For all-round work we advise, if it is possible to erect one, an aerial of the T type, which, for the reception of amateur signals, should be 110 feet in length and about 50 feet in height, provided the flat top portion consists of 4 wires spaced 2½ or 3 feet apart. An aerial of this type will permit the reception of waves at 200 meters and will be almost equally efficient on the longer wave-lengths, such as 600, 1,000 and 2,500 meters.

D. P. D. also desires to know the possible range of his receiving set with a crystaloi detector and other equipment of the usual amateur design. It is difficult to state definitely how far he would be able to receive, but if he is familiar with the Continental telegraph code and can copy radio signals at a speed of from fifteen to twenty-five words per minute, he should be able to determine for himself just how far the set will work. During the night hours it may be possible to receive signals from the Gulf of Mexico or possibly from the Pacific Coast, but in the daytime about the best that can be expected is the reception of signals from local stations. It is sometimes difficult in a mountainous region to receive signals from a considerable distance, because in traveling through the Rocky Mountains, wireless waves are required to take a rather hazardous journey and a good deal of the energy may be lost en route.

Our inquirer is still puzzled on the subject of receiving tuners and desires to know if a 2-slide tuner, having a possible range of 790 meters, is more efficient for the reception of amateur signals than inductively-coupled receiving tuner primarily built for the wave-length of 2,500 meters. Undoubtedly the two-slide tuning coil will give the best results because when the inductance values of it are adjusted to 200 meters the dead-end effect will not be so great as in the receiving tuner built for the longer range of wave-lengths. In the ordinary circumstance, a simple two-slide tuning coil will give just as good results in the reception of amateur signals as a more expensively constructed loose coupler.

In his fourth query the correspondent requests a diagram of connections for an inductively coupled receiving tuner and also for a double slide tuning coil. So many diagrams of this sort have appeared in past issues of The Wireless Age, particularly in the July, 1916, issue, that it seems unnecessary to repeat them here, and the book, "How to Conduct a Radio Club," has innumerable diagrams suitable for all conditions and types of radio telegraph receiving apparatus.

The inquirer closes his communication by asking the type of telephones used by the Navy Yard wireless operators. The latest installations in the United States Navy are supplied with the Baldwin telephones, which are especially constructed for wireless telegraph work, and are from eight to ten times as sensitive as the ordinary telephone receiver. A prominent feature of this particular type of telephone is the use of a micanite diaphragm, which in turn is actuated by an armature placed close to the magnets.

* * *

A. A. P., Santa Maria, Cal., desires to know whether glass or air is the better di-electric for a high potential condenser. He says that some experimenters assert that there are considerable hysteresis losses in a glass plate condenser.

The hysteresis loss in glass condensers is quite appreciable, but not enough to interfere with the practical working of the set. An air condenser, using the air at ordinary atmospheric pressure, is rather expensive and requires considerable space to erect, because the plates must be sufficiently separated to prevent sparking between them when the secondary winding of the high potential transformer is connected. A type of air condenser employing air at a pressure of 250 pounds between plates is manufactured, but the construction is beyond the resources of the average amateur experimenter and it would be better to resort to the ordinary glass condenser. Care, however, should be taken to secure a grade of glass free from mineral properties and notably free from lead.

This experimenter possesses an eight-wire aerial, 100 feet in length, and desires to know the inductance, capacity and wave-length, but as he has not stated the distance above the earth, we cannot reply. Ordinarily, however, an aerial of these dimensions, spaced about sixty feet above the surface of the earth, has a fundamental wave-length of 300 meters, and is highly suitable for the reception of signals at commercial wave-lengths.

* * *

A. A. P. requests the dimensions for a 3,000-meter loose coupler. This subject has been discussed so many times in the Queries Answered department that it seems unnecessary to go over it again. In the book "How to Conduct a Radio Club" the dimensions are given for a receiving tuner that will respond to wave-lengths of 3,000 meters and a complete diagram for the connection to an oscillating vacuum valve is published.

The correspondent desires to know if this tuner is used for the reception of amateur signals whether it will be as efficient as another tuner especially constructed for 200 meters. Unless the precaution to fit the tuner with dead-end switches is taken, it will not be as efficient as one built expressly for the wave-length of 200 meters. A tuner of the latter type is fully described in the last chapter of the book "How to Conduct a Radio Club," and under test has proved very efficient on the amateur wave-length of 200 meters. Receiving sets of this type will shortly be placed on sale by the Marconi Publishing Corporation and should prove of interest to experimenters who heretofore have not been able to purchase one of this type. The constructor should not be alarmed at the diminutive proportions of a 200-meter tuner because a coupler built for this value of wave-length has very few turns of wire in both the primary and secondary windings.

* * *

S. H. M., Richmond Hill, N. Y.:

The call letters of amateur stations and their locations are fully given in the book entitled "Radio Stations of the United States" on sale by the Government Printing Office, Washington, D. C.

* * *

M. N. P., Elsinore, Cal., has a one-inch spark coil and is apprehensive that it will be burnt out when operated in connection with an electrolytic interrupter on 110 volts direct current. He need, however, have no fear of this if the interrupter is constructed for variation of the current flow. In certain types of electrolytic interrupters means are provided whereby the distance to which the platinum electrode is dipped into solution may be closely regulated and in consequence the current flow can usually be cut down to a safe value for the primary winding. Generally an inquiry addressed to the manufacturer of the interrupter will reveal whether or not it is suited for a small spark coil.

* * *

U. F., Louisville, Ky., inquires:

Ques.—(1) What are the dimensions of a condenser to be used with a Thordarson ½ k.w. transformer, an oscillation transformer and a rotary gap as described in the book "How to Conduct a Radio Club," so as to comply with the government regulations? The aerial is to be 50 feet in length and 40 feet in height.

Ans.—(1) The subject is gone into so exhaustively in the book "How to Conduct a Radio Club" that it seems unnecessary to go over it again in these columns. The book states specifically that the condenser can in no case exceed the value of .01 microfarad and if one of these dimensions is employed the connecting leads to the primary winding of the oscillation transformer and the rotary spark gap must be exceedingly short. It is the custom at the majority of amateur stations to use a condenser of .008 microfarad. A single plate of glass, 14 by 14 inches, covered with foil, 12 by 12 inches, with an average thickness of ⅛th of an inch, will have a capacitance of .002 microfarad and four of these plates connected in parallel will give the required value, .008 microfarad. The oscillation transformer described in the book has the correct dimensions for this antenna system and the emitted wave will be near to the value of 200 meters.

Ques.—(2) I have a loose coupler, the dimensions of the primary being 7½ inches in length by 3½ inches in diameter, wound with No. 24 single cotton covered wire. The secondary winding is 7 inches in length, 3 inches in diameter, wound with No. 30 single silk covered wire. What is the longest wave-length to which this apparatus will respond when connected to a single wire aerial 175 feet in length and 30 feet in height?

Ans.—(2) The fundamental wave-length of this antenna system is about 300 meters and if a condenser of small capacitance is connected in shunt to the secondary winding the apparatus is adjustable to wave-lengths of 3,000 meters.

* * *

W. H. M., Seaford, Del., describes an elaborate umbrella aerial that is supported by a gas pipe mast. The mast is set in a cement base and he wishes to know if it will have sufficient insulation to permit the mast to be used as a portion of the antenna system. He also desires to know the natural wave-length of the antenna and asks whether the ribs of the umbrella should be evenly spaced and of the same length.

We have no knowledge of the formula by which the fundamental wave-length of an umbrella aerial can be determined accurately; consequently, it would be better to purchase a wave-meter and measure the natural period of the antenna circuit. Cement has not sufficient insulation for the potentials of a wireless telegraph aerial; it is customary to support a mast on glass blocks or heavy porcelain bushings, the mast being held in position by the guys alone.

We should prefer to have the ribs of the umbrella evenly spaced and of the same length as it is generally considered best to have the transmitting aerial of uniform construction throughout.

* * *

J. J. S., Jr., Tampa, Fla., requests data for the construction of a 1 k.w. 500 cycle rotary quenched transmitting set, but these cannot be given in the space at our disposal in this department and could only be obtained at a considerable expense from the engineering department of a commercial wireless telegraph company. J. J. S. also wants to know the kilowatt rating of the apparatus designed by A. E. Henninger in the February, 1916, issue of THE WIRELESS AGE. This set will consume about 1 k.w., but is not primarily a 500-cycle set. It was designed to give a spark frequency of about the equivalent of a 500-cycle set, although the apparatus is not supplied with 500-cycle alternating current.

The correspondent's further inquiry regarding the range of a receiving station cannot be accurately answered, as one who is familiar with the telegraph code should be able to determine for himself the possible range of the apparatus. The matter is discussed in the book "How to Conduct a Radio Club."

* * *

F. W. S., Omaha, Neb.:

Any type of transmitting apparatus where the condenser is charged with alternating current does not generate undamped oscillations. If, however, the arc gap shown in your diagram was supplied with direct current at 1,500 volts, sustained oscillations would be generated and accordingly flow in the antenna circuit.

A telephone transmitter highly suitable for radio telephone work was described on page 22 of the July, 1916, issue of The Wireless Age. We do not know of any manufacturer who makes a specialty of microphone transmitters suitable for wireless telephone work.

The condenser for your high potential transformer may have a capacitance of .008 microfarad. If your 8-inch by 10-inch glass plates are covered with foil 6 inches by 8 inches each plate will have a capacitance of approximately .00066 microfarad and consequently twelve plates connected in parallel will give about the desired capacity.

* * *

J. N. J., Union, Ore.:

Your aerial has a fundamental wave-length of about 237 meters and when connected to the receiving apparatus you describe should permit the reception of night signals of from 600 to 1,000 miles. The daylight range is problematical, depending upon local conditions.

There is little difference in the results obtained between a two-wire and a four-wire aerial. A four-wire aerial has a smaller value of resistance and when the span of the flat top portion is short, it may be of value to use a great number of wires. However, when the flat top portion is at least 60 feet in length almost identical results are obtained with either aerial. (?)

* * *

H. P. S., Lynn, Mass.:

The apparatus described in the February issue of the monthly service bulletin of the National Amateur Wireless Association is probably more sensitive than that described on page 82 of "How to Conduct a Radio Club." It is difficult to place apparatus of this type in a receiving cabinet of small dimensions, but you should be able to arrange such a design after careful consideration of the operation of the set. You can decrease the dimensions of the receiving cabinet by using multi-layered coils for the grid and wind circuits of the oscillating vacuum valve. Coils of this type constructed ready for use are now on sale by the Manhattan Electrical Supply Company, New York City. The telephones with the micanite diaphragms can also be purchased at the same address.

For a cabinet receiving set on the order of that described on page 82 in the book "How to Conduct a Radio Club," it is suggested that one of the cabinets contain the oscillating vacuum valve, the high potential battery, the necessary telephone connections, the grid condenser and the condenser for the wing circuit. The second cabinet may have the primary and secondary windings of the inductively-coupled receiving tuner and the aerial tuning inductance. The third cabinet may contain the loading coils of the wing and grid circuits. It will not matter if they are placed in slight inductive relation. In fact, if the coils are placed within an inch of one another, the oscillation transformer L5 and L6 may be dispensed with.

* * *

N. A. J., Trenton, N. J.:

Ans.—(1) You will not be able to make use of the full power of a 2 k.w. closed core transformer at your transmitting station if your station is to be operated at a wave-length of 200 meters. About the best you can do is to consume between one-half and one-quarter kilowatt if the frequency of the current supply is 60 cycles. Previous issues of The Wireless Age have contained a number of articles on the construction of high potential transformers and you are advised to procure these issues and duplicate the designs given therein. The average amateur experimenter secures the best results with an open core transformer rather than one of the closed core type. The design for a transformer of this construction is fully described in the book "How to Conduct a Radio Club."

Ans.—(2) A magnetic leakage gap is merely a tongue of iron which extends from one side of the core to the opposite side, there being a break at the center of about one-fourth of an inch over which the magnetic lines of force pass. The open core transformer naturally possesses the requisite amount of magnetic leakage, and no special construction is therefore required.

Ans.—(4) The range of the transmitting apparatus operated at the wave-length of 200 meters depends largely upon local conditions, and, of course, upon the over-all efficiency of the set. Amateurs frequently do from 40 to 100 miles during daylight hours and 500 to 800 miles after dark. But to obtain similar results a sensitive receiving set must be employed at the receiving station. The aerial you describe has a fundamental wave-length of close to 400 meters and, to be operated at the restricted wave-length of 200 meters, the flat top portion must be reduced to 60 or 70 feet in length.

* * *

A. B., New York, inquires:

Ques.—(1) What is the best form of aerial for long distance receiving to erect on a space limited to fifty by forty feet, using masts if necessary.

Ans.—(1) Knowledge of local conditions would aid us in giving advice, but we cannot see how you can do better than to erect an ordinary flat top aerial of inverted L type with six wires spaced about three feet apart. The higher you can swing this aerial the better will be the results obtained, but, of course, the proposition is one that you can best decide for yourself.

Ques.—(2) Approximately what would be the wave-length of the aerial that I could erect in this space?

Ans.—(2) It depends on the height to which the flat top portion is placed. Probably about 250 meters.

* * *

W. P., of Brooklyn, writes that he has installed ½ kw., sixty-cycle transmitting set with which he secures a very heavy spark, but amateur stations within a quarter of a mile claim that his signals are not readable. He sends us a diagram of connections which we find to be correct in every respect, but we believe that the trouble lies in the lack of resonance between the primary and secondary windings of the oscillation transformer. It may be that the circuits are not in tune. Consequently a small hot wire ammeter or a small bulb lamp shunted by a turn of wire should be inserted in the antenna circuit and certain adjustments made of the inductance in the primary and secondary windings until a brilliant glow of the lamp is secured. Ordinarily a two-volt battery lamp will suffice for the purpose, and will indicate conditions of resonance. If, after this experiment has been gone through, improvement does not result we have no additional advice to offer with the exception that there may be a poor earth connection. If possible, the lead from the transmitting apparatus should be connected to the street side of the water mains and in any event care should be taken to see that there are no high resistance joints between the oscillation transformer and the earth or between it and the antenna proper.

W. P. also says that he rewired his receiving apparatus and the connectors thereto with much heavier wire than used formerly, and immediately upon doing this the signals from other stations weakened. He urges us to believe that the decrease is due to the solder used in the connecting lugs, but we advise that this cannot possibly be so. If the connecting wires are well soldered into the lugs it should have no effect on the strength of signals. It may be that with this rearrangement of the wiring some portion of the circuit has become actually interrupted. If so a telephone test circuit should be applied to the various windings of the apparatus to determine if they are electrically closed.

The receiving apparatus described on page 71 of the first edition of the book, "How to Conduct a Radio Club," is applicable to the reception of amateur signals, provided the primary and secondary windings are constructed so as to have sufficiently low values of inductance for the wave-length of 200 meters. A receiving tuner designed particularly for the wave-length of 200 meters is described in the last chapter of that edition.

* * *

F. S., Parkersburg, W. Va.:

It is evident from your fifth query that you already possess a copy of the book, "How to Conduct a Radio Club," and if you will read this publication carefully you will find complete answers to every question in your communication. A plate of glass, 8 inches by 10 inches, covered with a foil 6 inches by 8 inches, has a capacitance of approximately .00066 microfarad, and twelve plates connected in parallel give the value of .008 microfarad, which is quite correct for the Thorardsen 1 kw. transformer. The dimensions for an oscillation transformer are given in "How to Conduct a Radio Club," and also a method of applying the tinfoil to the glass plates. Vacuum valve detectors can be purchased from any of the advertisers listed in this magazine.

* * *

R. B., Omaha, Neb.:

The April, May, June and July issues of The Wireles Age contained complete answers to all the queries in your recent communication. A table of the natural wave-length of four-wire flat top aerials up to 150 feet in length is given in the book, "How to Conduct a Radio Club."

The loose coupler you have mentioned is evidently designed for reception of long wave-lengths and the primary winding should be covered with No. 24 single silk covered wire and the secondary winding with No. 32 single silk covered. If the secondary winding is shunted by small variable condenser, it wil respond to the wave-length of about 8000 meters. See the article on "How to Conduct a Radio Club" in the July, 1916, issue of The Wireless Age for a diagram of connections applicable to this apparatus.

* * *

T. R., Jr., New York City:

The receiving apparatus described in the October, 1915, issue of The Wireless Age, by A. C. Burroway, will easily respond to a wave-length of 2,500 meters and will give good results at that wave-length when connected to an aerial with a flat top portion at least 150 feet in length.

* * *

J. P., Ridgewod, Brooklyn, N. Y.:

We have carefully scrutinized the diagram of connections accompanying your query and find no error therein, but just why you are not able to receive signals is another matter. Your tuner is correctly designed for the wave-length of 600 meters, but not so well adapted for the reception of the time signals at 2,500 meters. You require a secondary winding of increased length for the best results. Be sure and connect the positive pole of your high potential battery to the plate, R, of the vacuum valve. Also connect the top terminal of your secondary winding to the negative side of the land filament.

Your aerial has a fundamental wave-length of about 200 meters. From the last five articles on "How to Conduct a Radio Club" appearing in The Wireless Age you should have no difficulty in the selection of a receiving tuner that will fulfill your requirements. You must first decide for yourself, however, the range of wave-lengths over which it is to respond and whether the complete equipment is to be used for the reception of damped or undamped oscillations. After having made this decision you can then select from these previous articles a receiving tuner that will give the maximum response.

* * *

A. G., Tampa, Fla., inquires:

Ques.—(1) What is the capacitance of a condenser utilizing glass plate 10 inches by 14 inches, with an average thickness of 3/32 of an inch, coated on both sides with tinfoil, 8 inches by 12 inches? What is the capacitance per single plate?

Ans.—(1) With glass of ordinary texture the capacitance per plate is approximately .0013 microfarad.

Ques.—(2) Will the capacity of this condenser be changed if it is immersed in oil?

Ans.—(2) Not if the plates are stacked and pressed closely together so that there is no oil intervening between them. However, if the dielectric is oil as well as air, the capacitance will vary according to the dielectric constant of the particular grade of oil used.

Ques.—(3) What is the wave-length of the Sayville, Tuckerton, Arlington and Nauen high-power stations?

Ans.—(2) Sayville, 9,400 meters; Tuckerton, 7,400 meters; Arlington, 6,000 to 7,000 meters; Nauen, 9,400 meters.

Ques.—(4) When can these stations be heard?

Ans.—(4) At intervals throughout the day and night. Tuckerton and Sayville can be heard from 7:00 p. m. to 12:00 p. m., Eastern standard time regularly.

The dimensions of the inductively-coupled receiving tuner you furnished us are not complete enough for making calculations, but off hand we could say that the possible wave-length adjustment is about 2,000 meters, and that also the mutual inductance between the primary and secondary windings is not sufficient for the best efficiency if the primary and secondary circuits are loaded to a longer wave-length by means of loading coils. You had better see previous issues of The Wireless Age and the book, "How to Conduct a Radio Club" for the dimensions and diagram of connections for a long distance receiving apparatus.

The Arlington station sends out time signals at 10:00 p. m., Eastern standard time.

* * *

R. H. L., Baltimore, Md., inquires:

Ques.—(1) What is the capacity in microfarads and the natural wave-length of an inverted L antenna consisting of two wires, 100 feet in length, placed four feet apart? The height is 50 feet and the lead-in is 30 feet in length.

Ans.—(1) The fundamental wave-length is approximately 281 meters, the capacitance .000395 microfarad and the inductance about 63,000 centimeters.

Ques.—(2) What is the maximum possible wave-length adjustment with this antenna connected to the following described apparatus:

The primary loading coil is 15 inches by 3 inches, wound with No. 24 single silk covered wire.

The loose coupler has a primary winding 5 inches in diameter and 7 inches in length, wound with No. 22 single cotton covered wire.

The secondary winding is 7 inches in length and 4½ inches diameter, wound with No. 30 single cotton covered wire.

A variable condenser of .007 microfarad is connected in shunt to the secondary winding.

Will I require additional inductance in the secondary circuit to place the primary and secondary windings in resonance?

Ans.—(2) With a complete loading coil and primary winding of the receiving transformer connected in series with the antenna system, the upper wave-length adjustment is 3,900 meters and with the full value of capacity in shunt with the secondary winding using the entire inductance the maximum adjustment is 4,620 meters. You thus see that to place these two circuits in resonance at the longer wave-length will require a loading coil in series with the antenna circuit of increased dimensions; but keep before you the fact that there are no spark circuits in operation at a wave-length of this value.

Ques.—(3) Can all types of wireless telephone systems be heard on ordinary receiving apparatus with crystalline detectors?

Ans.—(3) Yes, provided the receiving tuner is constructed to permit resonance with the transmitting station.

Ques.—(4) What flux density is used in designing the cross sectional area of a transformer core?

Ans.—(4) The actual density varies with the frequency. At the frequency of 25 cycles from 60,000 to 90,000 lines are allowed per square inch; for 60 cycles 40,000 to 50,000 lines per square inch; for 120 cycles, 30,000 to 50,000 lines per square inch; for 500 cycles, 5,000 to 10,000 lines per square inch.

From one to three dry cells are used with a carborundum crystal, but usually only one is required.

Your aerial, sixty feet in height, thirty-eight feet in length, consisting of two wires, spaced three feet apart, has a fundamental wave-length of approximately 178 meters.

* * *

A. B. R., Stuttgart, Ark., writes us as follows:

My station is practically inoperative during the summer months and my troubles are not those of the usual amateur station, namely, poor connections, faulty instruments, or poor earth connection. I believe there must be some condition external to my station which is causing this, but so far I have not been able to solve the problem. I have a complete set of apparatus, including a vacuum valve detector, inductively-coupled receiving tuner and an antenna 100 feet in length and 72 feet in height at one end, and 45 feet in height at the other end. I experience this trouble principally between the months of May and September, and I should like to have you give me some advice.

Ans.—(1) There is nothing wrong with your apparatus nor your station as a whole. The fact is, that long distance receiving work in the United States, particularly from spark stations operating at wave-lengths between 600 and 2 500 meters, is only possible during the winter months of the year, that is, from September to May, but from May to September it is rather doubtful whether or not long distance stations can be received. Occasionally on cold evenings during the summer months, signals are readable from ships a considerable distance at sea, but not ordinarily. Consequently there is nothing you can do except to wait until the favorable months arrive, in the meantime satisfying yourself by communicating with local amateur stations. About September 15th, or possibly later, you will find that during the night hours you will be able to receive signals from far distant stations, and the condition that allows this to take place is not entirely attributable to conditions of heat or cold. It seems to be more a matter of seasons than one of temperature.

R. B. H., Allentown, Pa., inquires:

Ques.—(1) When using my transmitting apparatus there is an extremely loud noise in my head telephones. Can this be overcome and how?

Ans.—(1) If found to be caused by electrostatic induction from your transmitting apparatus, it can be overcome by disconecting the terminals of the telephone cords from the receiving apparatus during the sending period and may be eliminated by placing a small switch acros the telephone binding posts during the period of transmission. You might separate your transmitting apparatus by several feet from your receiving equipment. It may be that you do not disconnect the earth wire from the receiving apparatus during the period of transmission; if this is not done you should construct an aerial switch immediately that will permit it.

* * *

C. E. G., Bryan, Texas., inquires:

Ques.—(1) Will an E. I. Company ½ kw. transformer send as far as a closed core transformer with the same power?

Ans.—(1) Yes.

Ques.—(2) How far should a ½ kw. coil send on a 200-meter wave?

Ans.—(2) About twenty miles.

Ques.—(3) How many plates of glass, 8 inches by 10 inches, should I use for condensers for this coil?

Ans.—(3) Eight plates connected in parallel.

Ques.—(4) How far should I be able to receive with the usual amateur receiving apparatus connected to an antenna 74 feet in length and 45 feet in height?

Ans.—(4) From 40 to 100 miles in daylight and from 100 to 500 miles after dark.

Ques.—(5) What is the wave-length of the aerial referred to in the fourth query?

Ans.—(5) About 195 meters.

* * *

C. H., Spencer, N. Y., inquires:

Ques.—(1) What is the wave-length of my aerial, which is 75 feet in length and 35 feet in height? It is composed of 4 wires, spaced 3 feet apart. The lead-in is 35 feet in length and the ground lead 17 feet in lenigth.

Ans.—(1) About 210 meters.

Ques.—(2) Is it necessary to insulate the layers of wire on the secondary winding of a 3-inch spark coil, and if so what material is used? The data for this coil are taken from the book, "How to Conduct a Radio Club."

Ans.—(2) Adjacent layers should be insulated by a good grade of paraffine paper or preferably by very thin Empire cloth.

Ques.—(3) What size condenser should I use with this coil to keep the wave-length within 200 meters?

Ans.—(3) A suitable condenser is completely described on page 28, Figure 9, of the book, "How to Conduct a Radio Club."

Ques.—(4) What is the approximate transmitting range of this coil using a suitable helix, spark gap and condenser?

Ans.—(4) From 10 to 40 miles, depending upon the type of receiving apparatus used at the receiving station. With crystalline detectors 15 to 20 miles has been covered with a similar coil.

Ques.—(5) Is the oscillation transformer more suitable than the ordinary single coil helix?

Ans.—(5) Not necessarily, but it permits the coupling between the primary and secondary windings to be more easily regulated than with the ordinary helix.

* * *

G. C. R., Richmond, Va.:

We do not know what stations were engaged in the wireless telephone conversation which you heard, but there are several experimental radio telephone stations in daily operating at Schenectady, N. Y., and also at Pittsfield, Mass. The United States Navy has been engaged in numerous wireless telephone tests, and it may be that the conversation which you heard emanated from some of their equipments.

* * *

E. F. Champaign, Ill., desires to know if two undamped receiving sets, like those described in the book, "How to Conduct a Radio Club," will interfere with one another owing to the fact that such receiving sets actually radiate undamped energy. In the problem given us these stations are located half a mile apart. These equipments will not interfere ordinarily with one another if the two antenna circuits have different degrees of damping, but we cannot make a definite statement on the subject. It is a fact that apparatus of this type does radiate undamped energy and has been used by several experimenters for wireless telephone conversations up to a distance of 1½ miles.

It does not seem necessary for us to take up the matter of the taps on the loading coils of the wing and grid circuits of the diagram published on page 82 of the book, "How to Conduct a Radio Club," because the majority of amateurs know that in any wireless telegraph receiving circuit it is desirable to have close variation of the inductance value. The experimenter may have just as many taps as he desires. For the longer range of wave-lengths, however, no taps are required on either the loading coil in the detector circuit or the one in the wing circuit. They are used at their full value.

* * *

W. C. H., Wind Rock, Tenn., inquires:

Ques.—(1) Please advise if the vacuum valve amplifier described on pages 77 and 78 in the book, "How to Conduct a Radio Club," can be used to amplify undamped signals received with the "beat" receiver described on page 82 of the book? If so, how?

Ans.—(1) The connection is feasible and will give the desired result, provided the one to one transformer, P, Figure 55, is connected in series with the head telephones and the battery, B-2, of Figure 62 on page 82 of the Radio Club Book. The connections from the auto transformer are then extended to the grid and filament of the second vacuum valve and so on. Some experimenters prefer a one to one transformer having a primary and a secondary winding and in certain stations, a step-up ratio of turns is employed. The secondary winding is then given double the number of turns in the primary winding. Inductively-coupled transformers of this type can be purchased from the Manhattan Electrical Supply Company, New York City.

Ques.—(2) Approximately what is the wave-length of a single wire aerial, 700 feet in length, 55 feet in height with an 80 foot lead-in and a 10 foot group wire?

Ans.—(2) The fundamental wave-length of this aerial is close to 1,100 meters.

Ques.—(3) By the use of two wires spaced 12 feet apart in this aerial will the strength of the received signals be increased materially?

Ans.—(3) Possibly a slight increase in the strength of signals may be experienced, but perhaps not sufficient to warrant the expense of the wire.

* * *

F. E. M., Troy, N. Y., inquires:

Ques.—(1) Will you please publish a formula to calculate the condenser capacity of a wireless telegraph set when the wave-length, spark frequency, secondary voltage and power input to the transformer are known.

Ans.—(1) These various quantities are related to one another in the following ratio, namely:

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

Where C = Capacity condenser in microfarads.

W = Watts delivered by secondary winding.

N = Cycle frequency of current supply.

This formula must be considerably modified for practical work, but is of sufficient importance for guidance in elementary design.

Ques.—(2) I have a 60 cycle 1 k.w. transformer, which, when used on forty cycles A. C., draws practically 2 k.w. Operated at the wave-length of 300 meters and connected with a rotary gap giving about 480 spark discharges per second, what is the required capacity for the condenser and how many 8 by 10 plates, coated on each side, with tinfoil 6 by 8 inches, are required?

Ans.—(2) You will probably not be allowed to operate this station at a wave-length above 200 meters and consequently the capacitance of the condenser should lie between .008 microfarad and .01 microfarad. Each plate of glass of the condenser you have described will have a capacitance of about .00066 microfarad and in consequence twelve plates connected in parallel will give the required value.

Ques.—(3) If I increase the speed of a non-synchronous rotary gap so as to produce about 800 spark discharges per second instead of 480 discharges, will a condenser of smaller capacity be required?

Ans.—(3) Yes, the capacity of this condenser must then be reduced. Ordinarily a non-synchronous rotary gap does not function well at spark frequencies in excess of 400 sparks.

From and For Those Who Help Themselves

(*Continued from page 58.*)

the weight of the motor's armature and the rotary disk. For example, if the rotor and armature were heavier, the rubber tip, D, would have to make a firmer contact against E. The position of the clutch and the connections may be seen from the cut. It is plain to see that when the current is made, the tip, D, is drawn away from E, and when it is broken, C forces D against E, automatically stopping it.

R. A. Wilkins, *California.*

FIVE-CENT CRYSTAL HOLDER

After experimenting with all kinds of detector cups I hit upon the plan of using an ordinary helix clip for holding the crystal. These clips can be purchased for five cents and any size or shape of crystal can be clamped in any position instantly. The end opposite the jaws should be flattened out and soldered to a support which can be arranged to suit conditions. B. A. Noe, *Indiana.*

National Amateur Wireless Association

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Editor, THE WIRELESS AGE.

MANAGING SECRETARY,
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450 4th Avenue, New York.

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

MEMBERS' EQUIPMENT.

1st. CERTIFICATE OF MEMBERSHIP.

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

2nd. AERIAL PENNANT.

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

3rd. MEMBERSHIP PIN.

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

4th. LIST OF RADIO STATIONS OF THE WORLD.

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

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

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

6th. HOW TO CONDUCT A RADIO CLUB.

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

7th. MONTHLY BULLETIN SERVICE.

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

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

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

CONCESSIONS:

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

INITIATION FEE

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

ANNUAL DUES

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

1st. The Monthly Bulletin Service.
2nd. THE WIRELESS AGE for one year.
3rd. How to Conduct a Radio Club or equivalent.
4th. 10% discount on any book on wireless published, and other features to be announced later.

SPECIAL NOTICE REGARDING CORRESPONDENCE.

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

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

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

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

APPLICATION FOR MEMBERSHIP.

Clayton E. Clayton, Managing Secretary,

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

450 4th Avenue, New York City.

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

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

My qualifications for membership are given in blank spaces below.

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

Street Address ....

Town and State...

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

* Option.

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

FILL IN ANSWERS TO THESE QUESTIONS.

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

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

Reference..

Reference..

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

....

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

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

....

National Amateur Wireless Association

A DIRECTING ORGANIZATION DEDICATED TO THE PROMOTION OF RADIO COMMUNICATION

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

GUGLIELMO MARCONI, PRESIDENT

Reduced fac-simile of letter head.

For Clubs and Members of National Amateur Wireless Association

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

LETTER HEADS AND ENVELOPES:

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

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

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

Special prices on 1000 Letter Heads to Clubs.

MESSAGE BLANKS:

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

STATION LOG BOOK:

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

in cloth 30c

RADIO STATIONS OF THE U. S.:

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

PHOTOGRAPHS AND PICTURES:

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

Half-tone picture of G. Marconi, suitable for framing 10c

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

WIRELESS MAP OF THE WORLD in colors 50c

1916 YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, published at $1.50, special to members and clubs (1915 Ed. 75c).. $1.35

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

Extra pennants for members 30c each

Fac-simile of 36 inch Pennant.

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