

# THE WIRELESS AGE



JUNE, 1914

## THE RADIO REVIEW

THE great service of wireless telegraphy at sea is a matter of common knowledge nowadays for every reader is familiar with the many incidents wherein lives and property have been saved at sea as the direct result of this means of communication. On land the value of wireless has not been as strikingly exemplified, but it is evident from what happened at Vera Cruz recently that its possibilities in war are at least as great.

*A Demonstration of Wireless Effectiveness in Mexico*

Heretofore, when a detachment of an army has been cut off from communication with its base by wire the only method of transmitting information has been by the heliograph and this at its best has proven uncertain and unsatisfactory, and more often not available at all.

Now an army needs to depend on neither wire nor heliograph for maintaining communication with its base. Equipped with wireless apparatus, a detachment, no matter how far separated from the main body of the forces, can keep in constant and instant communication with it.

How valuable this service may be was shown when the Mexicans called on the detachment which was guarding the water works at El Tejar under Major Russell to surrender. The force was a small one and might easily have been overwhelmed by the Mexicans had it not been able to reach Gen. Funston at Vera Cruz.

But as it was when Major Russell received the demand to surrender, he sent the messenger making the proposal back to his commander and at once sent a wireless message back to headquarters.

What followed is told by the Associated Press dispatch as follows:

"The wireless message brought about a quick change to active army duty.

"Within a few minutes it had notified Major Russell that reinforcements were on the way and in little more than an hour, instead of the 240 marines at the outpost there were 1,200 men, while the entire garrison of Vera Cruz was ready for any movement that might be ordered.

"Seven companies of the Fourth Infantry regiment were sent forward under the command of Col. Robert C. Van Vliet, as well as two battalions and three companies of marines commanded by Col. John Archer Lejeune.

"When the reinforcements arrived at the water works station, Major Russell and his men were not at all hard pressed. The Mexicans had contented themselves with a scattering fire consisting of not more than four or five shots. From Major Russell's lines only one shot was fired. The water works station post in the American lines was placed so far out of the city

only because the authorities regarded it as essential to protect the city's water supply."

If the war in Mexico is to continue, there is no doubt but the incidents of this sort will become very common. Between the aeroplane and wireless surprises and ambushes will be very rare in warfare hereafter, a thing which would give us an almost inestimable advantage in the sort of campaign we should have to engage in in Mexico.

**W**HILE the Railway Telegraph Superintendents convened at New Orleans are considering the merits of wireless as an auxiliary to "safety first" in railroading, news comes from Vera Cruz that our fighting men have applied railroad wireless to safeguarding passengers in a broader sense.

*"Safety  
First" on  
the Refugee  
Train*

An outfit has been installed on the refugee train which almost daily penetrates the Federal lines between Vera Cruz and the capital to bring foreigners into the zone of safety afforded by the United States flag. Five wireless stations on the western side of the city keep vigilant watch day and night for the call of "S. O. S.," this being the signal agreed upon to give notice that the train has been attacked and foreigners are in danger.

The apparatus is rigged on the rear platform of a Pullman car and stands about five feet above the roof of the car. Its construction is due to the inventive genius of Ensign Maddox of the battleship Utah. Chief Electrician C. P. Porter of the battleship New Jersey has been detailed to ride back and forth upon the train to keep the wireless plant in order and to flash the warning signal if danger makes it necessary.

**A** NEWSPAPER editor in Boulder, Colo., voices his alarm in learning the great peril in which the world is placed. He observes: "This matter of handling electricity is getting to be a dangerous thing.

*The  
"Perils" of  
Wireless  
Again*

At Madrid, Spain, Señor Igelsias recently 'lighted and extinguished at will fifteen electric bulbs at a distance of 600 yards.' It is also claimed that in February Marconi lighted an electric bulb at a distance of six miles, by a wireless current. Electricity to do this must be very powerful. In the hands of a villain, electricity may yet be so used as to set whole cities on fire, kill individuals at will without being liable to even the least suspicion. And if individuals can be slaughtered, why not entire armies and whole communities? One cannot tell where all this will end."

We are indebted to the man who culled this clipping for the pertinent observation that after much careful consideration the only remedy he can see is that we who have enemies who are electrically inclined refrain from

carrying around with us in our pockets receiving plants strung up in series with a pound of dynamite. This would be a great sacrifice, and yet, for the sake of the world, we should do it.

THE success of the wireless telephone experiments which Mr. Marconi has been and is still conducting calls to mind the fact that the inventor whose epochal discovery has meant the paving of thousands of lives passed his fortieth milestone on April 5th.

*Oversea  
Phone  
Predicted*

It is expected that he will now be honored by election to the Italian senate, to which he was elected over a year ago but was prohibited from taking his seat because of the provision that an Italian senator must be not less than 40 years of age.

Mr. Marconi has recently left London to personally superintend telephony tests between mercantile ships and the powerful English shore stations. On his departure he is quoted as saying: "I think we shall be able presently to telephone wirelessly from England to America. It may be a question of years—I do not know how soon, but I think it will come. Our chief difficulty is in controlling sufficient power to carry a message that distance."

Considering how conservative Mr. Marconi's public utterances have always been it now seems certain that the practical wireless telephone has arrived at last.

THE EDITOR.

# Wireless Telegraphy in Railroad Service

An address read before the Convention of Railway Telegraph Superintendents  
New Orleans, May 19-22

By L. B. FOLEY

Superintendent of Telegraph Delaware, Lackawanna & Western R. R.

THE Lackawanna Railroad company has had in contemplation for the past five years the installation of wireless telegraphy for break-down, or emergency service and in 1909 conducted some experiments in that direction, but the apparatus at that time was not sufficiently developed to be of practical use. During the spring and summer of 1913 we erected steel towers at Scranton and Binghamton, obtaining wireless apparatus of the Marconi company for two 2 K. W. stations, one at Scranton and one at Binghamton, with a 1 K. W. installation on our limited train running between Hoboken and Buffalo.

On the roof of our Scranton passenger station we erected a tower 70 feet in height, giving a total elevation above the surface of the ground of about 175 feet, and from this point to a stack 175 feet high at our locomotive shops, 750 feet distant, installed a four-wire flat top antennæ. Lead wires were brought from the eastern end of the passenger station over the edge of the roof of the building to the operating room on the second floor. In this station is located a 2 K. W. radio-telegraph equipment. The transmitter includes a motor generator installed in the basement of the station and which, running at 1,750 r.p.m., converts the sixty-cycle three-phase central station energy into the required frequency at 250 volts for the radio outfit. The current is then led through a sending key to a transformer, where the electromotive force is stepped up to 20,000 volts and is used to charge a bank of six copper-plated Leyden jars (total capacity .012

microfarad) which discharge through a multiple plate quenching spark-gap in the usual manner, giving a high-pitched musical spark.

Inductively coupled transmitting circuits are used, the radio-frequency transformer and inductances being wound of strip copper in flat spiral form, clock spring fashion. A hot wire ammeter in the antenna circuits gives a reading of 14 amperes when the station is sending on a wave-length of 1,620 meters. The station is equipped with a small control panel carrying voltmeter, ammeter, wattmeter, frequency meter and generator field rheostat. The motor generator is started and stopped by two signal relays operated by a hand switch. The detector used is of the double crystal form. The receiving tuner is of the inductive coupled type with a switch for connecting the detector circuits directly to the antenna for "picking up" under broad tuning adjustment. No difficulty is experienced from interference and a broad-tuned circuit is used altogether for working with Binghamton and the train. Messages received at Scranton from Binghamton (63 miles distant) are copied on a typewriter. The Binghamton towers are 175 feet in height, with a four wire flat top antenna 400 feet long and have lead wires from the middle point to the station office which is located on the second floor of the Binghamton passenger station building and is equipped with the same apparatus as that used at Scranton. A change-over hand switch is used to transfer the antenna from sending apparatus to receiver. The quenching

gap and blower are located just behind the operator.

On the "Lackawanna Limited" train the aerial or antenna is formed of wire arranged in four rectangles, one on the roof of each of the four forward cars, lengthwise, with an additional wire lengthwise, and all wires parallel with the top of the car, each rectangle being carried on porcelain insulators at the corners and center of each car, with wire linking connection between cars. The installation of the additional wire lengthwise and parallel with the top of the car, which at first was omitted, increased the transmission radius from the moving train to fixed stations from 50 miles to 87 miles, i. e., 37 miles. The four car-antenna form a flat top about 280 feet long, 10 feet wide and 12 feet above the rails. The wires clear the tops of the cars about 18 inches, being low on account of bridges and other overhead interferences; therefore, the radiating power is limited, but it is expected to make changes later, in the aerial on the train, to obtain a radius of 100 miles or more. The lead is taken from the middle of the antenna through the side of the second car, near the roof, into a compartment two feet by four feet, which contains the wireless apparatus and operator. The wireless apparatus upon the train is of 1 K. W. rating and similar in principle and operation to that at Scranton and Binghamton. The motor generator on the train is operated on 30 volts direct current from the car-lighting generator, which carries on its lines a set of storage cells. This motor generator draws about 40 amperes and provides alternating current at 250 volts for the radio transmitter, including a ten-unit quenching gap, three glass jar condensers of .002 microfarad each, and the usual radio-frequency transformers. The antenna current is high, due to the peculiar antenna conditions.

During the months of January and February we were obliged to make use of our wireless system to handle messages and train orders between Binghamton and Scranton on account of telegraph and telephone wires being damaged and communication interrupted by storms. On Sunday, March 1st, one of the most disastrous sleet storms known in this section of the country, followed by a heavy fall of snow and high winds, began in the after-

noon and continued for a period of 18 hours, prostrating poles and wires within a radius of 100 miles from New York in Pennsylvania and New Jersey. The only service we had for a period of five days was by wireless; we handled all of our telegraph work by wireless between Hoboken and Scranton for a period of ten days. During the ten days 1125 messages were sent and received; on March 6th, 120 messages were handled by wireless between the above points between 9 A.M. and 6 P.M., many of the messages containing fifty words or more.

In addition to wireless installations at Scranton, Binghamton and on the Buffalo limited train, temporary wireless stations were installed at Hoboken and Dover.

The Lackawanna Company now has five wireless stations as follows:

| LOCATION        | CALL  | WAVE-LENGTH |
|-----------------|-------|-------------|
| Hoboken.....    | W B U | 2100 meters |
| Dover.....      | W B X | 1000 meters |
| Scranton.....   | W P T | 1620 meters |
| Binghamton....  | W B T | 1620 meters |
| Limited Train.. | W H T | 1000 meters |

We are equipping a 5 K. W. station at Buffalo which, when completed, will give us wireless service between Hoboken and Buffalo.

On April 1st our company had a special train, equipped with wireless telegraph apparatus, from Ithaca to Hoboken, carrying 550 Cornell students; our operator on board the train handled 128 radiograms from the train to fixed stations at Binghamton, Scranton and Hoboken for the accommodation of the students, who were en route to their homes for Easter.

Our experience with the wireless telegraph during the few months that we have had it in operation has been invaluable in many ways and it has been decided to extend the service over the entire system.

We have recently made some experiments with the wireless telephone in connection with our present installations, having transmitted communications a distance of 63 miles between fixed stations and a distance of 53 miles with a moving train.

The wireless telegraph can be depended on between fixed stations and between moving trains and fixed stations. The

transmission is as rapid and reliable as that obtained over a Morse telegraph wire; therefore its many advantages and uses in railroad service can readily be understood by practical telegraph men. The cost of apparatus is a matter of negotiation and may later on be standardized by the Marconi company on the lines of the present standard telephone railroad agreement.

After a few weeks' use of the wireless we discovered many ways to use the service to advantage and, at the suggestion of one of our associate members, now in the wireless field, Mr. Nally, I compiled a list, on December 16th last, of some of the advantages to railroads of having wireless service as an auxiliary to the telegraph service. Later on, in the great storm of March 1st and 2d, we discovered that the wireless was not an auxiliary to the telegraph, but was a valuable substitute.

To the members who may not have read the communication referred to I take the liberty to quote a few of the conclusions:

"Communication by wireless telegraph to and from stations and moving trains is no longer an uncertainty. There are many fields for the wireless telegraph in railroad train operation. It will not be necessary to increase the number of trainmen, as a trainman can easily learn the telegraph alphabet, or a telegrapher can be utilized to operate the wireless, also performing the duties of a trainman. Later on it may be found necessary and profitable to install a telegrapher on limited trains running long distances without stopping to handle commercial telegrams for the public. Telegraph offices on trains, in the future, may be of as much value to the public as branch offices in hotels or other places where large numbers of people congregate. With direct communication the train dispatchers can keep in touch with the conductor of a train; in fact, the wireless permits the dispatchers to board every train. The Lackawanna company has used the wireless for handling train orders and finds it as accurate and reliable as the telegraph or telephone in transmitting these orders. The total loss of means of communication between stations, caused by prostrations of poles and wires, is a thing of the past."

## THE SHARE MARKET

New York, May 18th.

The Mexican influence has been felt strongly during the week and the developments in the share market as a whole have not been favorable. Yet notwithstanding familiar discouragements and the pessimism to which many are weakly submitting there are fundamental reasons for taking a more confident view of the future.

The crop outlook is good and business conditions are generally sound. Persistent liquidation has served to weed out the weak spots, but because business has been conducted on a bedrock basis commodity prices have shown a very considerable decline. Right now there is no oversupply of desirable merchandise, and with basic conditions exceptionally sound the situation is positively ripe for a fresh movement. Confidence is the chief element lacking.

The unreasoning antipathy toward business enterprise is a state of mind which will have to exhaust itself. Sober second thought and average common sense strengthens the belief that the present spell must soon run its course and reason prevail, for it would seem that the very worst had been discounted.

The slight gain in American Marconis may be a sign of incipient reaction and the fact that the local market stood the recent strain well affords promise of better conditions.

Bid and asked prices to-day:

American,  $3\frac{3}{4}$ —4; Canadian,  $1\frac{5}{8}$ —2; English, common,  $15\frac{1}{2}$ —17; English, preferred, 12—14.

## MOTOR LIFEBOATS FOR LINER

A cablegram from Glasgow, Scotland, says that the first British motor lifeboat has just been supplied to the new Clyde-built Allan liner *Alsatian*, now sailing between Liverpool and Canada. The boat is 28 feet in length with a beam of 8 feet and is very compact. She is supplied with a four-cylinder Gleniffer paraffin motor, but her most striking feature is the complete wireless installation which she carries. The installation has a range of 100 miles.



I.

Plottin' routes on war-maps;  
 Gettin' sleep in cat-naps;  
 Tellin' flustered colonels exactly where they are.  
 Reelin' out on buzzer lines,  
 Peelin' eyes for smoke signs;  
 Info' for the "Old Man"; gathered near and far.

II.

Ridin' with the scout-screen,  
 Seein' what's to be seen,  
 Radio goes trottin', mule team on a spree.  
 Soon it's "Open Station!"  
 Workin' like 'tarnation,  
 Settin' up the pack-set; poundin' on the key.

III.

Huskies on the hand cranks  
 Makin' the old mill clank;  
 Humpin' up their shoulders, turnin' out the juice.  
 Operator sweatin',  
 Section chief a-frettin',  
 Gotta get headquarters; won't take no excuse.

IV.

Driver of a reel cart—  
 Tell you, that's a real art  
 Handlin' of your clutches; payin' out the line.  
 Lancemen ridin' after  
 Ain't got time for laughter;  
 Toilin' with their pikepoles; dasn't waste their  
 time.

V.

River swiftly flowin';  
 Got to keep on goin',  
 Ain't no ford across it? Wig-wag, swim or flash.  
 Lines of information,  
 Miles of separation,  
 Must at once connect 'em, by the dot and dash.

**WARFARE** teems with stories of strategy and if the hostilities between the United States and Mexico continue it is likely that many of these tales will be linked with stories of the achievements of wireless telegraphy. In any crisis which confronts a military force efficient communication is an all-important factor.

When the far-reaching use to which wireless can be put in warfare is carefully considered its possibilities in times of strife seem endless.

Even in the early stages of hostilities in Mexico wireless has already shown its worth; the air has been filled with marconigrams telling of the progress of the



strife and containing news about Americans whose fate was in doubt. Perhaps the best tribute to the value of wireless is contained in the story of how the commander of a United States force, ordered to surrender by Mexican troops, utilized the art.

The Mexicans outnumbered the Americans, but the commander of the latter, instead of yielding to the demand for surrender, sent a wireless message to the commander of the United States troops at Vera Cruz; and in about an hour the small detachment of Americans had been reinforced by almost a thousand men. It is needless to say that there was no American surrender.

In the army the chief users of wireless telegraphy are the members of the Signal Corps. These men are detailed to accompany the main body of the independent cavalry, far ahead of the army. The commander of the independent cavalry is instructed to keep in communication with the principal American force—that is, to send information as speedily as possible concerning what he has learned of the movements of the enemy.

The advance proceeds without incident for some time. The men of the cavalry are scattered far over the country, keeping a sharp lookout for the enemy, blocking its patrols from reconnoitering and preventing hostile soldiers from obtaining a position from which an attack could be made in force. Day by day the advance proceeds without any signs of the foe. Then, without warning, a clatter of rifle fire comes from the front. This is the signal that the cavalry has come into contact with the enemy. The commander of the field army is far in the rear and it is imperative that he should be informed at once of the proximity of a hostile force.

In years gone by mounted messengers would have been sent galloping back. The portable wireless set has made this unnecessary.

The commander of the cavalry nowadays hurriedly writes a message to the general giving him the essential information and hands it to the sergeant riding at the head of the Signal Corps.

Then the section chief calls "open station" and the riders turn and dismount. The horses are linked in a circle and placed in charge of one man, while

the others turn their attention to the pack animals. These animals accompany the detachment, bearing boxes containing wireless equipment, and sections of poles attached to the pack saddles. The burdens borne by the pack animals are hurriedly yanked off and then begins the task of putting the wireless apparatus in position.

The leading pack horse bears a small iron frame. The instant the latter touches the ground one man springs upon it, holding 'a section of pole from which radiate the wires of the antenna. Four men are paying out these wires from hand reels. The man on the frame raises the pole, another man glides under it; there is a snap, it is made secure and the pole goes up higher. Section after section is added and the mast finally extends sixty feet in the air.

A wave of the hand from the section chief starts a squad of men driving insulated pegs into the ground. They fasten the ends of the antenna and drag out four long lines of rubber-covered wire, composing the counterpoise or artificial ground. A chest is opened and adjustments of wires are made; then the chest is coupled to a wire from the mast and connection is made with the ground. Upon the iron frame is fastened a small dynamo, a half-kilowatt hand generator, the cranks of which are grasped by four men. The generator is connected to the instrument chest and the crank men start heaving.

A similar piece of apparatus is set up in the headquarters of the army or in a place designated by the general. This set remains there during the day, for the army moves slowly, while from it a buzzer line extends to the actual whereabouts of the commanding officer himself.

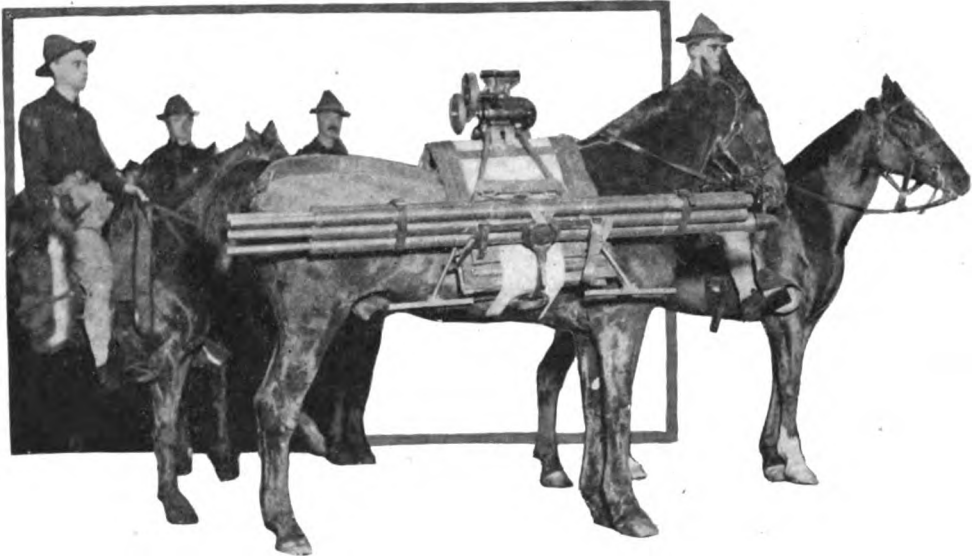
An incident that well illustrates the usefulness of wireless telegraphy in warfare occurred when the Mexicans demanded the surrender of the detachment which was guarding the water works at El Tejar. Major Russell was in command of the American force, which was a small one and might have been easily defeated by the Mexicans. Instead of hoisting the white flag, however, the American commander sent the messenger carrying the demand to surrender back to the Mexican lines and dispatched a wireless

message to General Funston at Vera Cruz.

Within a few minutes Major Russell was told by wireless that reinforcements were on the way to aid him, and about an hour afterward the little outpost contained a garrison of 1,200 men instead of only 240 marines; moreover, the entire American force at Vera Cruz was in readiness for an order to advance at any moment.

When the reinforcements, consisting of seven companies of the Fourth Infantry,

air to Rear Admiral Fletcher in the harbor, and through him to Rear Admiral Badger, fast approaching with another division of the Atlantic fleet. A few moments after the customhouse fell into American hands a large force of Mexicans was seen moving over the hills in the western outskirts of the city. Their intention, as read by Captain Rush, was to flank a battalion of our marines in the railway yards along Montesinos Street. No time was lost in getting word to the Prairie, and in short order the transport's



*Animals accompany the detachment, bearing boxes containing the wireless equipment, and sections of poles attached to the pack saddles. The masts and apparatus may be unloaded with great rapidity, yet they are securely attached to the saddle*

as well as two battalions and three companies of marines, arrived at the water works station, Major Russell and his men were not in the least hard pressed. The Mexicans had contented themselves with a scattering fire of not more than four or five shots and only one shot was fired by the Americans.

In little more than an hour after fourteen American marines from the whaleboats of the transport Prairie landed at Pier 4, Vera Cruz harbor, under command of Captain William R. Rush of the flagship Florida, a squad of signal corps experts had erected a mast on top of the Terminal hotel. Information and requests for instructions went through the

guns had broken up any hope of Mexican interference from that quarter.

It is safe presumption that from day to day the work of the field companies and signal corps will figure more and more in the war news. The public will discover what the military man knows already: that there are new units of war—the field companies—whose work is as effective and as necessary, if not as conspicuous, as that of the fighting regiments and the fighting companies.

The plans of the war department are as follows:

For every division of the army there are to be two field companies, each carrying three complete sets of wireless equip-

ment, with dynamo, transmitting apparatus, and forty or ninety foot masts. The men of the signal corps have carefully studied the field regulations sent out by Major-General Leonard Wood, chief of staff.

In these instructions it is ordered as a working rule that the wireless shall be used whenever the distance, the character of the service, and the nature of the country prevents the laying of telegraph lines. The fact that also it is to be used to intercept messages of the enemy raises the question of whether one may soon hear of the "wireless spy" in warfare. It will be of particular benefit to the mobile cavalry, and it will also be used to keep parallel columns in communication on the march.

The Marconi Wireless Telegraph Company of America recently completed at its factory at Aldene, N. J., the first of the new army cart sets designed for use by the Signal Corps. The cart set combines every essential required for the hardest kind of service and will transmit messages at least 300 miles under all weather conditions. It will receive messages sent from any distance up to 3,500 miles.

The set consists of two carts which are attached together to form a wagon when the outfit is in transit. The carts, when joined, are drawn by four horses or mules, and carry eight men. The forward section, or cart No. 1, holds a complete sending and receiving outfit; the rear cart carries an 8-horsepower Sterling motor, operated at 1,200 revolutions per minute, which is connected direct to a two-kilowatt generator. Eight lengths of bamboo, jointed to form an aerial eighty feet long, are strapped to the sides of the cart. This pole carries the antenna which intercepts the sound-waves in the air and conducts them to the receiving apparatus. The carts are painted in a shade of gray peculiar to the use of the army signal corps. They are built to withstand the severest strains incident to hard usage and passage over rough ground. The generator that supplies power for the sending apparatus of the outfit also supplies current for six incandescent lights for use at night.

Because of the whirring sound of the generator the two carts are separated a distance of about seventy-five feet while

the outfit is being used for receiving messages. The receiving set consists of two pairs of telephone receivers, various forms of tuning inductances, variable condensers, a wave meter, and two detectors, three large voltage and amperage meters, rheostats, and other appliances. The transmitting apparatus consists of a sending key, condensers, transformers and generator, three large volt and ammeter rheostats and other appliances.

The Marconi company is also completing an automobile wireless telegraph outfit, combining sending and receiving stations on the same chassis, which will be equipped with a motor to serve the dual purpose of furnishing power to operate the car and also supply the power for the generator.

There has been a considerable change of opinion during the last few years concerning the wireless apparatus wanted for military purposes. The following is an example of the old specifications for portable military stations:

"The sharpness of the tuning of the stations is to be five per cent.—that is to say, a change of wave-length of five per cent in the tuning of the receiver must render readable signals inaudible, after which a corresponding change of five per cent. in the tuning of the transmitters must render the signals readable again."

The authors of these specifications apparently believed that they were guarding as much as possible against interruption of communication by hostile stations. In order to meet these requirements, however, experimenters developed very sharply tuned transmitters. The stations interfered little with the working of the enemy's stations, but provided no advantages for doing away with interference of hostile sets with the communication between their own stations. The operators at these stations discovered that their receivers were not affected by their own transmitters if their wave-length differed by more than five per cent. They discovered, however, that other stations of a commercial type, differing in wave-length by considerably more than five per cent., interfered to a great extent with their operations.

This is explained by the fact that interfering stations were using closely coupled transmitters which emitted a wave with flat tuning and comparatively high damp-



*In the field regulations it is ordered that wireless shall be used whenever the distance, the character of the service and the nature of the country prevent the laying of telegraph lines*

ing. The sharply tuned receivers of these receiving stations were not affected by the highly tuned transmitters of the military stations differing slightly in wave-length. In consequence the commercial stations kept up good communication between themselves and effectually interfered with marconigrams between the military stations.

The conclusions of wireless experts who have followed closely the operation of wireless stations in war are as follows:

The transmitters should not be sharply tuned; the receivers should be open to extremely sharp tuning; changes of wave-length, either in the transmitter or the receiver, should be brought about by the movements of a single handle controlling all the circuits.

The Marconi field stations adequately comply with all of these requirements. The coupling of the transmitting circuits gives flat tuning to the transmitting wave and keeps maximum efficiency. The movement of a single handle effects a change of wave-length of both transmitters; it also effects the change of wave-length of the receiving circuit. By arranging the receiver the sharpest possible tuning is given, even against interference from comparatively flat-tuned and highly damping stations. Interference can be escaped more easily if the enemy uses sharply pointed transmitters.

A new wireless station mounted on a motor truck is being constructed with all haste for use by the Signal Corps in Mexico. The machine is being built on a new design by Signal Corps engineers.

A new "rapid transmitting panel," containing the latest improved wireless apparatus has been set about midway in a big six-cylinder auto truck, which carries in boxes at each side, a jointed portable aerial reaching eighty-five feet into the air when fully extended. The electric power for the wireless is furnished by the motor of the truck in direct connection with an electric generator, supplying enough current to light the mounted wireless room and run the instruments at their full capacity. The apparatus has a range of 400 to 800 miles in sending, and of nearly 2,500 miles in receiving. The machine is for service at the army's general headquarters, giving the commander of forces easy communication with a fleet at sea, or with any of the small portable field instruments carried by sections of the Signal Corps.

In recent preliminary trials the machine was subjected to strict tests. As soon as the work reaches a satisfactory stage of completion field tests will be given and the possibilities of the equipment accurately determined. Quick shipment to Mexico will follow.

It is likely that aeroplanes will be frequently used by the American forces in Mexico. Experiments with wireless telegraph sets on flying machines have led to the conclusion that a station which will be able to transmit communications more than fifty miles under all conditions will be a reality within a short time. The Marconi aeroplane set was designed purposely to make it adaptable, as far as possible, to any type of flying machine. In constructing aeroplane sets it was found difficult to build sets which came within the weight limits and provide an effective aerial system. Designed to have the widest possible margin for the distribution of weight, the Marconi aeroplane set has been made up into several separately contained units.

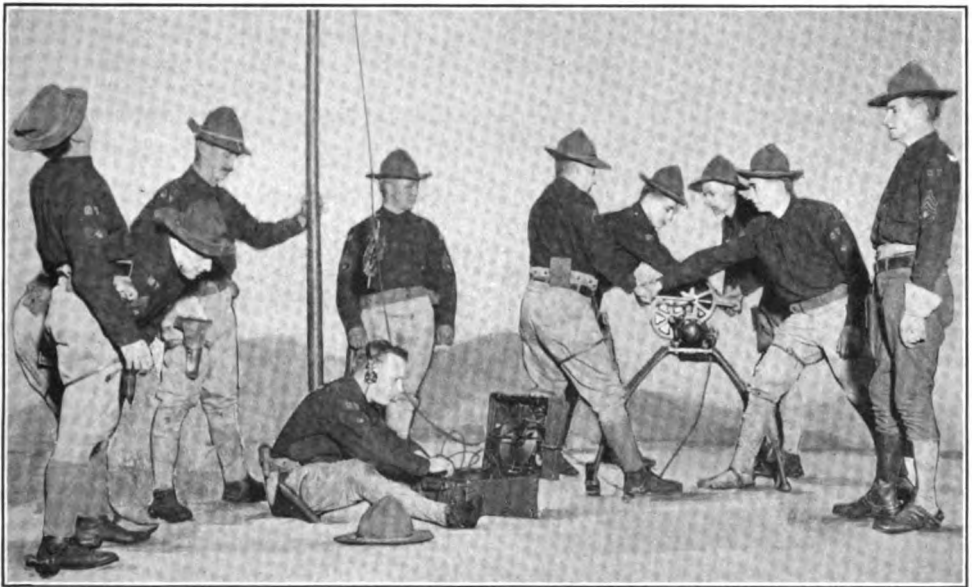
The strength of the apparatus was shown when an accident occurred in Great Britain to a Flanders monoplane on which a set had been installed. The aviator in charge of the flying machine started on a long flight. A peculiar accident occurred

after the aviator had circled about the surrounding country several times. The machine was flying at no great distance from the ground, and when he suddenly descended to effect a landing, the first skid of the machine caught in the earth. The monoplane, which was flying at more than sixty miles an hour, "turned turtle" and the aviator was hurled to the ground, sustaining serious injuries.

As a result of the accident the fusilage of the machine was smashed in two places and the propeller considerably damaged. Although the wings escaped great damage

used. It is now possible to use an aerial wire contained in the machine. This is a considerable advantage over the old method because it enables the pilot to steer his aeroplane nearer to other machines and does away with the difficulties which might be experienced from a trailing wire when making a landing in a confined space.

Experimenting with wireless apparatus on aeroplanes has not been done without loss of life. During a flight at the Brooklands Aviation Grounds, made for the purpose of experimenting with wireless,



*Wireless telegraphy is playing an important part in present-day military operations, for these stations have a range of many miles, are easy to transport, and carry messages independent of wireless that might be cut by the enemy*

it was necessary to have them stripped of their fabric and overhauled. The front skid was broken in half and the exhaust pipes, radiators and lubricating pipes on the engine were damaged. The oil tank to which the wireless apparatus was connected was demolished, and, therefore, it was expected that the installation would be found out of commission. It was discovered, however, that the set had not been damaged in the least and was in excellent condition to be operated. Even the aerial wire, which was attached to the broken fusilage, remained unbroken.

In the early experiments with wireless sets on flying machines a trailing wire was

Mr. Fisher, the pilot of the Flanders machine, was carrying a passenger. Fisher was circling about the grounds for the third time when he lost control of the machine and it fell to the ground. Both men were killed as a result of the accident.

In the navy wireless fills as an important place as it does in the army. Graduates of the signal school of the Newport Training Station are aboard the vessels of the United States fleet now in Mexican waters, keeping the Washington officials informed by wireless of the conditions on the coast of the enemy's country, and sending important communications.

# The Engineering Measurements of Radio Telegraphy

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## ARTICLE IX

*A method of measuring inductance accurately at radio frequencies and low voltage, partly due to Dr. Seibt, is considered in detail. Examples of measurements obtained by this method are given. In this connection, a general method of studying an algebraic power relation between two related quantities is described, and its application to the relation between the inductance of a coil and the length of the coil is shown.*

WE pass now to measurements of inductance at radio frequencies. The first method described is a very convenient null method, which is so simple in operation and is capable of application to inductances of such widely different values that it has been found of advantage to keep the apparatus described permanently set up, in order that permanent means for rapidly determining unknown inductances shall be available. Section 25. MEASUREMENT OF INDUCTANCE AT RADIO FREQUENCIES AND LOW VOLTAGE BY THE MODIFIED SEIBT METHOD. The following method is suitable for the measurement of air-core inductances between a microhenry and several hundredths of a henry. In general, the frequency at which the measurement is made is dependent on the inductance to be determined. The method is largely due to Messrs. Lester Israel and Alfred Kuhn, and is based on the Seibt method of measuring capacity.

(a) THEORY. Let the two oscillating circuits, I (consisting of the inductance  $L_1$  and the capacity  $C_1$ ) and II (consisting of the inductance  $L_2$  and the capacity  $C_2$ ) be connected so that their capacities are joined in series as indicated in Figure 51. Furthermore, suppose that the source of electricity, S, charges the capacities  $C_1$  and  $C_2$ , and that these capacities are then discharged through their respective inductances producing free alternating cur-

rents in circuits I and II. We assume that there is no reaction (or coupling) between circuits I and II. Let  $i_1$  be the current that flows in circuit I, and  $i_2$  that in circuit II. We desire to find the condition that must be fulfilled in order that  $i_1 = i_2$ . Let  $e_1$  and  $e_2$  be the potentials to which  $C_1$  and  $C_2$  are charged.

To begin with, we know that the total potential difference of the source S will be divided between the capacities  $C_1$  and  $C_2$  in inverse proportion to their capacities. That is,

$$\frac{e_1}{e_2} = \frac{C_2}{C_1} \quad (63)$$

When the capacity  $C_1$  is fully charged, the energy stored in it is

$$W_o = \frac{1}{2} C_1 e_1^2 \quad (64)$$

When this capacity has fully discharged itself, and the current through the inductance  $L_1$  is a maximum, the energy in the magnetic field of the inductance is

$$W_m = \frac{1}{2} L_1 i_1^2 \quad (65)$$

If we take the resistance of circuit I as negligibly small (which is a condition which is fairly easily fulfilled in practice), we may take

$$W_o = W_m$$

by the law of the conservation of energy.

Consequently,

$$\frac{1}{2} L_1 i_1^2 = \frac{1}{2} C_1 e_1^2 \quad (66)$$

and similarly for circuit II,

$$\frac{1}{2} L_2 i_2^2 = \frac{1}{2} C_2 e_2^2 \quad (67)$$

We divide equation (66) by (67), remembering that we have assumed that  $i_1 = i_2$ . We obtain, after algebraic simplification,

$$\frac{L_1 C_2}{L_2 C_1} = \frac{e_1^2}{e_2^2} \quad (68)$$

Introducing now the condition of equation (63), we find finally,

$$L_1 C_1 = L_2 C_2 \quad (69)$$

Consequently, we reach the interesting

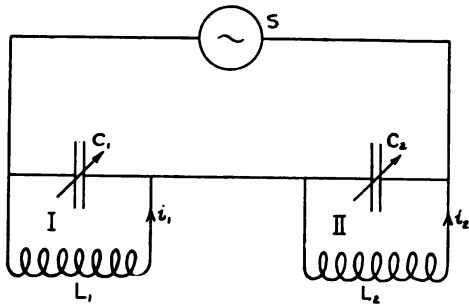


Fig. 51

conclusion, that for equality of currents in circuits I and II, we require only equality of periods (or wave-lengths) of these circuits, quite regardless of the ratio of the values of the inductance and capacity of each of these circuits. (This is true only if the dampings of the circuits in question are negligible.)

Let us consider now the arrangement shown in Figure 52. Circuits I and II are each coupled inductively with circuit III by means of the inductances  $L_3$  and  $L_4$ . We take  $L_1 = L$ , and we arrange  $L$ ,  $L_1$ ,  $L_3$ , and  $L_4$  so that the mutual inductance between  $L$  and  $L_3$  is equal to the mutual inductance between  $L_1$  and  $L_4$ . Also, we make  $L_3 = L_4$ . As will be seen, coils  $L_3$  and  $L_4$  are connected in opposition in the circuit III, so that, if equal currents flow in  $L$  and  $L_1$ , the indicator I will not be affected. That is, as we have shown above, there will be no indication in circuit III if the periods of circuits I and II are equal.

The insertion of an extra inductance  $L_x$  in circuit II and the changing of  $C_1$  to a new value such that the original period is retained unchanged, will therefore cause no change in the indication in circuit III. We will assume that we are provided with one standard inductance  $L_n$ , and that we desire to measure the un-

known inductance  $L_x$ . In succession we arrange circuits I and II as indicated in Figure 53, parts (A), (B), and (C). In each of these cases, circuits I and II have the same period as is shown by zero indication in circuit III. As will be seen from part (B), when the standard inductance  $L_n$  is inserted in circuit II, the capacity  $C_1$  must be changed to  $C_2$  for equality of periods; and when the inductance  $L_x$  is inserted,  $C_1$  must be changed to  $C_3$ .

The following relations hold:

$$LC = L_1 C_1 \quad (70)$$

$$LC = (L_1 + L_n) C_2 \quad (71)$$

$$LC = (L_1 + L_x) C_3 \quad (72)$$

From equations (70) and (71), we find very readily,

$$L_1 = \frac{C_2}{C_1 - C_2} L_n \quad (73)$$

and from all three equations, we find,

$$L_x = \frac{C_2 (C_1 - C_3)}{C_3 (C_1 - C_2)} L_n \quad (74)$$

So that, if we have the calibration of the condenser of circuit II, and know the value of the standard inductance  $L_n$ , it is possible to measure any unknown inductance by merely inserting it in place of  $L_n$ , and noting the new setting  $C_3$  of

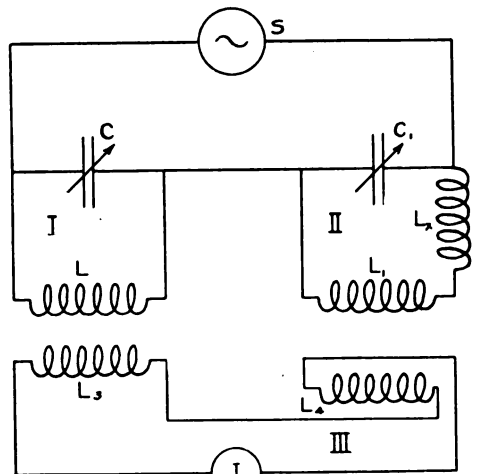


Fig. 52

the condenser corresponding to a zero indication in circuit III. Indeed, we may calculate, with a given apparatus, the values of  $L_x$  corresponding to any particular  $C_3$ , so that the operation of

determining an unknown inductance can be very readily accomplished.

(b) ARRANGEMENT AND DESCRIPTION OF THE APPARATUS. A wiring diagram of the entire apparatus

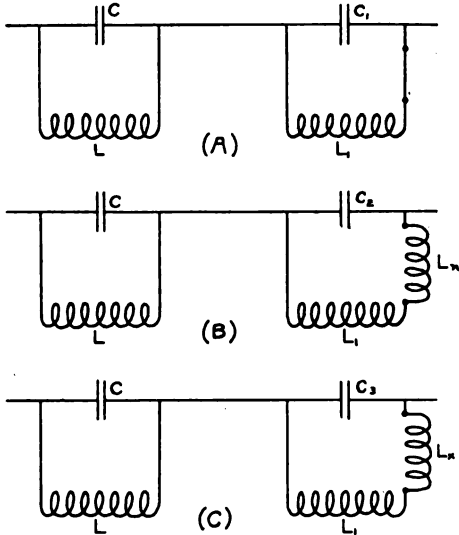


Fig. 53

is shown in Figure 54. The buzzer A is operated by the battery B, the current being controlled by the resistance R. In this way, because of the inductance of the buzzer magnet winding the condensers C and  $C_1$  are periodically charged. It will be seen that, in the gap in circuit II, there can be inserted either a short piece of wire, a standard inductance  $L_n$ , or the unknown inductance  $L_x$ . Care must be taken to place this gap in circuit II at the proper point. A common mistake is to place the gap at one of the points indicated by crosses on the lead wires to the condenser  $C_1$ . If this mistake is made, the apparatus will not operate properly. As will be seen,  $L_3$  and  $L_4$ , which are the secondaries corresponding to the primaries L and  $L_1$ , are connected in opposition. The indicator used was a combination of crystal detector D and telephone T. A galvanometer was substituted for the telephone receiver in one series of observations, to compare it with the telephone. The entire apparatus is shown set up in Figure 55. The buzzer A was a small "Lungen" high pitch buzzer. It is shown, together with its controlling resist-

ance R in the center background. The two condensers C and  $C_1$  are in the back to the right and left. They were each 0.005 microfarad variable air condensers. The two couplers,  $L_3$  and  $L_1 L_4$  are in the center front. They are mounted at right angles on a common base. Situated between them, and with its axis at right angles to that of each of them, is the standard inductance  $L_n$ . All these coils were single layer coils wound with silk-covered copper wire on wooden cores. In the foreground are visible the crystal detector (which was of the "Pyron" type), the 2,000 ohm double head band telephone receivers, a throw-over switch for use in circuit II, and an unknown coil on which some measurements of inductance were made.

(c) PROCEDURE. With the gap in circuit II short-circuited, the apparatus is set in operation. If alteration of capacity  $C_1$  does not produce a silence point in the telephones T, it is probable that either  $C_1$  is smaller than C or that  $L_1$  is smaller than L, or that coils  $L_3$  and  $L_4$  are not properly connected in opposition. The first trial should be to reverse the connection say of  $L_4$ . Condenser C should then be set to such a value that the silence point is obtained with prac-

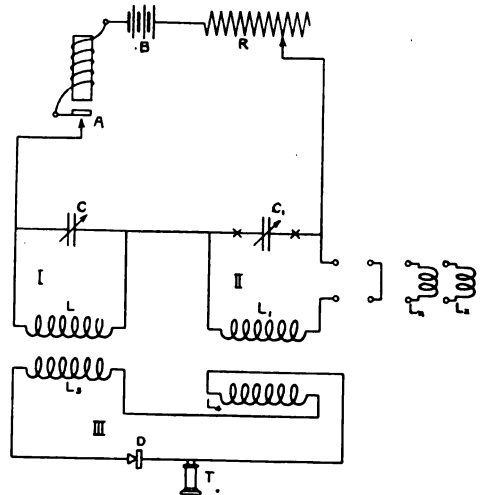


Fig. 54

tically all the capacity  $C_1$  inserted in circuit II. That is, the reading of capacity  $C_1$  for the silence point with no added inductance in circuit II should be at about  $170^\circ$  (on a condenser graduated



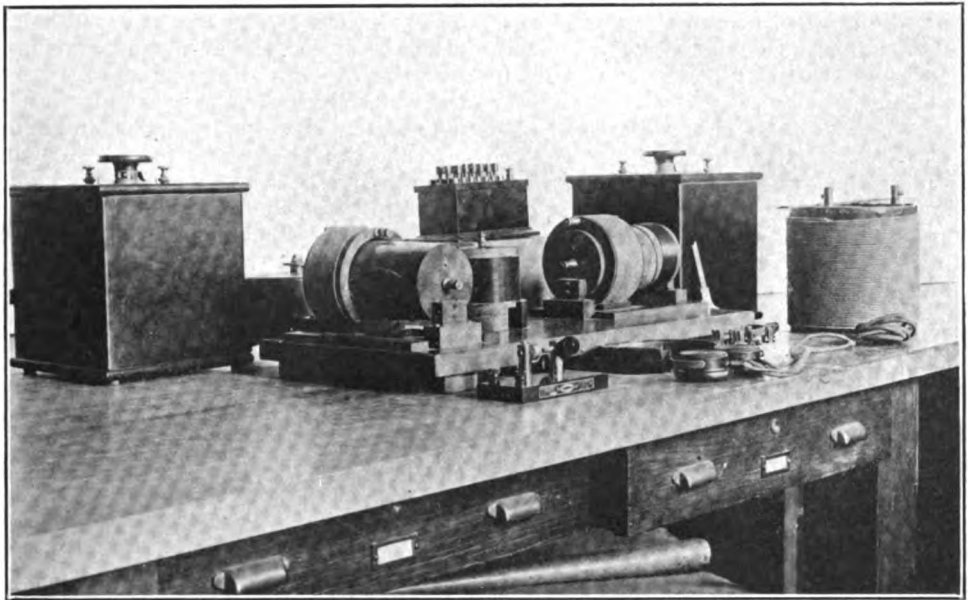


Fig. 55

from 0 to 180°).  $L_n$  should then be inserted in the gap, and the value  $C_2$  for silence obtained. And finally  $L_x$  should be inserted in the gap, and the silence value of the capacity  $C_3$  recorded. It is to be noted that if the apparatus is rigidly and well set up, the observations of  $C_1$  and  $C_2$  may be taken once and for all, and need not be repeated each time a new unknown inductance is measured. However, if there is any doubt as to whether the apparatus has been put out of adjustment between measurements, the first two observations should be repeated before each new measurement.

Since the effective damping of circuits I and II is affected by the reaction on these circuits of circuit III, it follows that, for an equality of damping in these circuits, the coupling between  $L$  and  $L_3$  should be the same as the coupling between  $L_1$  and  $L_4$ . The coils  $L_3$  and  $L_4$  should therefore be so arranged that by sliding or turning them the couplings referred to can be easily adjusted. A sharp silence point is practically always dependent on this adjustment. Furthermore, if an unknown inductance of high resistance (which therefore introduces a large damping in circuit II) be measured, the sharpness of the silence point will disappear, but can be at least partially restored by slightly readjusting the couplings. Care should be taken that the crystal detector

is in a sensitive adjustment, and that the buzzer is working steadily, preferably on a small current. In adjusting the capacity  $C_1$ , the body of the observer should not be too near it. This measurement is an extraordinarily sensitive one, and the capacity of the body near  $C_1$  is quite sufficient to make a marked change in the position of the silence point. If condensers of the usual variable air type, having movable plates mounted on a vertical spindle, are employed, care should be taken not to press downward forcibly on the knob of the condenser in adjusting it, since such condensers are generally not sufficiently rigid to hold their capacity unchanged under such treatment. The knob should be rotated by applying a tangential force of rotation to the circumference of the knob.

(d) ERRORS OF THE METHOD; THEIR ELIMINATION; AND PROBABLE ACCURACY. A single layer standard inductance of (calculated) value 0.001897 henry was tested against an unknown inductance. The variable condenser employed in circuit II was a calibrated standard which, for the range of settings employed, had capacities which were proportional to the settings.

It was found that

$$\begin{aligned} C_1 &= 171.4 \pm 0.1^\circ \\ C_2 &= 58.6 \pm 0.1^\circ \\ C_3 &= 84.9 \pm 0.2^\circ \end{aligned}$$

(The diminished accuracy in the case of  $C_2$  was due to the higher resistance and distributed capacity of the unknown inductance.)

Hence  $L_x = 0.0001004$  henry  
(Accurate to 0.5%)

The unknown inductance used was actually a precision 0.0001000 henry coil wound with litzendraht (multiply stranded wire) on a serpentine core. The agreement of its theoretical value with that experimentally determined is satisfactory.

Using as an indicator a galvanometer of 164 ohms resistance, and for which one degree deflection corresponds to 5.1 (10)<sup>-6</sup> amperes, the accuracy of the measurement was 1%.

From equation (73), we find that

$$L_1 = 96.7 (10)^{-6} \text{ henry}$$

So that the wave-length at which the measurements were made is 1,310 meters, corresponding to a frequency of 229,000 cycles per second. Furthermore, the decrements of circuit II were of the approximate value of 0.01; and for circuit I, about 0.005.

A single layer inductance having a number of fixed sections was then measured. It was wound with heavy copper wire on a core 18.4 cm. in diameter, and the lengths of the windings of each section measured parallel to the axis of the coil were measured. They were respectively 3.8, 7.6, 11.5, 15.1 cm. The inductances of these various sections, measured in microhenrys, were 31.5, 94.6, 172, 258. It was decided to study more in detail the relation between the length of the sections and their inductance, and since the methods used are applicable in a wide variety of cases, we shall consider them quite fully.

Section 26. ON THE DETERMINATION OF THE RELATION BETWEEN TWO QUANTITIES (for the case of an algebraic power relation).

Let us suppose that we have measured two quantities,  $x$  and  $y$ . These quantities depend on each other in such a way that when one is changed, the other is changed also. Thus, one may be the *capacity* of a parallel plate condenser and the other the *distance* between the plates; or one may be the *effective resistance* of a wire and the other the *frequency* at which that resistance is measured. Or, as in the case we are considering, one may be the *inductance* of a cylindrical coil and the

other the *length* of the coil. What is desired is the exact algebraic relation between them. Unfortunately, unless this relation is of a very simple form it is very difficult to determine it, and about all that can be done is to note to what extent the relation between the quantities under consideration differs from certain standard algebraic forms. This will be the case with the relation between the inductance of a coil and its length, for the relation in that case can be shown to be a very complicated one.

As is well known, the inductance of solenoids is proportional to the square of the length of the coil, provided that the length is *very great* in comparison with the diameter of the coil. If the length and diameter of the coil are not widely different, the square law is not accurate, and the smaller the length of the coil compared with the diameter, the less accurate it is. Let  $L$  be the inductance of any portion of the coil, and  $s$  its length. Then, if  $L$  varies as  $s^2$ ,  $L/s^2$  must be a constant for all values of  $L$  and corresponding values of  $s$ . We shall test this for the coil we have just measured.

| $s$  | $L$   | $L/s^2$ |
|------|-------|---------|
| 3.8  | 31.5  | 2.18    |
| 7.6  | 94.6  | 1.64    |
| 11.5 | 172.0 | 1.30    |
| 15.1 | 258.0 | 1.13    |

Here  $s$  has been expressed in cm., and  $L$  in microhenrys. On examination of the columns  $L/s^2$ , it will be seen that it is not constant, so that for these short coils, the inductance does not vary as the square of the length. However, the differences between the successive values of  $L/s^2$  are 0.54, 0.34, and 0.17. It will be seen that these differences are rapidly diminishing; that is to say, that  $L/s^2$  is approaching a constant value as  $s$  is increased. Our original statement, that for long coils the inductance varies as the square of the length is thus verified, and the deviation from this law for short coils is also clearly indicated.

The method just shown for determining the law connecting  $L$  and  $s$  suffers from the drawback that if we do not know in advance from theoretical considerations that the inductance depends on the

square or some other definite power of the length, we should be at a loss as to how to proceed. This defect is in large part remedied by the following logarithmic method, which applies broadly to every case where one quantity varies directly as some definite power of another quantity, and that power is to be determined.

Let the quantities be  $x$  and  $y$ , and suppose that

$$y = m x^n$$

where  $m$  and  $n$  are constants. From this equation we have,

$$\log y = \log m + n \log x \quad (75)$$

or

$$\frac{\log y - \log m}{\log x} = n, \quad (75)$$

which is a constant.

Consequently, we may determine  $n$  as a constant, if the relation between  $x$  and  $y$  is the one stated. Suppose that we take for our unit of measurement of  $x$  a quantity such that the first (and smallest) value of  $y$  corresponds to it. Then, since the first value of  $y$  corresponds to a value unity of  $x$ , we have, from equation (75),

$$\log y_1 = \log m \quad (77)$$

where  $y_1$  is the first value of  $y$ . This follows because the logarithm of unity is zero. Calling  $x_1$  the first value of  $x$ , we compile the following table in any given case:

| $y$   | $x$   | $(x/x_1) = X$ | $\log y \log X$ | $\frac{\log y - \log m}{\log X}$ |
|-------|-------|---------------|-----------------|----------------------------------|
| $y_1$ | $x_1$ | 1             | $\log m$ 0      | Indeterminate                    |
| ...   | ..    | .....         | ... ..          | $n$                              |
| ...   | ..    | .....         | ... ..          | $n$                              |
|       |       | etc.          |                 |                                  |

If we apply this to the case of the coil we have been considering, taking  $L$  for  $y$ , and  $s$  for  $x$ , we obtain the following table:

| $L$   | $s$  | $(s/s_1) = S$ | $\log L$ | $\log S$ | $\frac{\log L - \log m = n}{\log S}$ |
|-------|------|---------------|----------|----------|--------------------------------------|
| 31.5  | 3.8  | 1.00          | 1.498    | 0.000    | .....                                |
| 94.6  | 7.6  | 2.00          | 1.976    | 0.301    | 1.59                                 |
| 172.0 | 11.5 | 3.03          | 2.236    | 0.481    | 1.53                                 |
| 258.0 | 15.1 | 3.97          | 2.412    | 0.599    | 1.51                                 |

The conclusions to be drawn from the values of  $n$  in the last column of this table are identical with those obtained from the first table.

If the relation between the quantities under consideration is more complicated, some assistance can usually be obtained from a knowledge of the standard curve forms and their corresponding function relations as studied in Analytic Geometry. In general, however, except in the simple case just considered, the task of discovering the relation involved between two sets of observations is an extremely difficult one.

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

### A CHAIN BETWEEN ENGLAND AND MANXLAND

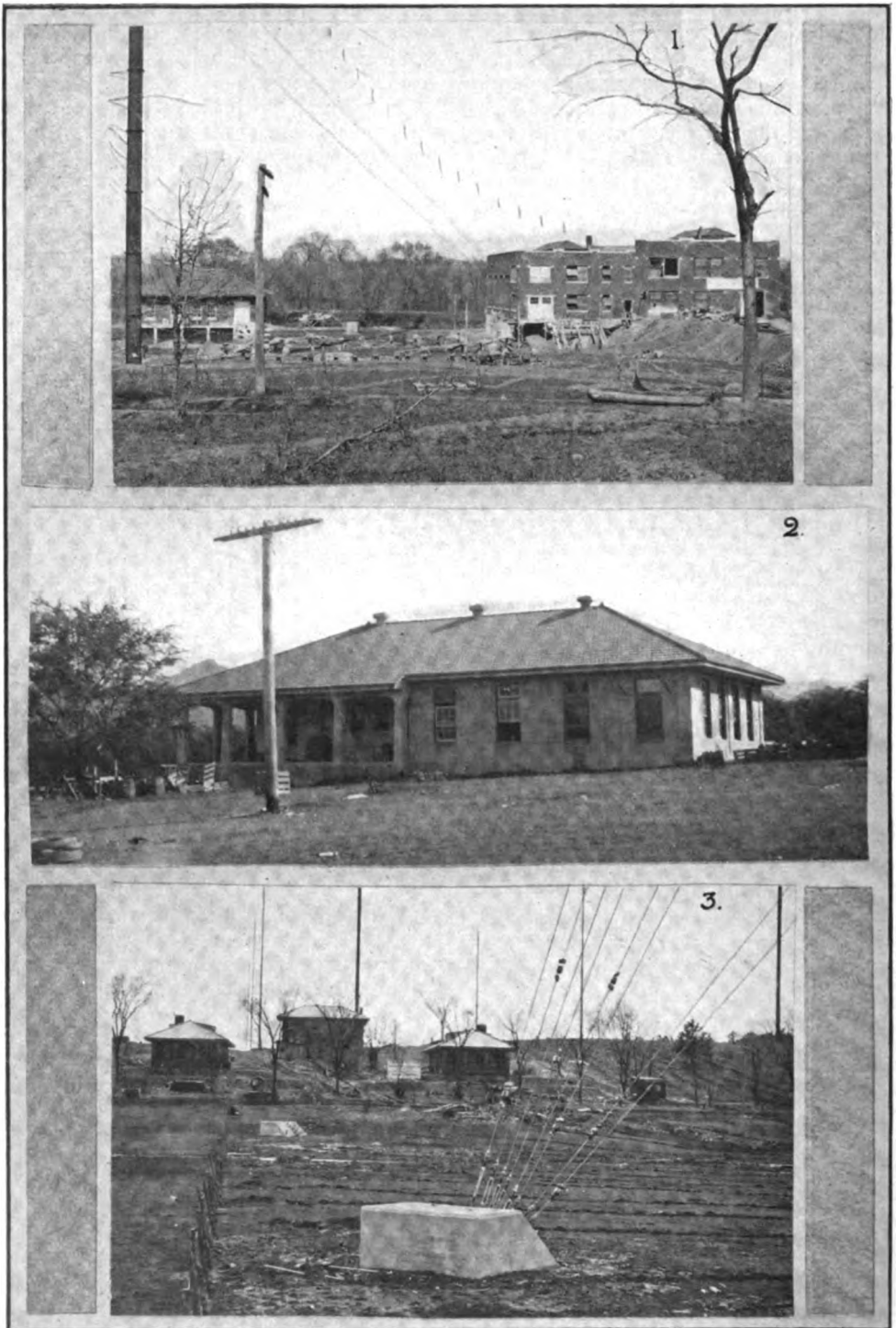
An English newspaper declares that wireless telegraphy between England and Manxland is assuming tangible shape, Lord Raglan having declared that telephonic communication was practically financially prohibitive. Lifelong experienced maritime captains and globe-trotters interviewed emphasized the comparative security and unique importance of insular wireless installations.

### AMATEUR PENALIZED FOR VIOLATING THE LAW

A wireless amateur of Los Angeles was reported to the United States Attorney for operating his station without a license and causing interference, being a violation of section one of the Act of August 13, 1912, to regulate radio communication, for which a penalty of \$500 is provided and the apparatus may be confiscated, in the discretion of the court.

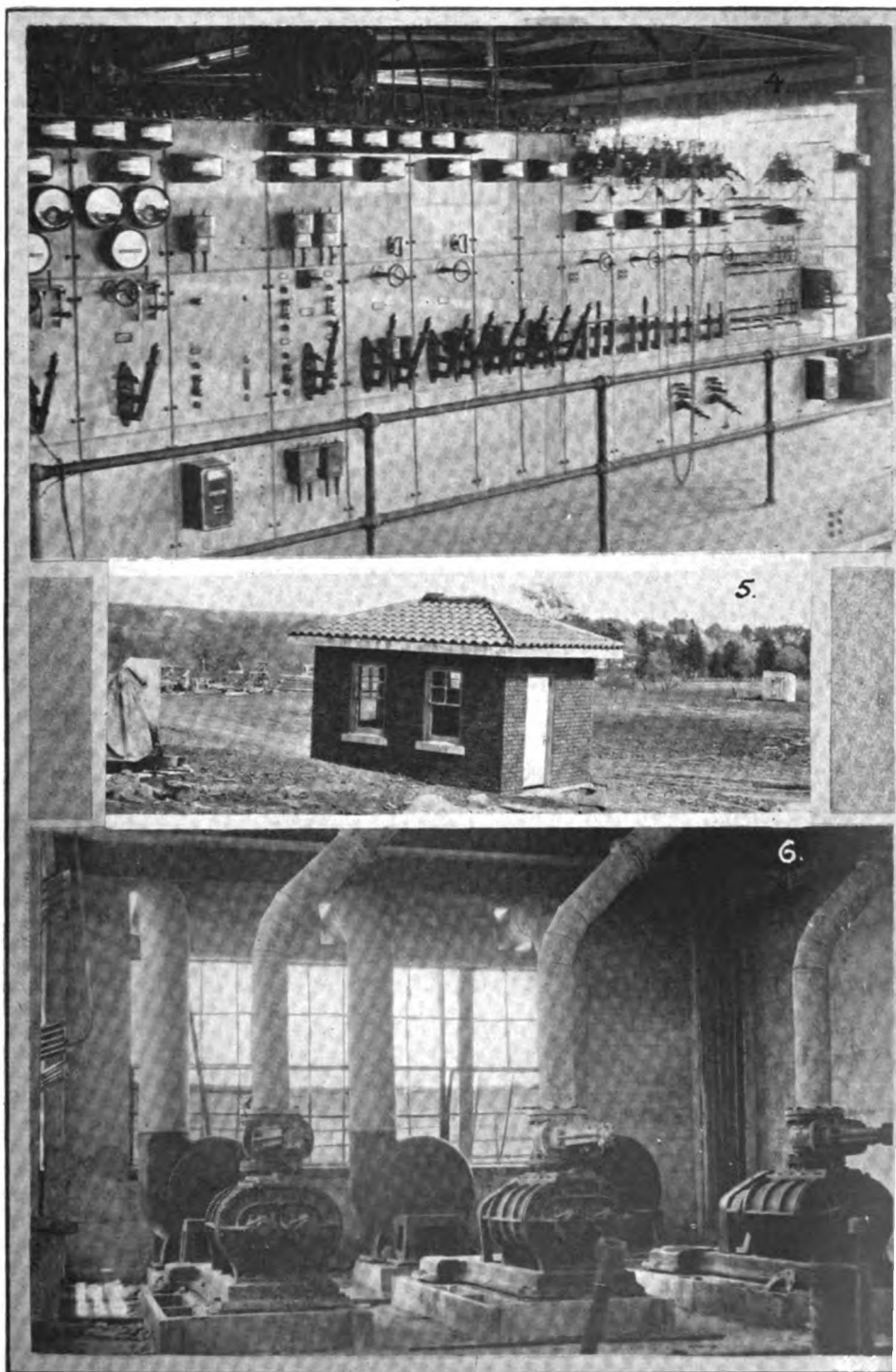
Judge Wellborn of Los Angeles, in passing sentence upon the offender, stated that as this was the first prosecution under the law in his district, he would assess only a nominal fine, with the understanding that all future prosecutions under this Act would be dealt with summarily, and the punishment materially increased. In view of the fact that the offender had disposed of his apparatus shortly before his indictment, the judgment did not include the confiscation provided by law.

# As the Marconi Trans-Oceanic



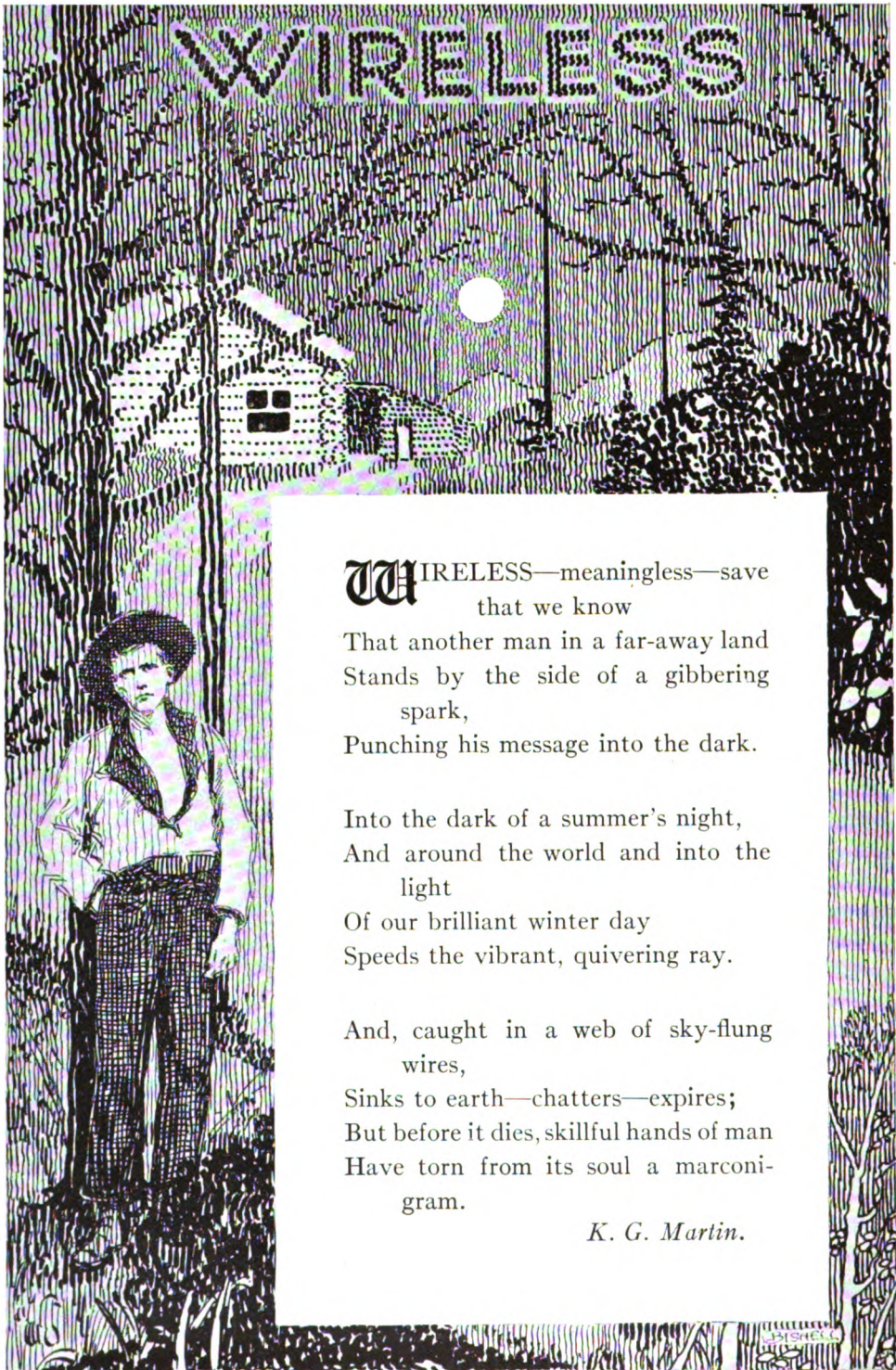
(1) View of the auxiliary operating building and power house at New Brunswick. (2) Where the messages will be received at Honolulu. (3) General view of the living quarters at New Brunswick, with a view of some of the masts.

## Stations near Completion



(4) An interesting view of the switchboard at the New Brunswick station. (5) A typical pu house, illustrating how carefully the architectural features of the buildings are carried through. (6) Interior of the Honolulu power house, showing the blowers.





**W**IRELESS—meaningless—save  
that we know

That another man in a far-away land  
Stands by the side of a gibbering  
spark,  
Punching his message into the dark.

Into the dark of a summer's night,  
And around the world and into the  
light  
Of our brilliant winter day  
Speeds the vibrant, quivering ray.

And, caught in a web of sky-flung  
wires,  
Sinks to earth—chatters—expires;  
But before it dies, skillful hands of man  
Have torn from its soul a marconi-  
gram.

*K. G. Martin.*

# The British Wireless Chain— Particulars of Stations

**I**N the course of a paper on wireless telegraphy read before the North East Coast Institution of Engineers and Ship-builders, England, in which the subject was covered generally and a comparison of different systems made, H. Fothergil recently gave the following details of the stations which will form the British imperial wireless chain:

Six high power Marconi stations are to be erected. One station in England for signaling in the direction of Egypt; a station in Egypt for communication in three directions—India, East Africa and England; a station in East African Protectorate for communication in two directions—Egypt and South Africa—a station in the Union of South Africa for communication in the direction of East Africa; a station in India for communication in two directions—East Africa and Singapore; and a station in Singapore for communication in two directions, namely, India and Australia, where the erection of another high power station is receiving consideration. The station will be operated on the high speed automatic system, and will be worked duplex.

The wave-lengths of all stations will be as great as possible within the limits of 15,000 and 50,000 feet (consistent with keeping the capacity, inductance and size of the aerials within reasonable limits) in order to insure reliability of reception at all times of the day and night; but the wave-lengths transmitted from any one station will be in all cases at least 25% different from those transmitted from other stations within its normal range, and with which it has to communicate. In all cases there will be a difference of five per cent between the wave-lengths emitted from any one station in order that each corresponding receiving station with which this station has to communicate may be able to tune out the waves emitted by the said station for the other station or stations with which it is also communicating. Where a station is required to communicate in more than one direction a separate transmitting aerial and a separate receiving aerial will be

provided for each direction. The note of each station will be different from those of any other stations within its range, but the notes of each transmitting circuit in any one station will be identical.

The power plant at each station will be in duplicate, and will include two water-tube boilers, each capable of generating sufficient steam for the whole requirements of any one transmitting circuit. In the case of a station required to send in two directions three boilers will be provided; and in the case of the station in Egypt, which is required to transmit in three directions at the same time, four boilers will be provided. The boilers will supply steam to turbines directly coupled to alternating-current generators which in turn will be coupled to revolving-disk dischargers. The total power including spares and auxiliaries at the terminal stations will be approximately 1,300 horsepower and the power at the intermediate stations will vary from 1,900 horsepower to 25,000 horsepower. Two auxiliary sets will be provided at every station, each consisting of a turbine coupled to a direct-current generator for supplying exciting current to the alternators and current for lighting and other auxiliary purposes.

The transmitting aerials will be of the multiwire directional type and will consist of a number of horizontal parallel wires supported 300 feet high by 10 masts, each wire being composed of seven strands of No. 19 S. W. G. silicon-bronze wire and brought down at one end to the transmitting station. The masts will be of the sectional-steel tubular type, the aerial wires passing through insulators attached to triatics stretched between pairs of masts, each mast being capable of withstanding a permanent horizontal strain of not less than two tons at the head of the mast, in addition to windage calculated at the rate of 30 pounds per effective square foot. The center line through the horizontal portion of the aerial will coincide with the line of direction of the station with which it is desired to communicate, the free or

elevated end of the aerial pointing directly away from the communicating station. The size of the aerials in each case will depend upon the length of wave emitted, but in no case will the length of each aerial be less than one-twelfth of the wave-length that the aerial is required to radiate.

The ground system will consist of a series of galvanized-iron plates buried in a symmetrical position relatively to the station house and connected to it by a system of radial conductors of galvanized wire leading to each plate from another set of plates buried around the station building.

Each transmitting circuit at each station will be provided with five transformers and a condenser consisting of about 500 cells. The high-frequency transformer for each circuit will comprise a multistranded primary conductor forming part of the oscillatory circuit, and a secondary winding connected to the radiating circuit and consisting of a special solenoid of similar cable to the primary winding but of smaller size. These primary and secondary windings will be entirely separate and arranged to be moved away from each other so that the coupling of the two circuits may be varied. The disk discharger in the oscillatory circuit will consist of a studded wheel, the number of studs corresponding to the number of the alternator poles, so that the condenser can be discharged at the moment of maximum amplitude in each alternation of the current. The two side electrodes, between which the moving studs pass, are of special construction and consist of slowly revolving disks so as continually to present a cool surface for the discharge.

The receiving and operating stations will be less than 10 miles distant from the transmitting stations, and will be provided with balancing aerials so as to prevent interference by the waves radiated from an adjoining transmitting station. The receiving aerials will consist of one or more silicon-bronze stranded conductors about 8,000 feet long and arranged similarly to the wires of the transmitting aerials. The operating room will be fitted with Morse hand keys and Wheatstone or other automatic transmitters of similar type. These will be connected by means of wires to the transmitting

station which will be operated from the receiving station.

### A NAVAL OPERATOR'S NERVE

Astride one of the huge antennæ of the big naval wireless station at Arlington, Va., this young man appears very much at ease, although he is suspended some 450 feet above the earth.

The rope on which he has chosen this lofty seat is of stranded wire, hardly over an inch thick, and the insulator upon which he sits, apparently quite comfort-



*Comfortably seated on the Arlington aerial*

able, is twelve inches in diameter of porcelain.

The extraordinary nerve required to climb down from the tower top, over the small rope and swing to a sitting position can easily be appreciated. This, after over four hundred steps had been ascended to reach the tower top.

A view of the Potomac River and the Washington monument can be seen in the background, and to the extreme left of the picture a glimpse of the Arlington National cemetery.



# OPERATORS' INSTRUCTION

## CHAPTER IX

### MARCONI RECEIVER TYPE No. 101

**T**HE 101 Receiver consists of an inductively coupled transformer with two solid rectifier detectors and the necessary accessory apparatus mounted on a hard rubber panel and enclosed in a mahogany case. The front elevation of this receiving set is shown in Fig. 29, the rear elevation in Fig. 30, and the circuit diagram on drawing, Fig. 31.

The aerial is connected to the binding post marked "Antenna," and the ground

purpose of the three other primary switches is to vary the number of turns of inductance in the circuit.

The secondary circuit contains the transformer secondary coil whose inductance is varied by the transformer secondary switch, the secondary condenser, the cerusite and the carborundum detectors, the switch for connecting either of these two in circuit, the potentiometer and the switch marked "Send," "Receive."

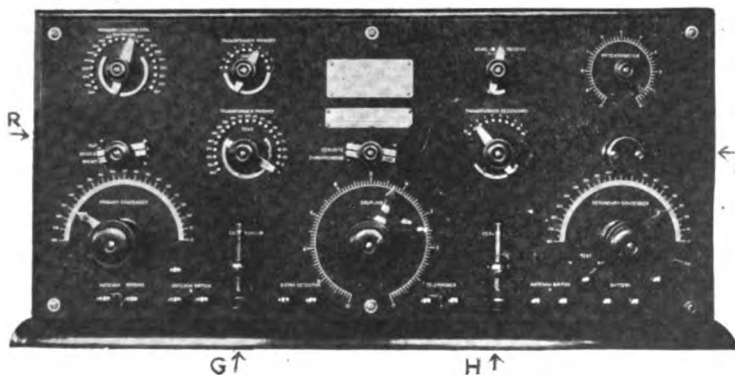


Fig. 29

connection is made to binding post marked "Ground." The circuit between these two points is adjusted to resonance with the incoming signal by variation of the two transformer primary switches, the primary loading coil switch, the primary condenser, and the primary condenser switch, which is marked "Out," "Series," "Shunt." The purpose of this switch is to connect the primary condenser in series or in parallel to the aerial or to disconnect the condenser entirely. The

The transformer secondary coil is moved in or out of the transformer primary coil by means of the handle marked "Coupling." The capacity of the secondary condenser is varied by the rotation of its handle and the potential across the carborundum detector is varied by the rotation of the potentiometer handle.

Supplied with this set is a mahogany box containing four dry cells, having three binding posts marked "1," "2," and "3." Numbers 1 and 2 connect to

the two binding posts on the receiver immediately under the word "Battery," while Number 3 is connected to the post at the extreme right on the same level with "Test" switch. This post connects the battery to the test buzzer circuit.

Since the detectors work better with the battery current flowing in one direction than in the other, it is necessary to determine experimentally which binding post to connect to the carbon and which to the zinc electrode.

The head telephones are connected to binding posts marked "TELEPHONES." The binding posts marked "ANTENNA SWITCH A-Posts 1 and 2" and "ANTENNA SWITCH B & C, Posts 1, 2

Since the satisfactory operation of the set depends to a great extent on the switch blades making perfect connection with the switch studs, it is necessary to see that there is always a good, firm pressure between them. If for any reason this pressure becomes too weak, remove the screw in the handle, take off the handle and remove the two screws holding the switch blades in place. The blades can then be bent slightly so that when replaced they will make positive contact.

Having connected the receiver in accordance with the instructions and drawings, the method of adjustment and operation is as follows:

Set the Primary Condenser Switch to

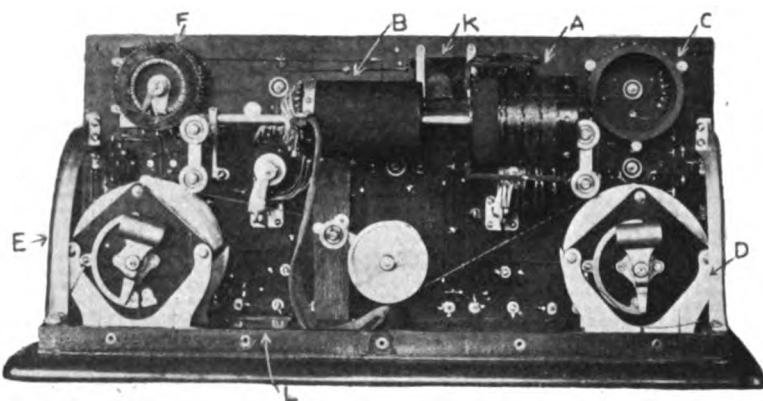


Fig. 30

& 3" are connected to points on Navy antenna switch. When the Navy switch is not used Posts A<sub>1</sub> & A<sub>2</sub>; B<sub>2</sub> & B<sub>3</sub>; C<sub>1</sub> & C<sub>2</sub>; and B<sub>3</sub> & B<sub>1</sub> are short-circuited with pieces of thick copper wire. The posts marked "Extra Detector" are for connection with an outside detector. If outside detector requires battery, place detector switch in position marked "Carborundum," if not place it in position, marked "Cerussite." Access to the interior of the set may be had by removing the three upper screws in the panel and the screws in the case along the lower edge of the back and sides. The case can then be lifted off, exposing the coils and wiring, which permits the location and repair of any trouble. The test buzzer is mounted within the metal cap directly over the secondary condenser and can be adjusted if necessary by removing the two cap screws.

position "Out," place coupling pointer at about 7 on the scale, Detector Switch to "Cerussite," Secondary condenser pointer to position "Out," Potentiometer to O, "Send" and "Receive" Switch to "Receive" (if used with Navy switch or break system relay, leave in "Send" position always), turn test switch to "In" position, which starts the buzzer, adjust Cerussite Detector point on crystal surface until loudest response is heard. This crystal requires very light pressure for maximum sensitiveness and the point may be screwed up or down by turning the hard rubber knob to left or right. Having found a sensitive point on the crystal, vary the inductance of the two primary transformer switches until the desired signal is heard, then loosen the coupling by rotating coupling handle to the right until the signal is just audible, then try other points of transformer secondary

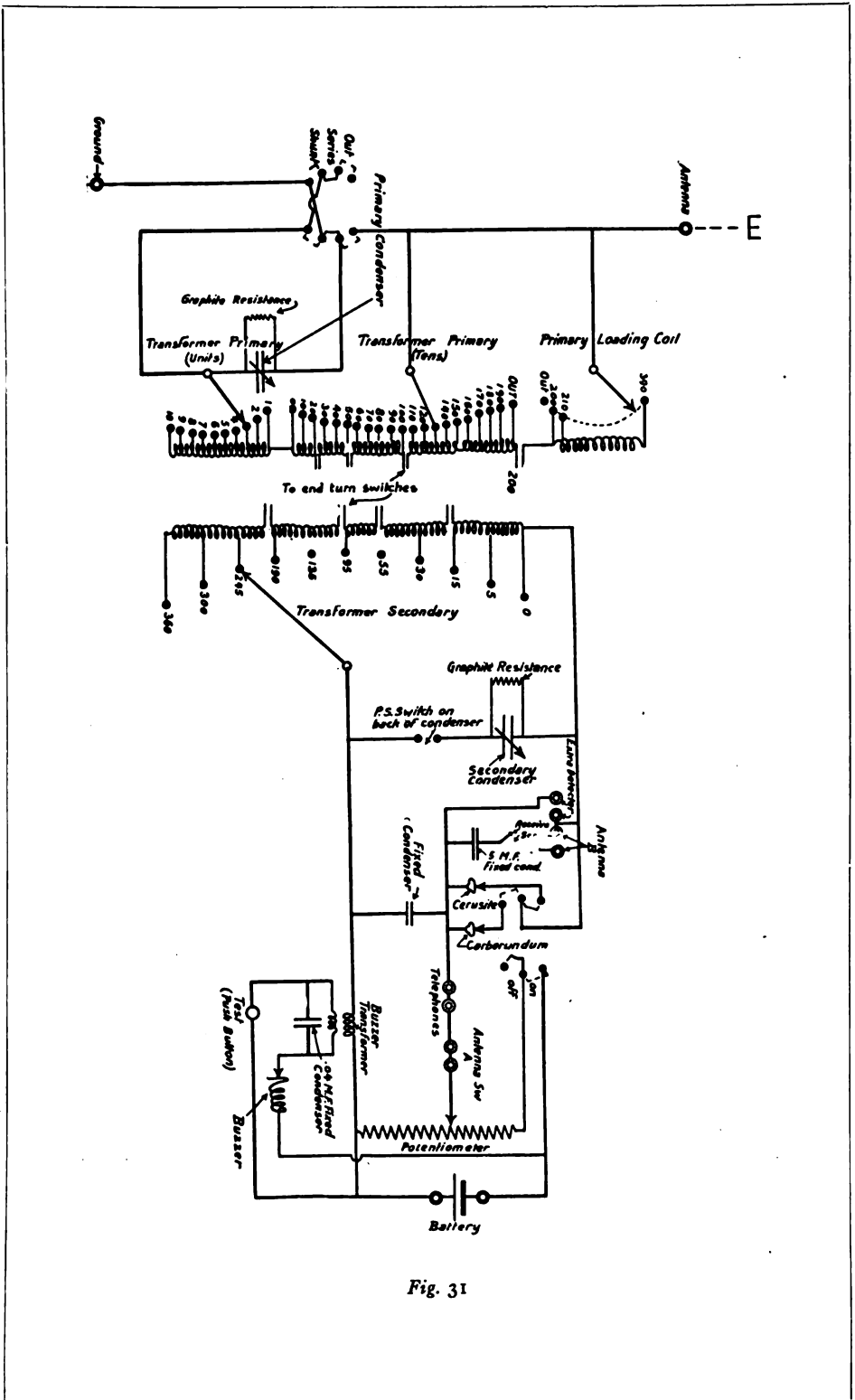


Fig. 31

switch and rotate secondary condenser handle to the left until a combination is found which gives maximum response. The Primary should then be readjusted more accurately until the best setting is found and the coupling then adjusted until the maximum strength of signal is obtained. The longer the wave-length the greater the number of turns of inductance necessary in primary and secondary circuits. If more inductance is necessary for a particular signal and cannot be obtained by adjustment of transformer primary switch, place this in position marked "Out" and rotate the primary loading coil switch from its position "Out" until sufficient turns are in the circuit. If the wave-length to be received is shorter than can be reached with primary condenser switch in the Out position, place it in the series position, set the ten turn transformer primary switch at 0, the unit turn transformer primary switch at 10 and rotate primary condenser handle until maximum response is obtained. Placing the primary condenser switch in the "SHUNT" position increases the wave-length of the aerial circuit corresponding to any given setting of the inductance switches. This may be done at any time instead of increasing the inductance. Generally speaking, the method of varying inductance is preferable and gives a louder response, but in exceptional cases a reverse is true and in any particular case a trial of the two methods can be made to find out which is the better. The best secondary setting for maximum response to any particular wave-length is with the maximum inductance and minimum capacity, but the greatest selectivity will be obtained with smaller inductance and greater capacity. When using the Carborundum Detector it will be necessary to adjust the Potentiometer to a point which gives the greatest sensitiveness. This latter detector, while considerably less sensitive than the Cerusite, is very permanent in its adjustment and not easily disturbed by static, loud signals or mechanical vibrations. It should be noted that when using the Cerusite detector on very weak signals the Potentiometer should always be in zero position, but that on signals of moderate intensity it does not matter particularly what position this may happen to be in. In order that the operator

may be able to measure approximately the wave-length of the incoming signals calibrations of the secondary are given with each tuner, it being understood that these are correct only when the secondary is coupled very loosely to the primary.

With the 101 receiver are supplied adjustable head telephones which are tuned to the group frequency of the transmitter. Also the electrical circuit through the telephones and the stopping condenser is tuned to the same group frequency.

It is advisable occasionally to insert a piece of paper between the spark points of the antenna and ground binding posts and telephone binding posts to make sure they are not short-circuited.

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### CLASSIFICATION OF SHIP STATIONS

The Bureau of Navigation has announced that the classification of vessels as given in the "Regulations for Radio Apparatus and Operators on Steamers," edition of July 1, page 8, paragraph 7, and "Regulations Governing Radio Communication," edition of July 1, page 5, "B," "Ship Stations," have been amended to read:

First Class—Vessels having a continuous service.

There shall be placed in the First Class vessels which are intended to carry 25 or more passengers—

(1) If they have an average speed in service of 15 knots or more;

(2) If they have average speed in service of more than 13 knots, but only subject to the twofold condition that they have on board 200 persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than 500 sea miles between any two consecutive ports.

Second Class—Vessels having a service of limited duration.

There shall be placed in the Second Class all vessels which are intended to carry 25 or more passengers, if they are not, for other reasons, placed in the First Class.

Third Class—Vessels which have no fixed periods of service.

All vessels which are placed neither in the First nor in the Second Class shall be placed in the Third Class.



*A glimpse of a street scene in picturesque La Paz. The difficulties of establishing communication between that city and other sections of Bolivia were taken into account when wireless telegraphy was considered as a means of linking the divided areas of the country*

## Portable Station Tests in Bolivia

**I**T seems fitting that wireless telegraphy (the realization of one man's dream) should have a place in the foreground in Bolivia—a country of dreams and romance. From La Paz, lying on the side of a lake, to the smiling confines of Riberalta or Santa Cruz; from the high wastes where the royal condor sits in solitude to the green plains where the streamlets are the arms of the sea, the whole land is one vast realm of fancy.

But it is this wealth of vegetation, holding untold riches, that is the real barrier to the development of nearly all of Bolivia. It cuts the country in two and makes communication between the north and the south well-nigh impos-

sible. Wireless telegraphy was called into service to overcome the obstacles due to this extravagance of nature.

The adoption of some means for linking up the divided areas of Bolivia was a matter of grave concern to the government of that country. It is necessary for travelers from La Paz to Riberalta to take to the river courses, and a two months' trip down stream means one of four or five months on the return, for the term river does not properly describe the pouring waters which better deserve to be called torrents; even then their great waves and vast expanse make such a description inadequate. Imagine a large river leaping from cascades into

rapids and from rapids into cascades and you will have a clear idea of one of these "streams" in Bolivia.

Trips on the torrents are made in "boats" fashioned from creepers pressed one against the other to form two huge bundles, which are joined by a little flooring of frail planks and make a primitive sort of raft. Occupants of the raft may well pray to be in the good graces of the helmsman when it leaps the sixty-mile-an-hour rapids. It goes hard with those who strike a rock; the crocodiles alone can tell the fate of these unfortunates.

Such a hazardous and necessarily slow means of communication makes the exchange of messages between the north and south extremely rare, while the impossibility of laying a single telegraph line in the forests is a foregone conclusion to all who know the country. As the most satisfactory solution of the problem, the utilization of Marconi's invention suggested itself to General Ismael Montes, the president of Bolivia. Experiments were commenced at once, but before a great deal could be accomplished, General Montes' presidential term expired, and his successor was occupied with other urgent matters.

The question was brought up again later, however, and the Marconi Company, unwilling to plunge into a venture without first submitting a proposal to the Bolivian Government, decided to send out two portable installations, the test performances of which would furnish information of material value in the construction of a general wireless network. Many tests were made with the two portable stations, some of the most interesting of which took place during the military maneuvers of 1911. The following account of the experiments were related by a man who witnessed them at close range:

"Leaving La Paz we set out. There is trouble ahead of us. For the first time in their lives, the mules are saddled with European pack saddles with all their impeding leathers. They start by rolling on the ground, and then, finding it unwise to rebel further, they accept their lot and away we go.

"After three hours' climbing on a ten per cent grade from the hollow in which lies La Paz, we reach the summit, 13,000

feet above the city, where the wind blows hurricanes. The thirty miles of the first stages of the journey are covered in seven hours; the little Bolivian soldiers, scarcely five feet high, swing along joyously, each carrying, in addition to his equipment, a tent and food for about ten days' maneuvers, for one must not reckon on a well-ordered commissariat in this great country where villages exist only every fifty miles or so.

"We halt at last, a little tired by this first journey. But we are happy and await impatiently the first experiments, just a little impatient of what this sandy and stony waste holds for us.

"The second day sees us thirty-eight miles along the white road, gloomy and dejected, relieved only by the endless chatter of the soldiers who ask countless questions about a new piece of apparatus they are escorting. They are quiet, intelligent fellows, certainly little in touch with this new development, yet so eager to be instructed that it would show a churlish disposition to be angry with them. Reaching headquarters a little behind time, we find that the second wireless station has arrived by rail. Here we join forces. The members of my little company have stood the journey well. They are dusty, but fresh and ready for the maneuvers next day.

"Wireless station A is with the state major general; station B follows the Blue army. At 5 A. M. we are up for the first experiments and both stations are erected. Station B accompanies the Blues, but, to my intense dismay, no message comes through. Mounting a horse, I gallop to station A in order to find out the reason for its failure to communicate, and to my surprise, I discover that the soldiers have forgotten to couple the dynamos to the mast. This is soon remedied; A gets into touch with us, and all goes well. An order comes to take down B and follow the Blue army. I gallop back to B station.

"I am held up by an amiable joker who remarks that my way of sending messages is very effective, but not very original. That is because he has seen me galloping from one to the other and hasn't a shadow of doubt but that it was I who had carried the telegrams.

"In the evening we arrived at Chijta, seventeen miles from Patacamaya, the

headquarters of the state general. The bugle sounds for supper, and we have the first bite since morning. The mast is erected to receive orders.

"Nineteen minutes later communication is established. The night is splendid, the signals are very clear, and the orders are sent perfectly. My critic of the morning I remember with heart burnings; would that he were here so that he might be convinced that the marconigrams had not traveled by courier this time."

"On the following day we travel another twenty-five miles. At night communication is established. The battle starts and orders are received right to time. Again the mast comes down and we get on the move. Fifteen miles further on we set up the mast again; all goes well.

"'What! fresh orders?' 'Yes. You are supposed to have no more ammunition. Retire to cannonments at Sica-sica!' Another fifteen miles back. Down comes the mast again and away we go. But what a journey! It is midnight. A lashing rain, and the world black as

the pit. We have to put up the mast again. It is quite evident we cannot communicate forty-two miles in the tempest, and how are we to set up the station in the dark and in the middle of a town?"

"We find a street a little further on and set up the mast by a sort of instinct. When all is ready along comes a courier at a gallop, collides with the stays, and down comes the mast.

"At last we are ready again. The spark is clear. Listen a moment. There! We have got into touch, and the wireless messages come, the signals being clearly distinguishable from the muttered rumbling of the storm. The rain is still pouring in torrents.

"'Hurry this 140-word wireless message to the general and we can get a little sleep at last.' It is 2 A. M. and in what state do I sleep?—in the room of a real general! Forty minutes later I have the satisfaction of seeing a courier arrive with a telegram which has come by wire; it is a copy of the one which came by wireless. What a success—forty minutes ahead of the wire! The



*This photograph shows a group of llamas. These animals are used on occasions to carry messengers, and are also employed for the transportation of freight*

next day I make an inspection of the mast and am amazed that we have been able to receive messages. The two wires, for almost two-thirds of their length, are laid on a roof of zinc. What harmony between the antennæ and the circuit!

"And so every day for ten days, erecting and dismantling the station two or three times a day without the slightest mishap, everything going along splendidly.

"At last comes the hour of reward—the review. The Marconi Wireless Corps marches past with every eye upon them, the men smart, the motors glittering, the cases polished as if they had just come from the works instead of having traveled 350 miles on muleback through dust and mud, this way and that.

"The admiration of the officers who were called upon to give an account of the services which this apparatus would render in time of war was unbounded. There were congratulations from the president and two fine reports in the general orders from the general-in-chief, a German officer, and the general-in-chief of the Blue division, who declared that during the whole of the maneuvers the apparatus worked night and day without interruption.

"It was a triumph, for it must be borne in mind that the apparatus was worked for the first time by these soldiers, that the telegraphists borrowed from the cable office were new to it, and that the A station was directed by an engineer who had only seen a wireless apparatus for the first time a month before."

The tests were followed very closely by the Bolivian government, and there was a strong sentiment in favor of a Bolivian chain. At length the Marconi company obtained the contract for the construction of the main chain of high-power stations.

General Montes, who was chiefly responsible for bringing wireless telegraphy into Bolivia, served his country in the war with Chile, obtaining his commission after a few months' service. He was seventeen years old and a student of law at the University of La Paz when he decided to enlist. He remained in the service until he was made a captain. While he was in the army he continued his studies at the university.

## BELGIAN ROYAL DECREE

A royal decree concerning wireless telegraphy has been published in the *Moniteur*, the Belgian government publication. It is in part as follows:

"Throughout Belgian territory and aboard all Belgian vessels, any project whatever for the installation of radio-electric apparatus suitable to serve or likely to interfere with the transmission or reception of radio-telegraphic signals, or any project whatever for the modification of the position, composition or capacity of an installation already regularly authorized must be submitted to the Department for Marine and to the Administration for Posts and Telegraphs. The application for authorization must indicate the nature of the installation, the object of the exploitation, including so far as the radio-telegraphic stations aboard ship are concerned, a statement of the taxes, if such are levied; details of the apparatus and its manner of operation, length of the waves, hours of operation, and, in general, all information allowing a close study of the project.

"The installations not regularly authorized and which may have been in service before the present decree has come into force will enjoy no privilege whatever; the exploitation must be suspended forthwith and an application for authorization must be made in conformity with the stipulation of the decree.

"When entering Belgian territorial waters foreign vessels fitted with electric radio-telegraphic apparatus suitable to serve or to interfere with the transmission or reception of radio-telegraphic or radio-telephonic signals, must cease all communications with any stations other than the nearest state shore station. Foreign vessels must signal their presence to this shore station and must wait till this latter has authorized or allowed them to communicate with either this particular or any other shore station. Foreign vessels, which prior to their arrival in Belgian territorial waters have obtained from the competent Belgian minister a special permit to be used regularly, are exempt from these regulations. Neither do these regulations apply to distress signals, nor to answers to distress signals emanating from vessels.



### THE AGE OF COMMERCIAL OPERATORS

In view of the fact that following in the wake of every ocean disaster a flood of newspaper editorials score the officials of the merchant marine for having "boys" on board vessels serving as wireless operators, the recent determinations of the Bureau of Navigation are interesting.

As a basis of information the data given by the applicant at the time licenses were issued by the Secretary of Commerce was tabulated; the results show that of the first-grade operators 57 per cent were 21 years of age or older, while 83 per cent were 18 or older. Of the second-grade operators 49 per cent were 21 years of age or older, while 75 per cent were 18 or older. Of both grades 82 per cent were 18 years of age or older.

no reason why it should not be improved still further in detail and also extended to cover a wider range.

The club believes that the number of good amateur stations in the country is great enough to make it possible for an amateur to reach the far West and possibly the Mexican border, if the stations were organized. The only thing needed is to secure the names and addresses of the owners of stations able to transmit fifty to one hundred miles. If amateurs will write to Mr. Clarence D. Tuska, Secretary, Radio Club of Hartford, No. 136 Oakland Terrace, Hartford, Conn., blank forms will be supplied which when filled out will be used as a basis for appointing official relay stations.

This plan seems to be about the only one by which the amateur can reach distant points by wireless and without get-

| AGES                  | <i>First Grade Operators</i> | NUMBER |
|-----------------------|------------------------------|--------|
| 21 or older . . . . . |                              | 1197   |
| 20 . . . . .          |                              | 244    |
| 19 . . . . .          |                              | 293    |
| 18 . . . . .          |                              | 197    |
| 17 . . . . .          |                              | 119    |
| 16 . . . . .          |                              | 36     |
| 15 or under . . . . . |                              | 13     |

| AGES                  | <i>Second Grade Operators</i> | NUMBER |
|-----------------------|-------------------------------|--------|
| 21 or older . . . . . |                               | 120    |
| 20 . . . . .          |                               | 29     |
| 19 . . . . .          |                               | 38     |
| 18 . . . . .          |                               | 23     |
| 17 . . . . .          |                               | 18     |
| 16 . . . . .          |                               | 13     |
| 15 or under . . . . . |                               | 6      |

### COUNTRY-WIDE AMATEUR CHAIN

Hiram Percy Maxim is authority for the statement that The Radio Club of Hartford, Connecticut, of which he is chairman, has organized a committee whose object is to develop a system of relay stations throughout as much of the country as seems possible. At the present time messages are being forwarded by relay from Hartford, Conn., to Buffalo, N. Y., via Northampton, Mass., and one of several intermediate stations. This plan has worked so well that there seems

ting into difficulties with the United States Government. It is expected that messages will be received and transmitted by courtesy entirely and that no money will be involved in any way, the effort being to keep the plan strictly amateur in every sense.

\* \* \*

At a recent meeting of the Canadian Central Wireless Club with headquarters in Winnipeg, Harold E. Mott was elected president, E. A. Dunn vice president, and H. L. Pulford, Armstrong's Point, Winnipeg, Canada, Secretary and Treasurer.

# New Methods for the Production of Continuous Electric Oscillations and for their Utilization in Radio-Telegraphy\*

By GUGLIELMO MARCONI

IT may be said that from its beginning up to the present time practical radiotelegraphy has depended upon the utilization of discontinuous electric oscillations; that is, of successive groups of oscillations of unequal amplitude produced by the discharge of a condenser or Leyden jar.

As is well known, electric oscillations produced by the discharge of a condenser were first investigated by Henry and Lord Kelvin, afterwards studied mathematically by Clerk Maxwell, and finally verified experimentally by Hertz.

It is now well known that if two conductors at different potential be electrically connected together by means of a spark, if the resistance of the circuit be not too high, the potentials of the conductors only reach equality after a greater or lesser number of electrical oscillations. As a consequence of this the conductors become for a short time the seat of an alternating current which may be of extremely high frequency.

If one of the conductors be the earth and the other a vertical wire, we have the essential features of the system with which, in 1895, I initiated my experiments in wireless telegraphy. Successive improvements have increased the reliability and range of the apparatus. This is well shown by the development of wireless telegraphy which resulted from the syntonous coupling of the antenna to an oscillating circuit, as first described in my English patent of April, 1900, and in the lecture which I delivered before the London Society of Arts on May 15, 1901.

The damping or decrement of the oscillations generated in the way I have referred

to, and the interval of time separating the consecutive groups of oscillations (an interval necessitated by the relatively long time required to change the condensers) present certain difficulties in regard to wireless telegraphy, and still greater difficulties in the case of wireless telephony. For this reason many workers in this branch of science have been seeking a method for the production and radiation of continuous oscillations.

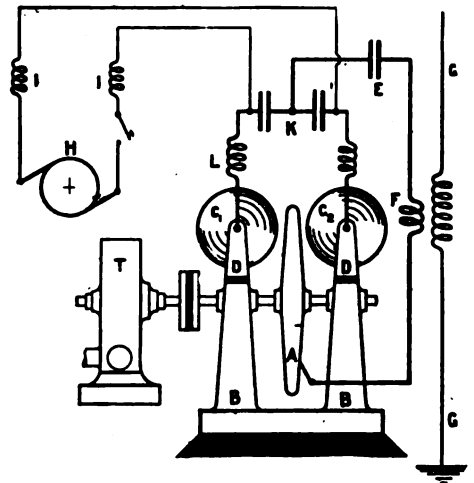


Fig. 1

There are two fairly well-known methods for the production of continuous waves. One is the so-called "Duddell Musical Arc," perfected by Poulsen; the other, the high frequency alternator typified in the Goldschmidt machine.

It is not my present intention to examine these two systems in detail, but I

\* Translation of a Communication made to the R. Accademia dei Lincei in Rome, on March 1, 1914.

shall only say that certain difficulties in working which have so far been an obstacle to their practical application exist in both systems.

The first arrangement by which I succeeded in producing continuous oscillations is described in my English patent of April 11, 1907 (Fig. 1). It consists of an insulated metallic disc, A, which is rotated at a very great velocity by means of a turbine or electric motor. Adjacent to the periphery of this main disc are placed two other discs,  $C_1$  and  $C_2$ , which are also rotated at a high rate of speed. These I will call side discs.

The two side discs are connected by means of brushes to the outside plates of two condensers, K, connected in series,

The working of the apparatus is probably as follows: Assuming that the generator, H, gradually charges the double condenser, K, and that the potential at the discs,  $C_1$  and  $C_2$ , becomes, say, positive at  $C_1$  and negative at  $C_2$ , then at a certain instant this potential causes a discharge across one of the small gaps, suppose the one between  $C_2$  and the main disc, A. This discharge will in turn produce an oscillation through the inductance, F, and the condenser, E, and this oscillation, on reversing, will naturally pass from the main disc, A, to the disc,  $C_1$ , the latter being already charged to an opposite potential. The charge of the condenser, E, will again reverse, acquiring energy at each reversal from the conden-

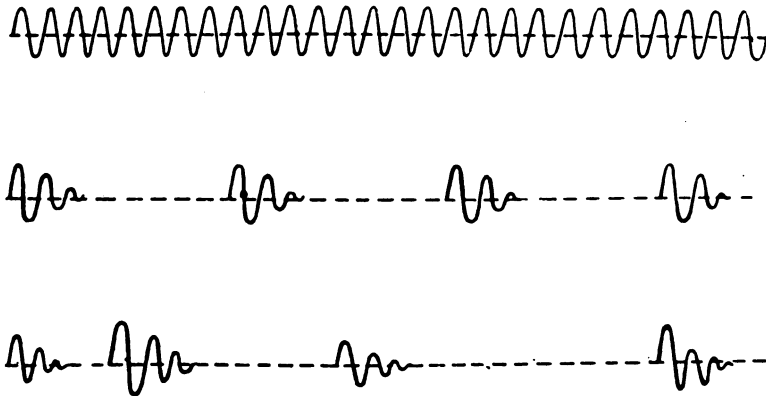


Fig. 2

and these condensers are in turn connected through resistances and inductances to the terminals of a high potential continuous current dynamo, H, or else to a high potential battery.

The main disc is connected to the inside plates of the two condensers, and forms part of an oscillating circuit consisting of the condenser, E, in series with the inductance, F, the latter being connected either directly or inductively to the aerial wire, G.

When the condensers are charged from a generator or a dynamo of sufficiently high potential, an electric discharge occurs between the side discs and the main disc (this discharge being neither a spark nor an ordinary arc), and continuous electrical oscillations are produced in the circuit, of a frequency depending upon the inductance and capacity of the circuit itself.

sers, K, which are kept charged by the generator, H.

This cycle can continue indefinitely; the losses which take place in the oscillating or radiating circuits being replaced by the generator, H.

If the main disc is stationary, an ordinary arc at once occurs across the gaps between the discs without any oscillations being produced.

This system has so far proved practicable for small powers, but has the disadvantage of not being quite reliable.

Another arrangement of mine for the production of continuous oscillations which is now being used for trans-Atlantic work, and with which unlimited power can be employed, is based on the principle of causing successive groups of oscillations, each generated by the discharge of a suitable oscillating circuit, to overlap each other in exact phase.

With the help of Fig. 2 I will try to explain my idea more clearly.

In the third line of this figure are shown groups of damped oscillations occurring at irregular intervals: in the second line are shown more frequent groups of oscillations occurring at equal intervals; and in the first line are shown continuous oscillations.

In the third line we have the condition which existed in the old spark systems, where the groups of oscillations followed each other at irregular intervals.

The close and regular groups of oscillations, which represent a very great step in the art of wireless telegraphy, are obtained by the employment of the apparatus illustrated in Fig. 3, which consists of an insulated metallic disc, *a*, having metallic studs fixed at regular intervals on its periphery, perpendicular to the plane of the disc. This disc is rotated at a high velocity between two other discs, *b b*, by means of a suitable motor. The studs of the central disc are of such length as almost to touch the two side discs, thus closing the circuit at regular intervals. This sudden closing of the circuit greatly diminishes the resistance of the spark, with a corresponding diminution in the damping of the wave; while the opening of the circuit, as soon as the studs of the central discs have passed the peripheries of the side discs, *b b*, stops any oscillations which may still exist in the condenser circuit. In this way, given a proper value of coupling between the condenser and radiator circuits, the energy of the condenser circuit passes entirely to the radiator without the occurrence of the usual reaction between the coupled circuits.

The advantage of this system lies in the radiation of regular groups of electric oscillations, the intervals between the groups being such as to produce in the receiver or in the telephone of the receiving apparatus a musical note which is easily distinguishable from the sounds and noises produced by the disturbances caused by atmospheric electricity.

The system of discontinuous waves to which I just now referred is that at present used in all the high-power stations erected by the Marconi company.

My idea in adopting the arrangements which I will now describe was to obtain groups of oscillations so close together and in such exact phase that their com-

bined effect on a resonant circuit should be to induce and maintain a high-frequency alternating current.

The system of continuous waves to which I now refer is based on the cumulative effect of a series of discharges, having the same period and in phase, acting inductively on a common radiator.

In fact, if we carefully consider the system shown in the second line of Fig. 2, it is clear that, if it were possible to bring the various groups of oscillations sufficiently close together, a continuous oscillation could be obtained; in the ordinary apparatus, however, two difficulties arise. The first difficulty is caused by the time

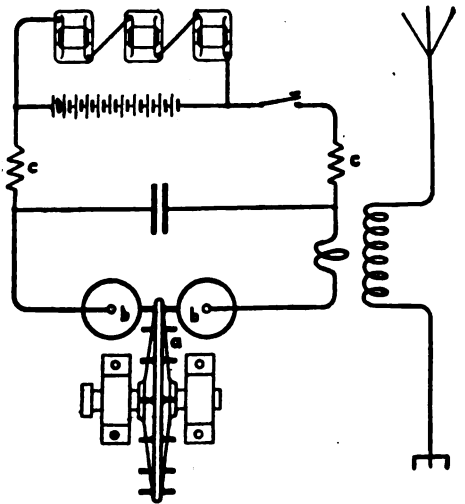


Fig. 3

required to charge the condenser, it being obvious that the condenser cannot be charged and discharged at the same time; and the second difficulty is due to the fact that the successive groups of oscillations must be in phase with each other as well as with the oscillations in the radiator.

Attempts to obtain rapidly succeeding groups, but without reference to their phase, have already been made by various workers in this field.

I believe that I have solved the problem by the use of the apparatus which I will describe with the aid of Fig. 4.

In this system are employed a number of oscillating circuits, 1, 2, 3, 4, charged from the same source of energy through respective inductances. Each discharge circuit includes a toothed metallic wheel,  $D_1, D_2, D_3, D_4$ , a condenser, and an induct-

ance coupled to the radiator or to an intermediate circuit which in this case is inductively connected to the radiator.

The toothed wheels are insulated from each other, but rigidly mounted on the same shaft, and so fixed that the condensers discharge and recharge in succession at regular intervals one after the other; so that at a given velocity the interval between the beginning of the discharge of one condenser and the beginning of the discharge of the next condenser is equal to the period of oscillation of the aerial or intermediate circuit, or else it may be an exact multiple of the said period of oscillation.

To make certain that the beginning of each discharge occur at precisely the right

stated in their official report, dated the 30th April, 1913, that my system—the system described above—was the only one which they had seen in successful operation over long distances.

It might be thought that the greatest velocity hitherto obtainable with revolving discs could not allow of a sufficiently high frequency for radio-telegraphic purposes; but this difficulty does not occur with stations working over distances of 4,000 kilometers or more, in which oscillations of a frequency higher than 50,000 periods cannot be usefully employed.

As long as it was considered necessary to employ waves of hundreds of thousands of periods such as are produced by the discharge of ordinary condensers, it

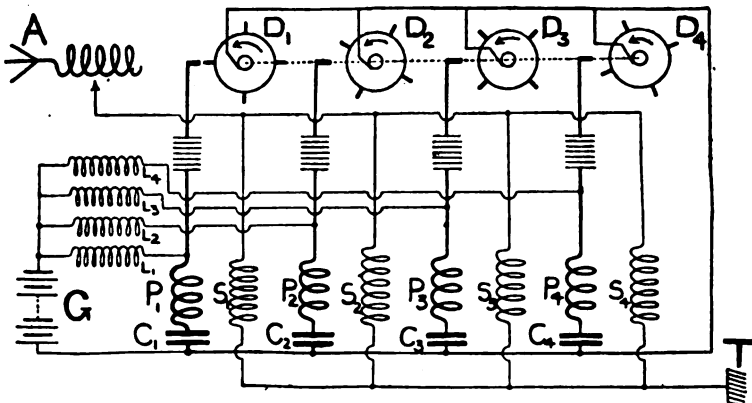


Fig. 4

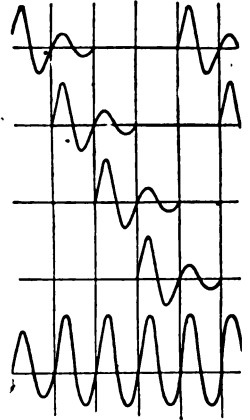


Fig. 5

moment the discharge circuit is provided with an auxiliary spark which is timed by means of another disc (omitted from the diagram); this spark is of greater potential than the main discharge, and is obtained by means of small auxiliary condensers.

The final effect of this system is shown in Fig. 5, where the oscillations produced in rotation by the 4 circuits and the resulting continuous oscillation induced in the aerial are indicated.

In regard to this system for the production of continuous waves, the Technical Committee appointed by the British Government to report on the merits of the existing systems of long-distance radio-telegraphy, and especially upon their capability for continuous communication over distances of 2,000 miles,

seemed hopeless to attempt to construct alternators or other machines capable of producing oscillations of so high a frequency.

Ten years ago it was generally thought that frequencies at least as high as 100,000 periods per second were necessary for radio-telegraphy. The experience which I have obtained in long-distance transmission has shown me that frequencies above 40,000 periods are considerably less effective than are lower frequencies. I have also noticed that, using the same amount of energy in each case, waves ten or more kilometers in length are propagated at considerably greater distances than are waves of one kilometer or less. This discovery has greatly facilitated and encouraged the investigation and construction of high-frequency alternators, as

well as the study of the other methods to which I have already referred.

In order better to illustrate the principle by which I have been able to join consecutively in phase a series of groups of oscillations so as to produce continuous oscillations, I will make a practical experiment, which I will explain with the assistance of the diagram shown in Fig. 6.

I cannot, however, show here an arrangement working in exactly the same way as that which I have already described, because no high potential continuous current is available.

Instead of the condensers charged to a high potential, I have here an inductance,

groups of oscillations would tend to interfere with and neutralize each other.

We shall now see how a lamp can be lighted by means of the oscillations induced in the circuit,  $L_2C$ , when such oscillations are in phase.

From this experiment it can also be seen: (1) That maximum and minimum values of current are obtained by varying the capacity of the condenser,  $C$ , within given limits—that is, by adjusting the electric period of the circuit while the velocity of the disc is kept constant; (2) further, that maximum and minimum values of current are obtained when the period of the circuit is kept constant while

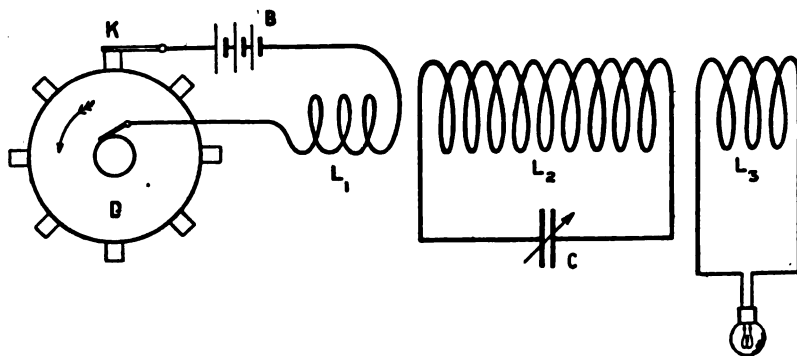


Fig. 6

$L_1$ , charged, if I may use the word, with a current furnished by a battery,  $B$ .

When the brush,  $K$ , makes contact with one tooth of the disc,  $D$ , a current passes through  $L_1$ , and when the contact is broken by the rotation of the disc the energy of the magnetic field of  $L_1$  is inductively transferred to the circuit,  $L_2C$ , causing the circuit,  $L_2C$ , to commence oscillating with the frequency of its own electrical period. If the velocity of the toothed disc,  $D$ , be so arranged that successive teeth make and break contact with the brush,  $K$ , in such a way that each group of oscillations be in phase with the preceding group of oscillations, then all these groups of oscillations, if sufficiently close, will act so as to add their effects together, producing continuous oscillations in the circuit,  $L_2C$ .

It is evident that the production of continuous oscillations can only occur when the velocity of the disc is such that all the oscillations produced in the circuit,  $L_2C$ , are in phase; otherwise the different

the velocity of the disc is varied within given limits.

[Experiment made here.]

The use which is now beginning to be made of continuous waves is not really owing, as some people seem to think, to special properties possessed by these waves whereby they ought to cover great distances with less expenditure of energy than that required by discontinuous waves, but is rather due to the desire to obtain in the receivers better syntonistic effects which would, firstly, reduce to a minimum the disturbances caused by atmospheric electricity; and, secondly, make it possible for a greater number of neighboring stations to work without interference.

In regard to the elimination of atmospheric disturbances, I have found in practice that accurate tuning and loose coupling between the circuits of the receiver do very little toward diminishing

the objectionable effects of these disturbances.

Electric waves due to nature, of which at present we have really very little knowledge, have the property of electrically impulsing the aerial systems of receivers, causing them to vibrate electrically to their own natural period, which is necessarily that of the wave which it is desired to receive.

The disturbing effect of these natural waves—commonly called X's by wireless operators—rapidly increases in intensity as the receiver is tuned to longer waves. In this may probably be found the explanation of the fact that long waves traverse great distances with smaller losses than do short waves.

easily distinguishable from the sounds produced by atmospheric disturbances. The ability to produce a clear and characteristic sound is of extreme importance, and I have not yet found any system which will give such reliable results as those in which a musical note is used.

The so-called X's generally consist of an electric impulse or of a short irregular succession of electrical impulses producing an instantaneous inductive effect, often of considerable intensity.

The sounds produced in the telephone of the receiver of the musical spark are caused by a very large number of small impulses following each other at short and regular intervals.

Modern receivers are so constructed

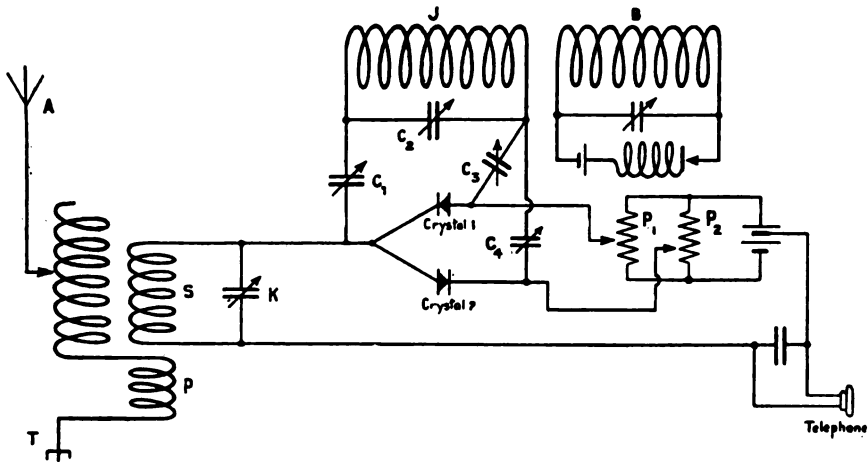


Fig. 7

The effect obtained in practice by weakening the coupling of the receivers is to cut down the signals in about the same proportion as the X's, and consequently little advantage is obtained thereby. Nevertheless, there is some difference between the waves produced by atmospheric discharges and those utilized for the transmission of radio-telegraphic signals; this difference allows the objectionable effects of the disturbing waves to be eliminated—at any rate, to some extent.

With discontinuous waves such as those produced by the disc system shown in Fig. 3, the succession of groups of waves produces in the telephone of the receiver a characteristic musical note, which is

as to take advantage of this difference between X's and signals; thus the objectionable effects of atmospheric disturbances are to a great extent eliminated.

In Fig. 7 is shown the receiver which has been used for more than two years in the trans-Atlantic stations. Here P is the primary of an oscillation transformer connected to the receiving aerial, and S is the secondary.

Nos. 1 and 2 are two sensitive crystals or Fleming valves, with their corresponding potentiometers, each adjusted for maximum sensitiveness, while the other is disconnected from the circuit, so that when both are connected together they produce opposite effects, and do not allow the passage of either signals or X's. It

is then found that if the potentiometer,  $P_2$ , be adjusted so that the opposing E.M.F. produced by  $P_2$  is only just sufficient to leave the crystal No. 2 in a non-conductive state while signals are being received, then the received oscillations will be efficiently detected by crystal No. 1, while the disturbances or signals of greater intensity will make the impulses of current from crystal No. 2 oppose those from crystal No. 1.

By making the resistance of No. 2 a little less than that of No. 1 even better results can be obtained.

Experience acquired in the use of continuous waves, especially when using auxiliary sparks, has suggested a new method of reception, which has been developed by Mr. H. J. Round. This method has been successfully employed for very long distances; it offers the advantage of using the principles employed for the reception of continuous waves, and of producing in the receiver a characteristic note dependent on the period of oscillation of the transmitted waves. The arrangement employed is simply a modification of my receiver which I have already described. The system of two opposing detectors which I invented is used with this arrangement.

These detectors are arranged so as to oppose their effects, but also in such manner that each can only receive signals if the latter be very strong. The crystals or detectors are then acted upon by a buzzer in a circuit, B, which emits a very short wave, with the result that for very short intervals of time the crystals become conductors.

In this way the energy stored up in the circuit, SK, is freed for very short intervals. It follows that if the groups of waves produced by the buzzer have a period slightly different from a sub-multiple of the period of the received waves, then the signals are received as a clear musical note.

In this manner, if the frequency of the received wave be 50,000 periods and the buzzer produce 4,900 groups per second, a discharge will take place through the telephone every ten oscillations. These discharges are stronger or weaker according as the short-wave groups coincide with the points maximum or minimum potential of the wave which is being received. The cumulative effect of these

discharges produces a note of 1,000 per second.

This method of reception is somewhat analogous to my system for the production of continuous waves which I have already described.

In my view, methods for the reception of continuous waves are now at the commencement of their development, and open up a new and large experimental field which promises to play a prominent part in the progress of wireless telegraphy and wireless telephony.

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### GREECE PURCHASES FOURTEEN FIELD STATIONS

Arrangements have been made for the Marconi Company to supply the Greek Government with fourteen field stations. Eight will be motor-car sets of  $1\frac{1}{2}$  K. W. power and the remainder will be special  $\frac{1}{2}$  K. W. pack sets with fifty-four foot masts.

The motor-car stations will be mounted on special lorry type chassis, and so arranged as to be entirely self-contained and suitable for use in rough country. Each chassis will be made with special clearances, fitted with solid tires and a 40 horsepower motor. The maximum range for each station will be approximately 250 miles, with a guaranteed minimum of 150. Eight men will be required to take charge of each of these motor-car stations, which when erected will cover some 1,300 square yards. The masts will be seventy feet high and the average height of the aerial fifty-six feet. The total weight of a motor-car station, including an estimated average weight for the personnel, will not be more than 7,600 lbs.

The pack stations are of a special type with fifty-four-foot masts, but the apparatus is so constructed that it can be carried easily on five horses. For these stations the maximum range is approximately eighty miles, and the guaranteed minimum fifty, with a total gross weight for each station of 969 pounds.

A commission of officers has been instructed by the Greek Government to visit the works at Chelmsford, in order to supervise the manufacture and mounting of the stations.



# New York to Philadelphia by Wireless Telephone

**W**IRELESS operators at Sandy Hook, Sea Gate and on ships leaving the harbor, together with scores of amateur wireless enthusiasts in Greater New York and along the Jersey coast, were mystified on the afternoon of May 13th by overhearing through their receivers the voice of Caruso singing. This was possible because the head piece receiver used in wireless telephony is similar in principle to that used in telegraphy.

Most of the delighted ones did not know to whom they were indebted for the canned solos of the great tenor, but it wasn't long before some of them found out that the concert was a part of a wireless telephone test made by the Marconi Wireless Telegraph Company at its station on the roof of the Wanamaker store in New York. Not only were the tenor's phonographic tones clearly heard by the operator at the wireless station at the Wanamaker store in Philadelphia but a commercial message, dealing with ordinary business of the day, was communicated by voice through the air for the first time from New York to Philadelphia.

Incidentally the Marconi people had a talk with the Southern Pacific steamship Antilles, which sailed at noon for New Orleans. At 4 o'clock a wireless was received from David Sarnoff, aboard the Antilles, saying that the telephonic operatic selections sent out from the Wanamaker station had been "received."

At twenty-five minutes to eight o'clock in the evening a cable message from Vera Cruz was telephoned by wireless to the Antilles and the ship's operator got it when the ship was about seventy-five miles off the Scotland lightship. He relayed it by wireless to the Marconi station at Cape May, from which point confirmation of its receipt was telephoned to the New York senders. The cable read as follows:

"The following cable has been received: Admiral Mayo reports that Tampico will fall by 9 o'clock to-night. The Federal gunboats Vera Cruz and Bravo are pulling

out of the river and going to sea, leaving Tampico to its fate. People are now leaving the city before its fall."

The tests were made by Frank A. Hart and H. Ernest Campbell of the engineering department of the Marconi company, Roland Crane, one of the company's wireless operators, was in charge of the station. The tests started soon after the Antilles started on her journey.

It wasn't long before wireless men waiting for ordinary marconigrams began to hear through their receivers the voice of Caruso and the sound of a man talking and counting slowly and deliberately. They knew of course that they were picking up wireless telephone tests and then they started to wireless around to find out at what station the experiments were being made. When the word got around that the Wanamaker store in New York was communicating by wireless telephone to the Philadelphia store, Messrs. Hart and Campbell began to receive inquiries by old-fashioned telephone as to what was going on.

There was sending only and no receiving in the experimenting in New York. After a message had been sent out the operator in the Philadelphia store would reply by wireless telegraphy that it had been received and then he would repeat what was said.

The operatic music was sent on its way to delight the ears of operators aboard ships by placing the trumpet of a phonograph close against the sender of the telephone apparatus.

The Marconi company recently received word from London saying that Mr. Marconi had completed his wireless telephone tests and that the apparatus was an entire success. The British company will now begin construction of sets for the Italian navy. They are guaranteed to maintain communication between ships over a distance of about thirty-two miles, although in practice they have been tried successfully over a much greater distance.



## The “Columbian”

*Thirteen members of  
the Columbian's crew, driven  
by the flames to take refuge in  
a lifeboat, were picked up by the  
steamship Franconia fifty hours afterward*

# The Marine Disaster of the Month

HOW wireless telegraphy saved the lives of some of the victims of flames which destroyed a ship at sea is graphically told in a marconigram sent by the captain of one of the rescuing vessels. He says that he “sighted a boat on the starboard bow,” and “being already prepared, the occupants were taken on board in a few minutes.” He concluded his message by saying, “Have marconied all ships to look out for two missing boats, and received replies from Manhattan, Haverford and Marengo.” That he had not used the wireless in vain was shown when, thirty-four hours after the rescue of those in the first boat, the Manhattan picked up more of the survivors.

The freighter *Columbian*, bound from Antwerp to New York, caught fire on May 3d, when she was about 300 miles south of Cape Race. The members of her crew were driven to take refuge in the lifeboats and fifteen perished.

Thirteen of the survivors were picked up by the steamship *Franconia* of the Cunard line fifty hours after they had been driven to the boats by a series of explosions of unknown origin. Among those taken aboard the *Franconia* was James Drohan, Marconi operator on the *Columbian*. It was feared that all the others had perished, for a long search by the *Franconia* failed to disclose any trace

of the other boats. Thirty-four hours after the rescue of those in the first boat word came that the steamer *Manhattan* had picked up Captain McDonald of the *Columbian* and thirteen of his men in another boat. Four survivors out of the fifteen who escaped in a third boat were picked up by the United States revenue cutter *Seneca* on May 17th.

The Boston office of the Cunard Line received a report on May 6th by wireless from Captain Miller, of the *Franconia*, telling of the rescue of a part of the crew of the *Columbian*. The message follows:

“Received wireless from steamship *Georgic* 11:24 A.M., May 4th, ‘Seydlitz passed in 41.27 N., 59.07 W., a large steamship burning all over. Hull high out of water, foremast and funnel gone, no people on board.’”

“At the same time a wireless from Sable Island requesting me to endeavor to identify steamship, should I pass close, was received. At 1:15 P.M. I received from Boston: ‘Great alarm over Seydlitz report of a big ocean liner afire. Rescues by *Franconia*. Please send brief dispatch.’”

“At that time rumor of rescue was not true.

“On receipt of *Georgic*’s message, I changed my course to cross given position of burning steamship, arriving there

at 3 P.M. Could discern no trace of wreck, but decided, owing to false report, and fearing influence on other possible rescuing steamships to encircle position at six miles and at 3.30 P.M. sighted a boat on the starboard bow. Being already prepared the occupants thereof were taken on board in a few minutes. A heavy swell was running at the time, so took precautions of putting out my seaboat to cover their embarkation. The boat contained thirteen men and a corpse lying awash in the bottom of the boat.

"The survivors had used trousers-leg from corpse on end of boathook for distress signal. Survivors were in a state of extreme exhaustion and mental collapse. Some had been burned by fire.

"They state that they had been adrift forty hours. Six were put under doctor's care in hospital, and others were given brandy and soup, bathed in hot water and put to bed. They immediately fell asleep. Little information can be obtained from them.

"The carpenter says the ship was the Columbian, sailing from Antwerp, and about 12,000 tons register. He was asleep and heard the alarm of fire, and was coming along the deck and had arrived about midships when an explosion occurred under his feet, which blew him overboard. He was picked up by a small boat.

"A lamp trimmer's son states that his father was coming forward calling for him when the deck blew up and the lamp trimmer fell in the burning hold. A quartermaster says that Captain McDonald, chief engineer, chief officer, and several others were getting a third boat out when a big explosion took place. He does not know if the captain and his boat were saved. The second officer got away with about twenty-four men ten minutes before the boat that was picked up.

"All agree the fire started at midnight Sunday, from a cause unknown. It was first reported by outlook man, who saw smoke coming up the fore hatch. Half an hour later the whole ship forward and amidships was in flames, with constant violent explosions. The wireless apparatus was wrecked.

"After picking up the boat we made another detour, searching for other boats,

and deeply regret could not find them, but many other steamers hastening to scene of disaster and trust if not already picked up following steamers will rescue them. Have marooned all ships to look out for two missing boats, and received replies from Manhattan, Haverford, and Marengo."

Four men were picked up in an open boat forty miles south of Sable Island on May 17th by the United States revenue cutter Seneca. They were barely alive, and were all that were left of a party of fifteen that set out from the Columbian, when she burned.

In the two weeks in which the third boat drifted through arctic ice floes, its occupants had but a scant supply of water and scarcely any food at all. Of the eleven missing from the original complement in the boat, all died at sea and their bodies were thrown overboard by the weakened survivors.

All four of the survivors were found in a state of complete collapse and were unable to tell a connected story of their horrible experience. Their boat was towed alongside of the Seneca by a small boat from the revenue cutter which went out on sighting the open boat at sea.

The wireless message from the Seneca telling the news that the boat had been picked up gave a general outline of what had occurred. Not only on account of the high winds was hope given up, but the chances that the Columbian's third boat would ever be found were discounted on account of the many ice floes through which it would have to pass to get into the steamship lane.

The Seneca was on duty as an ice patrol boat, and it was while scanning the horizon for bergs that the ship's lookout sighted the open boat through his glasses. The first report of the lookout was to the effect that the boat was empty, as not a sign of life could be observed.

The Seneca, however, put on full steam ahead and soon launched her gig to go to the boat and look it over. The gig's crew found the four emaciated men huddled in the bottom, and pressed brandy to their lips. On the deck of the Seneca, to which they were quickly removed, they received more stimulants, and then they were turned over to the ship's surgeon.



## When You Stop to Consider—

There is nothing in which men more deceive themselves than in what they call zeal.



Manners carry the world for the moment; character for all time.



Work is a grand cure for all the maladies and miseries that ever beset mankind—honest work which you intend getting done.



Before employing a fine word, find a place for it.



Wit makes its own welcome and levels all distinctions.



Every individual has a place to fill in the world, and is important in some respect, whether he chooses to be so or not.

Variety is the mother of enjoyment.



The vain man is the really solitary man.



You have no business with consequences; you are to tell the truth.



He who gains time gains everything.



Great thoughts reduced to practice become great acts.



Find out what your temptations are and you will find out what largely you are yourself.



The talent of success is nothing more than doing what you can do well.



Silence is the resolve of him who distrusts himself.



When a man no longer is anxious to do better than well, he is done for.



A man without self-restraint is like a barrel without hoops, and tumbles to pieces.



Self-confidence is the first requisite to great undertakings.



Responsibility walks hand in hand with capacity and power.

# How to Conduct a Radio Club

By E. E. BUTCHER

## ARTICLE V

SINCE the inception of wireless telegraphy, efforts have been made to imitate as much as possible the physical actions of wire telegraphy. It is only natural, then, to expect that attempts should have been made to construct wireless apparatus enabling the receiving radio operator to "break in" on or to interrupt the sending operator.

It is well understood that in wire telegraphy should the receiving operator desire to interrupt the sending operator and request, say, the repetition of a word, he need only open the line circuit by means of a switch mounted on the base of his sending key. Unfortunately, this cannot be done so readily with wireless telegraph apparatus and various means have been devised in an effort to solve the problem.

Certain "break-in" devices have been described in amateur publications from time to time, and if the directions given were closely followed fairly certain results could be obtained. It is preferable at all times to employ the "break-in" method in which the transmitting and receiving apparatus is alternately connected to and disconnected from the aerial wires by a series of electromagnetic switches which are operated by contacts mounted on the transmitting key. Thus during the periods of transmission the receiving apparatus is momentarily disconnected from the aerial, but when the transmitting key is raised the apparatus is connected into a receiving position. (See U. S. patent No. 739,287.)

This is by all means the most dependable method. The average radio club, however, has not the facilities at hand for constructing elaborate electromagnetic switches. Alternatives are therefore offered. Perhaps the simplest arrangement of all, and one with which many amateurs are familiar, is that employed by the Marconi Company. An elementary circuit diagram is shown in Fig. 1.

The aerial wires at any station are represented at A. The aerial tuning inductance belonging to the transmitting apparatus is shown at  $L_2$ , the secondary of the transmitting oscillation transformer

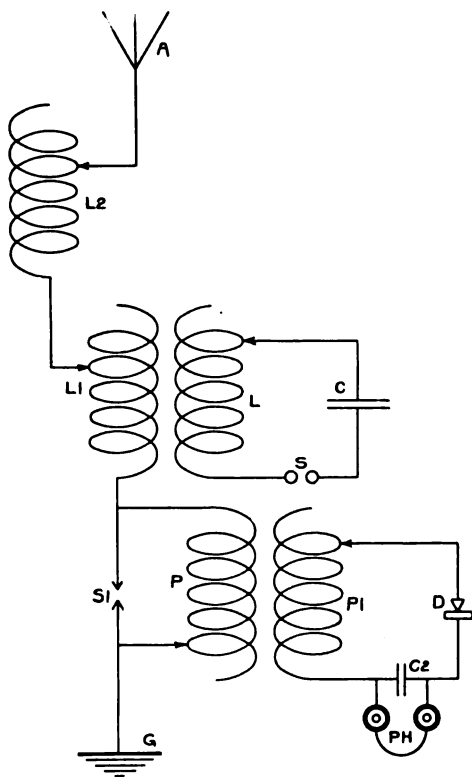


Fig. 1

at  $L_1$ . The closed oscillatory circuit of the transmitting set is indicated at LCS.

In series with the open oscillatory circuit we have the spark plate  $S_1$ , which is placed as near to the earth as possible. The terminals of the spark plate are connected to the primary winding of the receiving tuner P.

It should be understood that the con-

nection to the winding P is not broken at all during the periods of transmission. The actual gap at  $S_1$  is kept very short so that the difference of potential at the terminals of P will be at a minimum. Moreover, the operator wearing the head phones connected to detector D, is not apt to undergo shocks as the spark plate is placed so near to the earth that the difference of potential between the head phone circuit and the earth is practically zero.

When the operator desires to transmit he simply depresses the transmitting key, the energy in the antenna circuit being discharged to earth across the spark plate. When the transmitting key is raised, the apparatus is in a receiving position. If the receiving operator desires to "break in" on the sending operator he holds down his key, making a long dash. The receiving apparatus at the sending station is connected in just long enough to allow portions of this dash to be heard. Thus the sending operator knows that the receiving operator desires his attention and he immediately stops sending.

A disadvantage of this system is that it cannot be employed with a sensitive crystal detector. It is only applicable in connection with the valve or the magnetic detector. Both possess marvelous stability and their proximity to the sending apparatus does not destroy their sensitiveness.

Considerable racket, of course, is produced in the head phones during the operation of the transmitter, so it is sometimes necessary to mount a pair of extra contacts on the transmitting key which short-circuit the head phones just previous to the closing of the primary circuit to the transmitting transformer.

It is not advisable for amateurs or radio organizations whose equipments are located on the upper stories of apartment houses or in wooden buildings several floors from the earth, to adopt this method as, owing to the difference of potential between the receiving tuner windings and the earth (if the spark plate is placed some considerable distance from the earth), severe shocks are apt to be experienced or the head telephones may be burned out. If the framework of the building is of steel or iron, and actual connections to the steel may be obtained,

it is perfectly safe to employ this method, but not otherwise.

Let it be clear, then, that the earth gaps, if necessary, may be at a distance of from 30 to 40 feet from the receiving apparatus, provided two leads are brought to the receiving apparatus.

It will be evident that the spark plug, in addition to performing the function referred to, makes quite an efficient lightning arrester and during severe lightning storms the head phones may be worn without fear.

### A New "Break-in" Method

We shall now describe a new "break-in" method which not only allows the receiving operator to "break-in" on the sending operator, but also for short distances will allow the simultaneous transmission and reception of wireless messages from one and the same aerial. The method is the subject of letters patent. The device has been used commercially for a number of years. While it possessed limitations, experiments with it should be of interest to amateur organizations.

One of the principal features of the method is that it requires no moving contacts. In fact, during the periods of depression of the transmitting key, no distant control switches are used. An aerial of the loop type is, however, necessary to carry on the experiment.

Reference to the diagram (Fig. 2) shows that the loop aerial is represented at A, and the secondary of the oscillation transformer at  $L_1$ .  $L_1$  is a doubly wound helix, that is to say, there are two coils wound in parallel on it. One terminal of each of these coils is connected to the two sides of the loop aerial.

The 3-prong gap  $S_1$  is connected in series to the earth. The conventional closed oscillatory circuit is represented by the spark gap S, the primary of the oscillation transformer by L and the condenser by C. The receiving transformer is represented by the windings P and  $P_1$ . This transformer may be of the type found in any amateur station. It is preferably of the inductively coupled type.

What ordinarily constitutes the slider for the aerial connection on this tuner is now connected to one side of the loop at M. The other terminal of the primary winding is connected to the other leg of

the loop at  $M_1$ . Lead  $M_1$  is also connected directly to the earth  $E_1$  near the receiving tuner. The closed or detector circuit is represented by the winding  $P_1$ , the carborundum crystal  $CAR$ , the fixed condenser  $FC$  and the phones  $PH$ .

It is important that the gap  $S_1$  be placed as near as possible to the actual earth connection. The points of the gap should be closed down to the least possible length, not more than  $1/100$  of an inch.

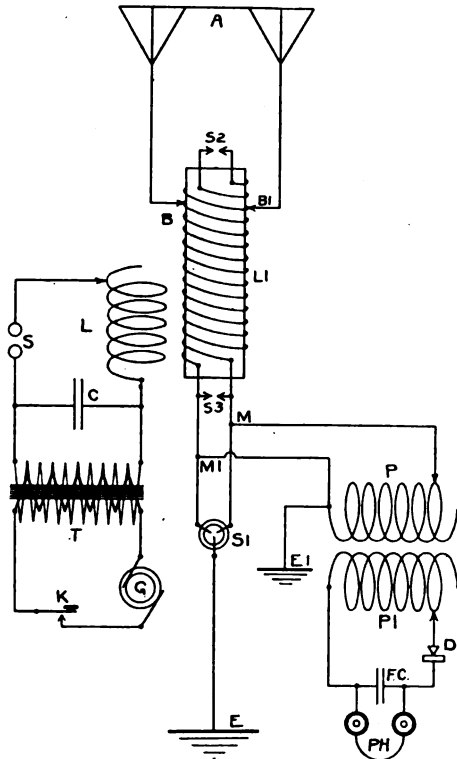


Fig. 2

A miniature spark gap  $S_2$  is connected to the upper terminals of  $L_1$ , and another placed across the terminals at  $S_3$ .

It should be understood that the inductance  $L$  is wound about  $L_1$  so that both windings of  $L_1$  are excited simultaneously. The power transformer for charging the condensers is indicated at  $T$ , the transmitting key at  $K$ , and the source of energy at  $G$ .

It will be evident that in order to make up this circuit the only difference between this apparatus and that to be found in the

ordinary amateur equipment is the use of the loop aerial, the doubly wound secondary of the transmitting oscillation transformer and the 3-point earth discharge gap.

Again, careful study of Fig. 2 will reveal the fact that the receiving tuner is not connected to the aerial in a freakish manner, but the circuit is that employed by the old DeForest system when using an inductively receiving tuner in connection with an aerial of the loop type.

Amateurs will find the double-wound helix easy of construction. In fact they may make use of any single coil helix at hand. If the windings of it are sufficiently spaced, they may interpose a second set of windings between its turns. Even though the first winding is made of bare wire or tubing, the second winding may be made of D. B. R. C. wire of the same size.

### The Theory of Operation

Let us suppose that the two connections  $B$  and  $B_1$  are so placed on  $L_1$  that the aerial circuit to earth is in resonance with the closed oscillatory circuit  $L C S$ . When the transmitting key  $K$  is depressed and the spark made to act, high-frequency oscillations traverse the open oscillatory circuit which now serves as a single unit in the regular manner. That is, while the aerial possesses the characteristics of the loop when receiving, it acts as a single straightaway aerial when sending.

If, then, the inductance values at  $B$  and  $B_1$  are suitably proportioned, no difference of potential will exist between the two sides of the loop (note this carefully), as is evidenced by the fact that no spark discharge takes place across the gaps  $S_2$  and  $S_3$ . (Keep in mind the fact that  $S_2$  and  $S_3$  should not be open more than  $1/100$  of an inch.)  $S_2$  and  $S_3$  are, properly speaking, safety gaps, which in case of accidental disturbance of the circuits serve to protect the head phones and other parts of the receiving apparatus from burn-outs.

If, then, no difference of potential exists between  $S_2$  and  $S_3$ , it is plain that no current flows in the primary winding of the receiving tuner  $P$ . The transmitting key  $K$  may then be depressed, signals transmitted without removal of the head phones from the ears or disconnections of the receiving apparatus.



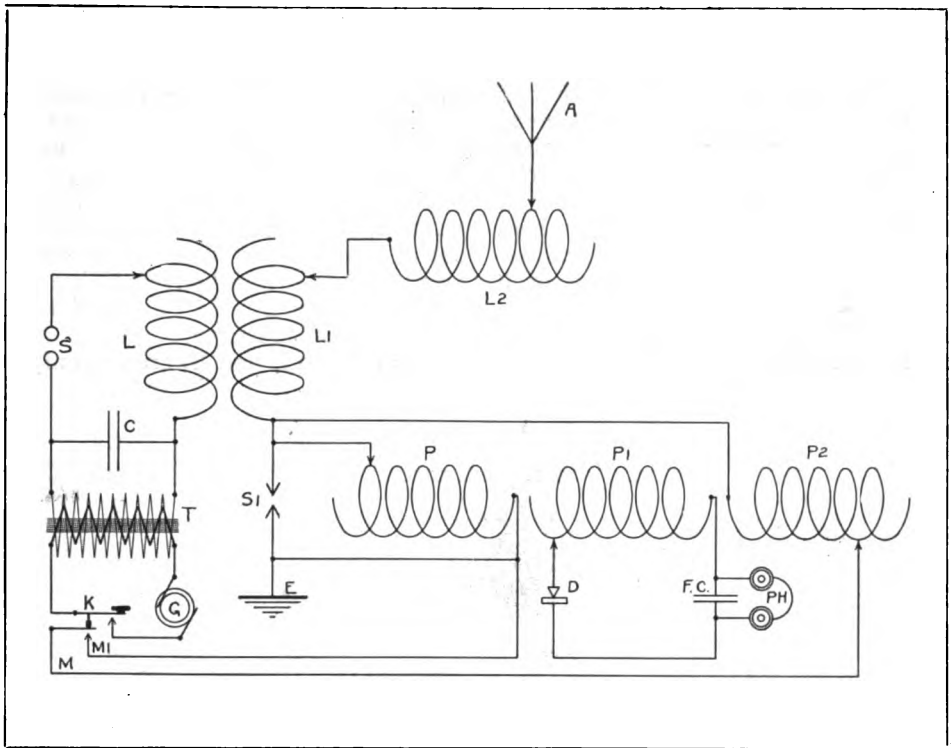


Fig. 3

As a matter of fact, a slight current does flow through the winding P. Careful examination will show that this winding is shunted by the right-hand spark discharge points at the earth gap.

It should not be forgotten that when this device is in operation the values of inductance at B and B<sub>1</sub> are not necessarily alike. In fact one winding invariably has more turns in use than the other. It is this very adjustment which balances the two slides of the loop and literally drives the energy out of the winding P, during the periods of transmission. Furthermore, even though this winding, as stated before, is shunted by the spark gap, which is discharging energy to earth, yet proper adjustments at B and B<sub>1</sub> will produce such conditions of balance that practically no energy flows through winding P. If, after several tests, there is still energy flowing in P, it should be shunted by a variable condenser which will assist in the dissipation of the unwanted energy.

There are, of course, as stated before, limitations to this device. While no

energy flows in P, yet considerable energy will flow in P<sub>1</sub> by direct induction from the transmitter. This will cause considerable racket in the head phones and will throw sensitive crystals out of adjustment. If, however, the wavelength being transmitted is somewhat different from that being received, the circuit in which P<sub>1</sub> is connected will be out of resonance with the transmitter, and, therefore, little or no sound will be experienced in the phones. It is best at all times to select carborundum crystals that are rugged and possess at the same time a fair degree of sensitiveness. Crystals which possess these characteristics are generally of the dark blue or light green variety.

### Duplex Wireless

With this device it is possible over very short distances to simultaneously send and receive signals from the same aerial. While the energy from the local transmitter is neutralized, that coming from the distant transmitting station flows through the aerial circuit and the

receiving tuner to earth. The transmitting key may then be held down continuously and if the oscillations received are at a frequency differing from that of the transmitter, they may be read, even though the local spark gap is in operation.

While making tests at a commercial station several years ago, it was found that the transmitting key could be held down and signals read from another commercial station at a distance of 8 miles.

The full amount of energy received does not of course flow through the

If the 3-point gap is placed as near to earth as possible, the head phones need not be removed from the ears. The transmitting key K is then depressed and the inductances B and B<sub>1</sub> adjusted until there is no discharge across safety gaps S<sub>2</sub> and S<sub>3</sub>. The earth gap, however, should be discharging, and if it is not, either the transmitting open and closed circuits are out of resonance or insufficient energy is being fed to the aerial circuit to jump the gap. This gap should be closed to the shortest possible length.

Inductances B and B<sub>1</sub> are not only ad-

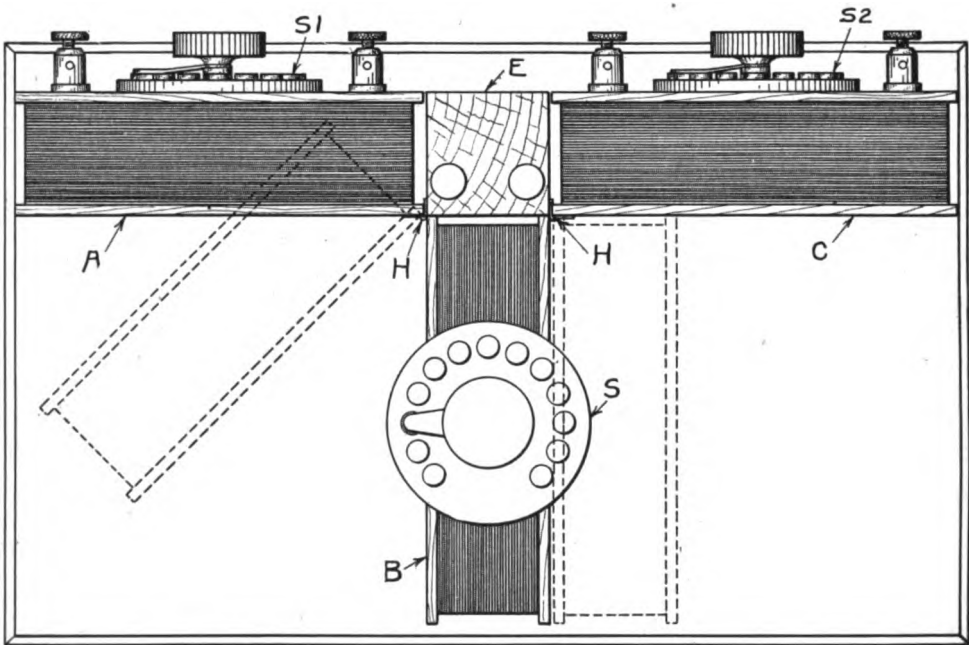


Fig. 4

receiving tuner windings. Careful inspection of the circuits will show that during the periods of operation of the transmitter the receiving tuner is shunted by a gap which is discharging energy to earth and is, at the same time, sufficiently conductive to leak away considerable amount of incoming energy. This apparatus is worthy a trial by every amateur organization.

When the apparatus used in connection with the latter "break-in" method is employed, it may be adjusted to working conditions in the following manner.

justed for conditions of no sparking, but their values are slightly varied so as to produce a minimum of sound in the head telephones. Total silence in the head telephones will not be obtained as has previously been explained.

Another New "Break-in" Method

While the first described "break-in" device, as previously stated, is not applicable to sensitive crystal detectors, the writer has devised auxiliary means by which this system may be employed without throwing out of adjustment even the

notoriously erratic silicon detector. That is, the receiving tuner may be shunted across the regulation Marconi spark plate and employed in connection with silicon, perikon and galena detectors without loss of sensitiveness during the periods of transmission.

The apparatus may readily be applied to any amateur station requiring, as it does, only slight additions to the present receiving tuner.

The arrangement of circuits is shown in Fig. 3. An explanation follows:

Fig. 3 is similar to Fig 1, with a few additions. The power transformer for supplying energy to the spark gap circuit is represented at T, the alternating source of current supply at G, the transmitting key at K. In addition to the regular contacts, the key has special contacts M and  $M_1$ . M and  $M_1$  are so placed and adjusted that they are placed in electrical contact just previous to the closing of the power circuit to the transformer.

The earth spark plate, in series with the open oscillatory circuit of the transmitter, is indicated at  $S_1$  across which is shunted the primary of the receiving tuner winding P. The secondary winding of the receiving tuner and its associated apparatus are represented at  $P_1$  and the crystal detector at D.

In inductive relation to  $P_1$  we have the additional coil  $P_2$ , which is wound in opposition to  $P_1$ , and is also shunted around to earth gap  $S_1$ . The winding  $P_2$  is of the same dimensions as the primary winding P and is made adjustable by a variable contact (switch or slider—preferably multiple point switch).

### Theory of Operation

It is evident, from the fact of the presence of the spark gap  $S_1$ , in shunt to winding P, that during discharge considerable difference of potential will exist in P which will be transferred to  $P_1$ , by induction. Even if the winding P were wholly eliminated, considerable energy would be induced in  $P_1$  by direct induction from the transmitting radio frequency circuits. This alone will throw a sensitive crystal out of adjustment. By the use of winding  $P_2$ , the unwanted energy in  $P_1$  may be wholly eliminated.

Just previous to the closing of the contacts on the transmitting key, the contacts M and  $M_1$  are closed which,

when the transmitter is in operation, will tap off a certain amount of the antenna circuit energy, causing it to flow through  $P_2$ . Magnetic lines of force are set up in  $P_2$  in opposition to those produced in  $P_1$ .

If the ampere turns of  $P_2$  are the same as those of P, and the coupling from  $P_2$  to  $P_1$  is slightly greater than that from P to  $P_1$ , the energy which otherwise might flow in the detector circuit during the periods of transmission, will be wholly destroyed and complete silence in the head phones obtained. Therefore if no energy flows in the detector D, its sensitiveness will be retained and it will always be ready for the reception of signals when the transmitting key is raised.

When this method is first used a little experimenting is necessary to determine the proper values of inductance in the opposition coil.

This apparatus is adjusted in the following manner:

When the transmitting circuits are in proper resonance, and the detector D is in proper adjustment for maximum sensitiveness, the transmitting key is held down and the values of inductance and coupling at  $P_2$  adjusted until complete silence in the head phones is obtained.

Thus the apparatus is in proper adjustment for an efficient "break-in" system and will work with great regularity. Each time the wave-length of the receiving tuner is changed it may be found necessary to readjust the values of inductance or coupling at  $P_2$ . But for any given wave-length no changes need be made. During the moments that the adjustments for silence are being made it may be necessary to make several readjustments of D, in order to maintain sensitive conditions.

The receiving tuner of ordinary construction does not allow this particular "break-in" system to be used to the best advantage. The writer prefers a receiving tuner of altered design after the drawings shown in Figs. 4 and 5.

The secondary winding of the receiving tuner is made on a rectangular frame B. B is fastened rigidly to the support E, as shown. The values of inductance in use are determined by the multiple-point switch S, mounted on the top.

The primary winding A is hinged (H) at the rear, so that it may be placed

in close inductive relation to B, at right angles or at any intermediate position as desired, thus allowing variations of coupling to be obtained. The number of turns in use at A are determined by the switch  $S_1$  mounted on the side as shown.

The opposition coil C is also mounted on hinges (H) and is of the same proportions as winding A. Coil C has a variable or multiple-point switch  $S_2$  mounted on the side, as shown.

No actual dimensions are given as it is expected that they will be selected to

The proper positions in the circuits for these condensers are readily understood by the average amateur.

### Limitations

It will be observed that in all the "break-in" methods described a discharge gap is placed in series with the earth. With the loose couplings employed under the present United States regulations the insertion of this gap is detrimental to the character of the emit-

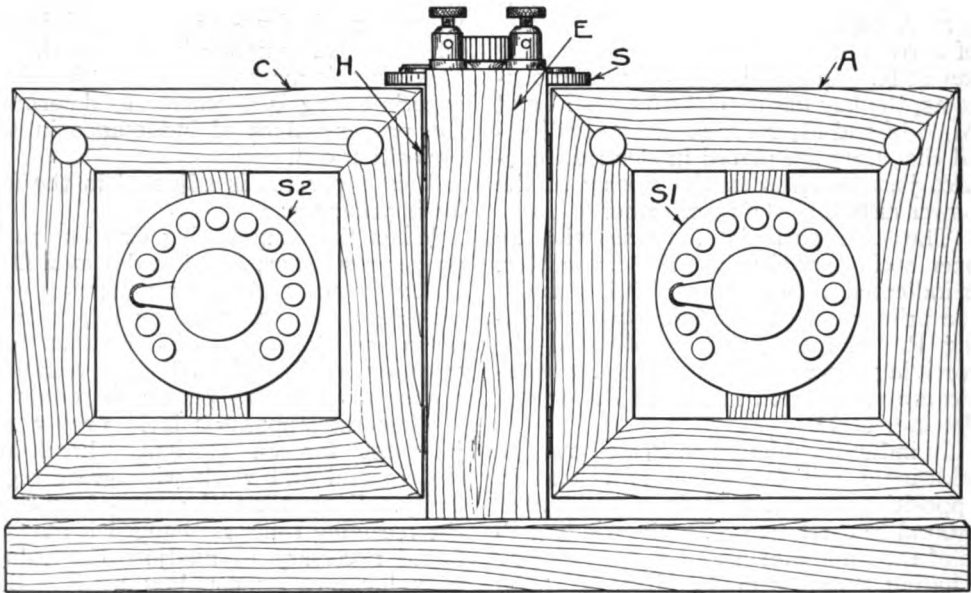


Fig. 5

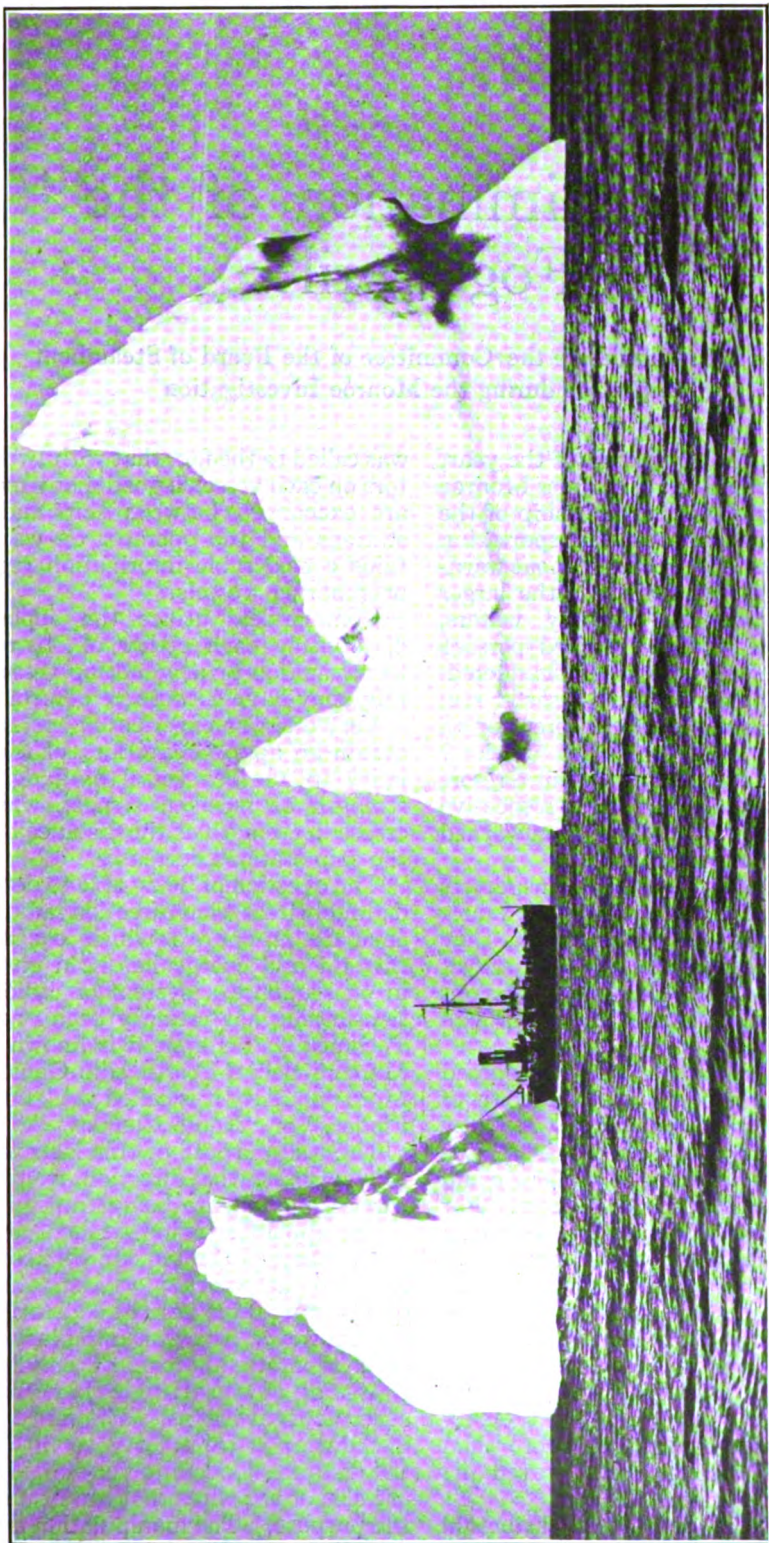
suit the range of wave-lengths it is desired to receive. For amateur work coil B may be 6 inches square, 2 inches in width and wound with a single layer of No. 30 wire. Coils A and C may be 1 inch in width. Each may be wound with 2 layers of No. 22 or No. 24 wire, the turns being divided between the points of a multiple-point switch to suit the builder.

As only rough adjustments of inductance are obtained by the use of a single multiple-point switch, it is expected that variable condensers will be used in the open and closed circuits to give the fineness of adjustment desired.

ted wave. In fact, unless sufficient voltage is employed at the spark gap and the coupling is fairly tight, the potential at the earth arreser will be insufficient to bridge the gap.

With quenched spark transmitters the use of an earth gap is entirely out of the question. It is then necessary to employ some form of electromagnetic switch which will short-circuit the gap during the periods of transmission. This brings the device under the claims of the United States patent mentioned previously in this article.

(To be Continued)



*Photographs such as this, one coming to our attention in these warm June days, make us fully appreciate what a wonderful aid is wireless to navigation. On Easter Sunday the U. S. Revenue Cutter Seneca, patrolling the North Atlantic, found these two gigantic icebergs in the steamer lanes and immediately sent out wireless warnings to all nearby steamships. From water line to tip these icebergs rose to a height of over 125 feet, and the Seneca, which is seen between the two monsters, appeared nothing but a pigmy of the sea in comparison*



# The Elimination of the Fog Peril

Some facts laid before the Committee of the Board of Steamboat Inspectors during the Monroe Investigation

**WHEN**, at the beginning of the year, the Old Dominion steamer Monroe and the Nantucket, a smaller ship of the Merchants and Miners Transportation Company, crashed together without warning and twelve minutes later the larger vessel sank beneath the oily waters, carrying almost half a hundred persons with her, the American public shuddered. Then with the horror of the disaster still fresh in their minds they clamored for an investigation. Where was the wireless? Was this great human agency but a resort in time of danger; could not the respective captains of both vessels have been warned of their proximity in time?

The Board of Steamboat Inspectors thought not. After examining the junior wireless operator in Philadelphia, they reported that wireless telegraphy had yet to prove that it could prevent collisions of ships approaching each other through a blanket of fog.

This decision was given widespread publicity in the newspapers in spite of the fact that from experience the Navy Department, the revenue cutter service and several big steamship owners could not agree with the inspectors. For months they had been making tests of a new device which had shown accurately the direction from which wireless signals come and locates the sending vessels in the thickest fog. The Marconi Wireless Telegraphy Company of America then laid before the investigating Committee a few pertinent facts bearing on the subject; demonstrating that on more than one occasion wireless had proved its utility in storm or fog.

The steamboat inspectors' attention

was called to the fact that with two operators on each vessel, a good many messages are exchanged between ship and shore stations and the operator on watch obtains considerable information regarding neighboring vessels.

Commanders utilize the opportunity of advising each other of obstructions to navigation or neighboring vessels that they may have encountered en route.

Very often an experienced operator will obtain an approximate idea of the proximity to another vessel by judging the strength of received signals, which increase in strength as the distance between the ship stations decreases.

The question of being able to determine definitely from what direction radio signals emanate is one to which considerable thought and energy has been given and in consequence a system of radio direction-finding has recently been produced. Technically this system is known as the Marconi-Bellini-Tossi-Radio Goniometer. More popularly it is called the "Direction Finder," or "Radio Compass."

The sole purpose of this instrument is to determine the direction from which wireless signals are being transmitted.

The apparatus is independent and supplementary to the regular wireless outfit installed at wireless stations and requires no power for its operation. It does, however, necessitate the installation of a separate antenna or aerial wires, consisting of two triangles bisecting each other at right angles. The range of this instrument is from forty to fifty miles, the distance depending very largely upon the size of the wires that are installed for the purpose. The manipulation is simple

and can be operated either by the radio operator or the navigating officer.

With a view of making this instrument adaptable to the conditions that obtain on the American coastwise steamers, initial tests were recently conducted on the steamer Northland, owned by the Eastern Steamship Corporation. During the voyage between New York and Portland, Me., a number of tests were conducted; the results of each being submitted to the captain and navigating officer of the vessel. The readings submitted were carefully compared with the ship's charts and compass, and the results obtained were pronounced correct. Captain Johnson of the steamer Northland personally checked the readings and expressed himself as being highly impressed with their accuracy.

Not long afterward the United States revenue cutter Seneca was equipped with the "Direction Finder," and this vessel put out to sea for the special purpose of conducting these tests, the results of which were also satisfactory. A report of these tests is now in the hands of Captain John Q. Walton, Naval Constructor, Washington, D. C. It was added that the U. S. Navy has been supplied with several complete outfits which they are now testing at their laboratories.

At the present time the shops of the Marconi Company are engaged in manufacturing a sufficient number of these instruments to place on the market and submit to the various steamship companies, with the privilege of thoroughly testing the apparatus before adapting it for general use.

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### ALASKAN MINES EQUIPPED

The Marconi Wireless Telegraph Company of America has recently closed a contract with the Jualin Alaska Mines Company for a 5 k. w. set to be installed in Jualin Juneau.

W. B. Hoggatt, former governor of Alaska and now president of the Mines Company, with headquarters in New York, stated that with this Marconi equipment the mining men confidently expected to maintain continuous communication over the mountainous Alaskan regions and relay, through the Juneau

station, messages designated for San Francisco and New York.

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### LICENSE WARNING

The Department of Commerce has addressed letters to wireless station owners containing a warning that it is unlawful to operate a station after its license expires. Three copies of Form No. 762, "Applicant's Description of Apparatus," are enclosed, two of which are to be filled in fully and accurately and returned to the office of their local inspector.

The number of storage battery cells is to be stated, or a description of the source of power given. A diagram showing the dimensions of the antenna should also accompany the papers and the expired license must be returned.

It is added that these instructions must be promptly and carefully complied with if the owner wishes his license renewed.

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### SETS OF GREATER POWER FOR THE NAVY

In order that communication with Rear-Admiral Howard, commander-in-chief of the Pacific fleet, may be maintained under all conditions the wireless plants on his flagship and at San Diego, Cal., will be greatly increased in strength. Assistant Secretary of the Navy Roosevelt, who returned to Washington recently after a month inspecting yards and naval stations on the west coast, announced that the wireless outfit at San Diego is to be supplanted by one four or six times as powerful, and that the wireless set on the flagship will be changed for a more powerful one.

The California station will then have a radius of 10,000 miles, and communication with Admiral Howard and with the Panama Canal should be possible under all conditions.

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A wireless set has been presented to the Massachusetts State Board of Charities for the use of Archie Thomas, a wireless operator, who has been a member of the leper colony at Penikese Island for several years.

# New License Examinations

New requirements and a method for conducting examinations for operators' licenses are to be adopted at all examining offices, according to E. T. Chamberlain, Commissioner of Navigation and the Regulations published by the Department of Commerce and all instructions previously issued in conflict are thereby amended.

The Continental Morse code test (5 letters to a word) shall consist of messages with call letters and regular preambles; conventional signals and abbreviations and odd phrases; and shall in no case consist of simple, connected reading matter. The test will be conducted by means of the omnigraph or other automatic instrument wherever possible.

The test shall continue for five minutes at the speed of 20 words, 12 words and 5 words per minute, respectively, for commercial first, second, and lower grades, and to qualify, the applicant must receive correctly 20, 12, or 5 words in consecutive order.

The code test sheets written by the applicant will be forwarded to the Bureau with the other papers, and the speed attained noted in the lower left-hand corner of the first sheet.

## Written Examination

The practical and theoretical examination shall consist of seven comprehensive questions under the following headings and values:

|   | Points<br>Maximum<br>Value. |
|---|-----------------------------|
| 1. Experience.....  | 20                          |
| 2. Diagram of Receiving and Transmitting Apparatus.....                                 | 10                          |
| 3. Knowledge of Transmitting Apparatus.....   | 20                          |
| 4. Knowledge of Receiving Apparatus.....  | 20                          |
| 5. Knowledge of Operation and Care of Storage Batteries.....                            | 10                          |
| 6. Knowledge of Motors and Generators.....  | 10                          |
| 7. Knowledge of International Regulations Governing Radio Communication, and the United |                             |

|  |     |
|--|-----|
| States Radio Laws and Regulations..... | 10  |
|  | 100 |

75 constitutes a passing mark for first-grade commercial.

65 constitutes a passing mark for second-grade commercial.

Question No. 1 shall determine the applicant's practical knowledge and experience in handling wireless apparatus. An applicant's experience will be determined largely from the personal question sheet and from satisfactory letters or references submitted. Experience, operating first-class amateur apparatus or the apparatus provided in good training schools, will be given a reasonable value, but applicants who have had experience as apprentices at commercial shore stations or on board vessels will receive higher marks.

Applicants who fail to attain 20 words in the code test but who attain a mark of between 65 and 75 in the written examination may be issued second-grade licenses.

## Re-examination

No applicant who fails to qualify will be reexamined at any examining office within three months from date of the previous examination. All examination papers, whether the applicant qualifies or not, will be forwarded to the Bureau of Navigation for filing as "Operator's record." When the records of the Bureau develop the fact that an applicant has failed to qualify and has applied for re-examination or been reexamined at the same or another office within three months, his existing license or license privilege may be suspended or revoked by the Secretary of Commerce. Applicants to whom are issued second-grade licenses will not be examined for first grade within three months under the same rule.

## Operator's License, Commercial Extra First Grade

The Department of Commerce will issue a special license to be known as Commercial, Extra First Grade to opera-



tors whose trustworthiness and efficient service entitle them to confidence and recognition.

These licenses will be given consideration by the Civil Service Commission in examinations for positions requiring knowledge of wireless telegraphy, when experience is rated as a part of such examinations.

Applicants for the Commercial, Extra First-grade license must pass a special examination. To be eligible for this examination they must hold commercial first-grade licenses, and their certificates of skill in radio communication, issued under the Act of June 24, 1910, or licenses under the Act of August 13, 1912, must record 12 months' satisfactory commercial service, of which at least six months have been at sea, during the two years previous to the filing of the application for examination, as shown by indorsement on the license service records, or other satisfactory evidence, and provided that the applicants have not been penalized for a violation of the radio laws and regulations.

A speed of at least 30 words per minute, Continental Morse, and 25 words per minute, American Morse (five letters to the word), must be attained. The technical questions and the questions on the radio laws and regulations will be considerably wider in scope than those for commercial first grade, and a higher percentage will be required.

All examination papers, including the code test sheets, will be marked and forwarded to the Commissioner of Navigation, with a recommendation by the inspector or examining officer. Examination papers will be marked upon the basis of 100, and licenses will be recommended only if 80 or better is attained.

Licenses of this grade will be issued by the Commissioner of Navigation, indorsed by the Secretary of Commerce, and delivered to the successful applicant through the examining officer.

Examinations for the Commercial, Extra First-grade license will be held at the following offices only by appointment: Commandants of the Navy Yards at Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa. U. S. Radio Inspectors at Customhouses of New Orleans, La.; San Francisco, Cal.; Seattle, Wash.; Cleveland, Ohio; Chicago, Ill.

In special cases, upon application to the Commissioner of Navigation, arrangements may be made for examinations at other points.

Applicants who fail to pass the examination will not be reëxamined within three months.

## ADVICE FOR MARCONI OPERATORS

By JOSEPH P. MORRALL

Many operators who are using the Marconi valve tuner have difficulty in tuning to resonance with long waves as the tuner is not wound for wave-lengths much longer than 1,500 meters. Some operators tune to higher waves by placing the intermediate condenser across the aerial and ground posts, thus shunting it across the primary of the receiving transformer. This will increase the wave-length of the aerial circuit, but it does not increase the wave-length of the detector circuit which must also be brought up to resonance with the desired wave.

This difficulty can be overcome if the wave-length of the aerial circuit is increased by adding an extra inductance in series with the aerial, instead of by means of the condenser. The wave-length of the detector circuit can then be increased by placing the intermediate condenser across the secondary winding of the receiving transformer. This can be done by connecting one terminal of the condenser to the upright post to which the detector is also connected, and connecting the other terminal of the condenser to the telephone post nearest the front of the tuner.

It will be found that a very long wave can then be received and the intensity of signals from Arlington will be increased nearly fifty per cent over those received with the condenser shunted across the primary of the receiving transformer.

## EXPERIMENTAL SERVICE BILL

A bill appropriating \$100,000 to establish an experimental wireless communication service between postoffices in the United States and offices in foreign countries has been introduced in the House by Representative Steenerson, of Minnesota. It provides that the necessary apparatus may be purchased or rented.

# The Readers' Forum

Paul Schultz, of 45 Christwood Street, Springfield, Mass., sends us a description of a duplex receiving system which he says may be used to advantage in the amateur field. He says that he has observed that when using any duplex system, such as by connecting two receivers to one antenna, any adjustments made

are respectively connected to two distinct receiving sets adjusted to different wave-lengths.

We have carefully examined the diagram and, while we agree with him to some extent in theory, we do not in practice. We see several limitations. He proposes to run the buzzer at such a speed that two receivers will be alternately connected to the circuit a sufficient number of times per second to allow the reception of the dots and dashes of the Morse code. Granted that the buzzer will make a sufficient number of makes and breaks per second to accomplish this, yet the note produced in the receiving telephones of each receiving tuner will not be that due to the spark note at a distant station, but will depend very largely upon the number of interruptions of the buzzer. Suppose then, that the antenna was so situated that it accumulated heavy static charges; then the buzzer contacts will literally "churn-up" such static charges and produce a note which may be more disagreeable than that emitted without the employment of a buzzer.

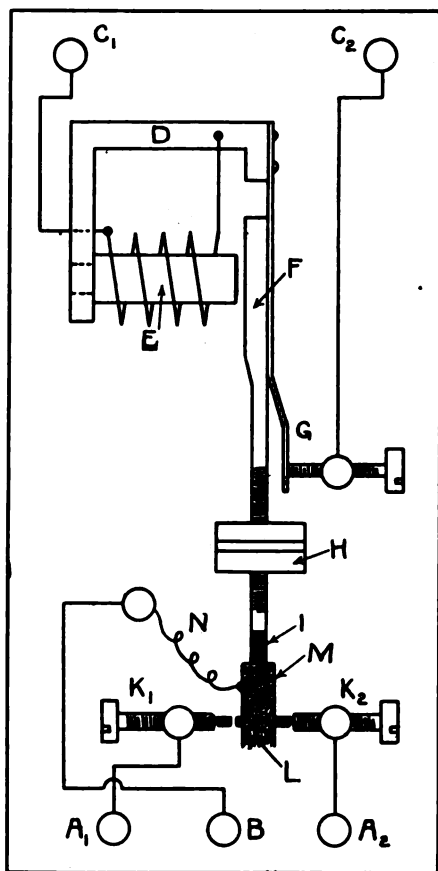
Furthermore, at the contacts G of the buzzer the sparking may be such as to set up disagreeable inductive noises in the receiving head telephones.

In his description Mr. Schultz says:

The lower part of armature F must be threaded in order to fit it with a weight H, which can be moved up or down and therefore any variations of the number of interruptions may be obtained. On the end of the armature a "U" shaped spring M is attached. This spring is about  $\frac{1}{8}$  of an inch in width and is insulated from the armature F by a piece of round fiber I. It is well to fit the inside of the spring M, with a piece of felt L, in order to dampen the vibration between the contact points K1 and K2. To the spring M is soldered a flexible wire N which is connected to the binding post B.

The working of the relay is as follows:

When a battery is connected to binding posts C1 and C2 the armature F is set into rapid vibration and therefore connects the spring M alternately to contacts K1 or K2. The antenna is connected to post B while one receiving is connected to post A1 and the other to post A2. The interruptions occur many times per second and the antenna is alternately connected to either receiving set No. 1 and No. 2, through binding posts A1 and A2.



Diagram, Paul Schultz article

on one receiver will invariably affect the other. He therefore purposes to overcome this difficulty by the arrangement shown in the accompanying diagram. Briefly, he mounts contacts on the end of the armature of any bell buzzer. These contacts are made to play against two stationary contacts A1 and A2 which

The buzzer may be adjusted for proper working conditions in the following manner:

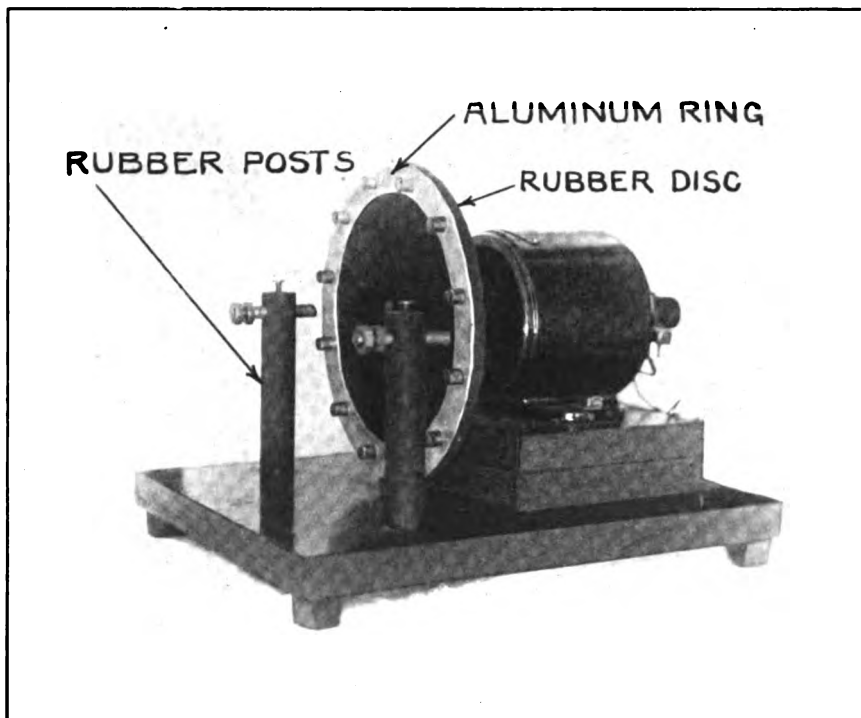
Connect a small battery in series with the phones to post A1 and A2 and regulate the interruptions at contact screw G. Bring the screws K1 and K2 close together until a sound is produced in the receivers and then screw these contact points carefully back again until there is no sound in the receivers. This indicates the shortest interruptions possible. Then connect the battery in series with the phones first to posts A1 and B and, after noting the tone in the receivers, shift the connections to A2 and B.

Adjust the contact screw K2 until there is the same sound in the receivers as produced by the

C. G. Fuss, of Little Valley, N. Y., says that he has experienced the difficulties encountered by the average amateur in the construction of a satisfactory rotary gap and that he has finally constructed one which he believes is well designed and will give better results than any other type of construction which may be employed. A photograph of the gap is shown in the accompanying diagram.

He writes:

The motor shown in the photograph is of the



*Diagram, C. G. Fuss article*

first connection. It is very important to have the same tone in the receivers in both connections in order to obtain good results.

The writer thus abruptly ends his contribution, making no statements as to whether he has actually used the apparatus or what results were actually obtained. The drawing, however, is sufficiently clear to enable any amateur to construct the apparatus. The experiment may be interesting to perform, even though the device proves to be inoperative.

standard variable speed type made by the Robbins & Meyers Company and sells for about \$10. This motor is strong enough for the purpose, particularly on account of the fact that I find that it is not necessary to run it at the maximum speed. The hard rubber disc shown is 7 inches in diameter and  $\frac{1}{4}$  of an inch in thickness. It is attached to the pulley of the motor by 3 machine screws.

To mark off a perfect circle and produce a true wheel I find it better to first mount the disc on the shaft and then, when slowly rotated, an awl may be held against it. This is by far the better method as there is then no danger of producing a "wobbly" wheel.

It will be necessary to mount the motor upon

a block of wood so as to allow the rubber disc to clear the base. This can be done by passing two bolts up through the base of the instrument, the block and the base of the motor.

A circle six inches in diameter is next marked upon the wheel. Then, with the aid of a protractor, the circle is divided into twelve equal segments. At each point of division a small hole is drilled. These are to hold the spark points, which are of brass about  $\frac{1}{8}$  of an inch in diameter and about the same in length. One end of each of these points is tapped and fitted with a machine screw so as to fasten it to the wheel. These points may be made or purchased. I purchased mine from the Clapp-Eastham Company at the small price of five cents each. Before fastening the points, cut out a ring of aluminum, 7 inches outside diameter and about  $\frac{3}{4}$  of an inch in width. Drill 12 holes in it to correspond with those in the wheel and place it on the wheel beneath the row of points, as shown in the photograph.

The posts that hold the stationary spark points are  $\frac{3}{4}$  of an inch hard rubber rods. They are held to the base by a screw, passed up through the base. Next the distance from the base to the center of the wheel is measured, and at this

in diameter and about 2 inches in length. One end of each is threaded and fitted with two nuts for connections. I purchased these points from the Clapp Eastham Company, although one might make them himself if he chose to do so. A small set screw is passed down into each post so as to hold the points.

Judging from the photograph and description accompanying it, the construction seems to be fairly rigid and we are under the impression that the gap will be found to be satisfactory in operation.

\* \* \*

Sanford G. Ryder, of East Rockaway, L. I., sends us sketches and a description of a wireless telephone transmitter which he believes is superior to the telephone transmitter in common use.

He reminds us of the fact that the ordinary type of telephone transmitter is not suitable for wireless telephone work and cannot carry more than one ampere of current without heating. But he says that if a transmitter is designed after the manner shown in his drawing, currents in excess of this amount may be handled with ease.

So far as we are concerned, the construction is novel and the drawings may be of value to amateur experimenters in wireless telephony.

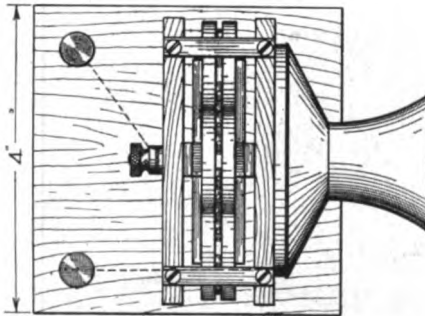
He writes:

Procure a regular telephone transmitter from any telephone company. Remove the back shell and interior parts which for our new design will not be required. The front shell, mouth-piece, and diaphragm are fastened to a wood support and base, as shown in Fig. 1.

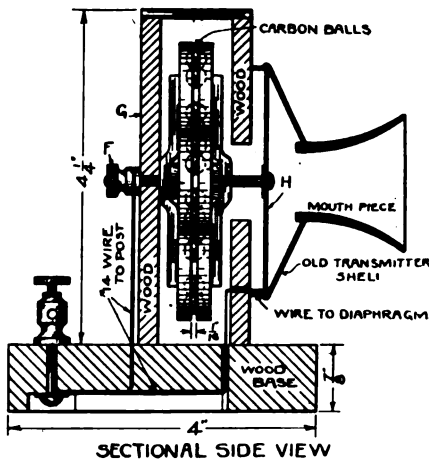
The design of the woodwork should be as near as possible to that shown in my drawings. It will be found that telephone transmitters vary in design and therefore the construction of the wood base and support may be altered.

The carbon back support B, Fig. 2, is made of brass; 2 sets are required, one for the rear carbon back and one for the front carbon back. The latter is connected to the diaphragm H, and the rear set is held in place by the support G. The carbon back supports are made as shown at C and D. They are then placed together, forming a cross. Eight carbon backs are required, each  $1\frac{3}{8}$  inches in diameter (four for front and rear sets). These backs may be purchased at any carbon supply dealer or at an electrical supply house. Each carbon back is arranged to carry a  $\frac{1}{4}$  of an inch carbon ball as shown at E. This apparatus should be mounted and arranged as per the drawing. Twenty-four carbon balls in all are required.

The post F is connected to the rear set of carbon backs and thence to the other binding post. The strips of brass, having dimensions of  $\frac{1}{8}$  of an inch x  $1\frac{1}{4}$  of an inch are used to hold together the front and rear wood uprights.



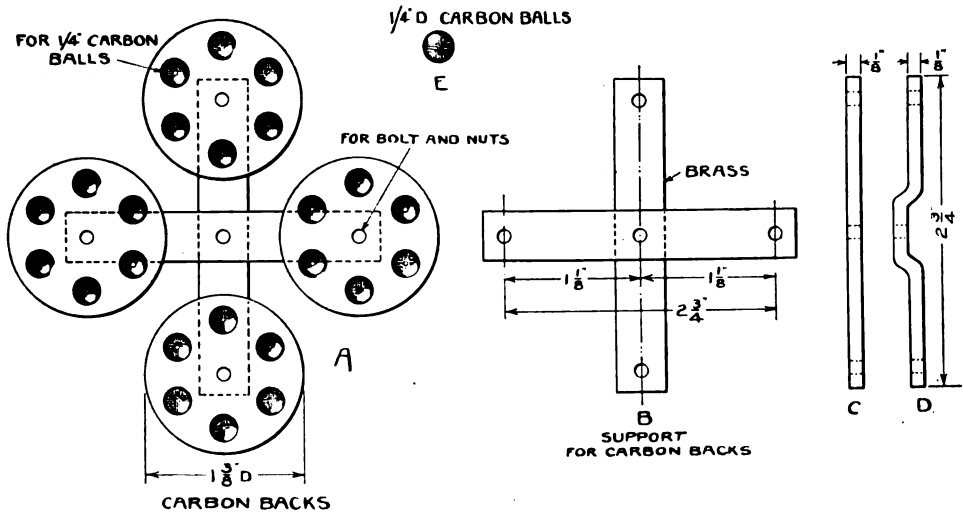
PLAN VIEW.



SECTIONAL SIDE VIEW

Sanford G. Ryder article, Fig. 1

distance up from the bottom of each post, a  $\frac{1}{8}$  of an inch hole is drilled for the stationary points. These stationary points are about  $\frac{1}{8}$  of an inch



Sanford G. Ryder article, Fig. 2

Oak or black walnut should be used for all woodwork and should be given two coats of shellac.

Are we to draw the conclusion that this transmitter will handle 4 to 5 amperes of undamped energy? If so, the experimenters cannot pass over our correspondent's design lightly.

We are aware that many experimenters have avoided the wireless telephone mainly on account of the fact that they were unable to design a satisfactory transmitter. Perhaps the description given may help them in the solution of the problem.

\* \* \*

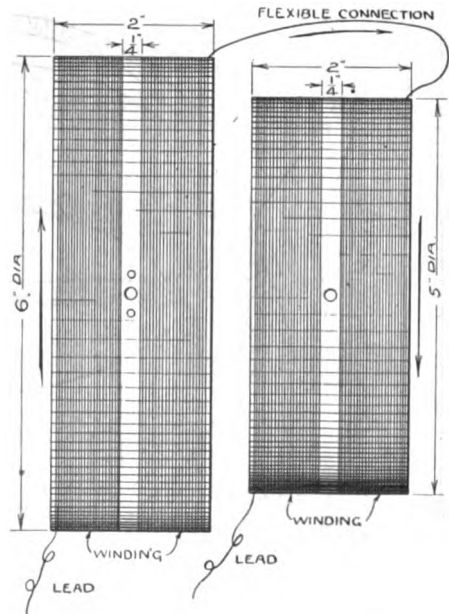
J. Lewis Munger, of 204 S. Nottawa Street, Sturgis, Mich., says that he believes that the type of variometer inductance which he describes is not generally found in an amateur equipment, but he believes the value of it is such that all amateurs would do well to construct one of similar design.

He accompanies his description by 4 sketches, 2 of which show the use of this device, first as an aerial tuning inductance and second as a coupling coil in a receiving tuner, where it simultaneously varies the wave-length of the aerial and detector circuit.

He then describes the construction of the variometer as follows:

To construct this variometer, first secure two cardboard tubes, one 6 inches in diameter, the

other 5 inches in diameter. Make both tubes 2 inches in width. Each of these tubes should be wound with a single layer of No. 24 S. S. C. wire. A space should be left in the winding of these tubes in the middle for about 1/4 of an inch, as shown in Fig. 1. Care must be taken to get the same amount of wire on each tube and also



J. Lewis Munger article, Fig. 1

to wind them in the opposite direction. The wires should be thoroughly shellacked to prevent them from loosening up. The tubes are connected as shown in Fig. 1. Now drill a hole in each

side of both tubes and through these holes put a piece of  $\frac{1}{4}$  of an inch round brass rod, 8 inches in length, as shown in Fig. 2. When mounting the variometer fasten a small tube to the brass rod so that it will revolve with the knob. A pointer may be fastened to the knob which will work over a scale, as shown in Fig. 2.

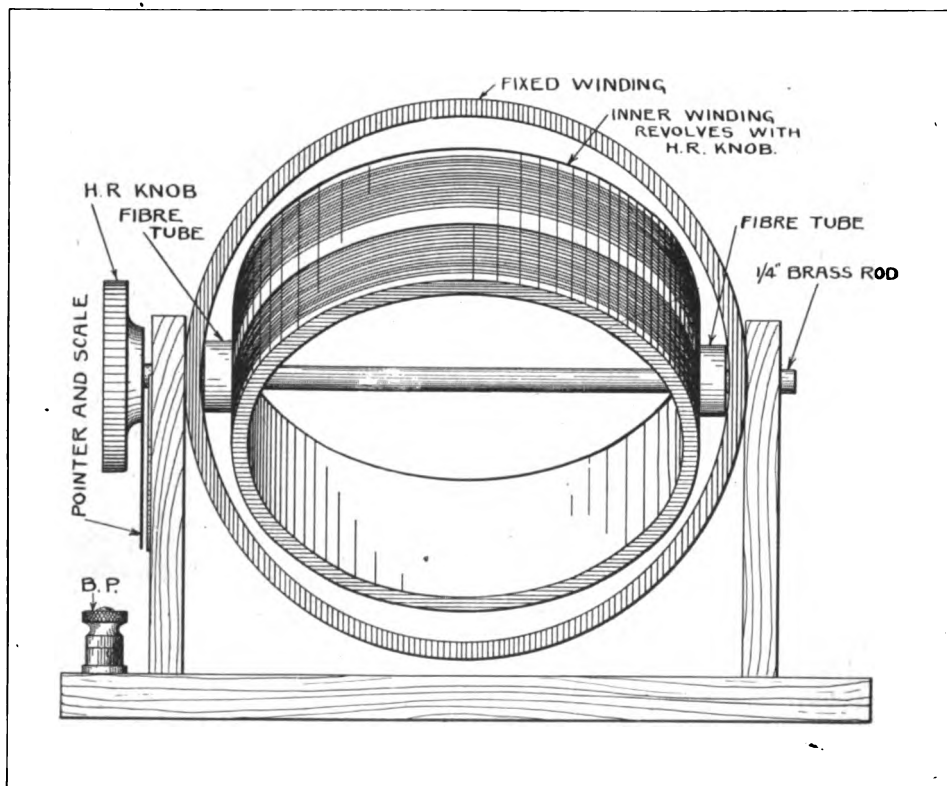
If the windings of the two tubes are identical in width, the inductance of the outer coil will be greater than that of the inner coil. Therefore, when the two coils are in concentric positions and so placed that the magnetic fields produced by each are in opposition, the value of inductance will not be zero. By a slight increase in the number of turns of the winding in the inner coil the condition may be approximated.

It makes no difference whether or not the inner or outer coils are wound in opposition, provided care is taken to connect the coils in series in such a manner that when in one position the two magnetic fields assist each other and in the opposite position, the magnetic fields oppose each other. Figure it out.

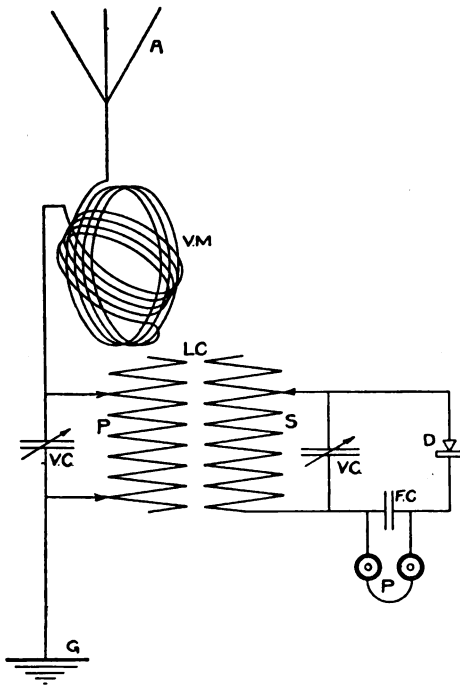
The variometer gives extremely fine adjustments of inductance, but there is always the objection that the ohmic resistance of the wire in the variometer is present after all conditions of adjustment of the relation of the two coils. Variometer coils of this type are often employed in connection with a fixed condenser, as the variable element for a wave meter.

\* \* \*

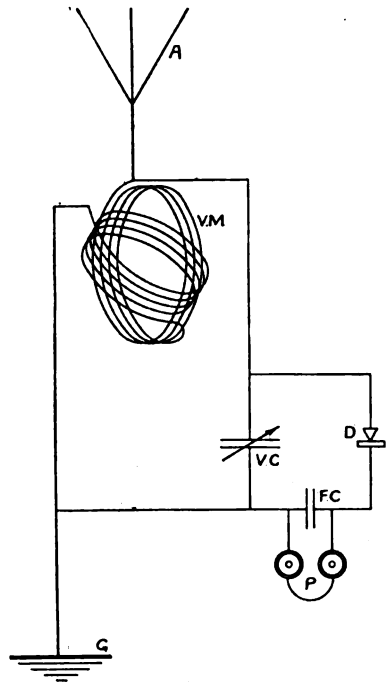
A. L. Groves, of Brooks, Va., sends us considerable data as to the wave-lengths employed by stations located all the way from Cape Cod, Mass., to Santa Marta, United States of Colombia, winding up with a description of an antenna and a tuner with which he is able to copy signals from Glace Bay, Nova Scotia, day or night, at a distance of 1,150 miles. We frequently receive inquiries from amateurs requesting data for a tuner suitable for the wave-length emitted from this station. Therefore, the results obtained



*J. Lewis Munger article, Fig. 2*



J. Lewis Munger article, Fig. 3



J. Lewis Munger article, Fig. 4

by our correspondent should be of interest.

He says:

In conducting experiments I find that with an aerial seventy-five feet high, total length 225 feet directional to the south, I can reach signals from Glace Bay, Nova Scotia, at a distance of 1,150 miles, day and night, continually. I use silicon as a detector. My receiving transformer primary is 8 inches in diameter and is wound with 300 turns of No. 20 S. C. C. wire. The secondary is 7½ inches in diameter and is wound with 500 turns of No. 24 S. C. C. wire.

In order to tune in Glace Bay signals I place

the primary slide on the 287th turn. I use the full amount of inductance in the secondary coil. There is very little difference in the strength of the signals during the day or night, but owing to the great amount of static, as a rule the signals are easy to read during the daytime.

Our correspondent has failed to advise us as to whether a variable condenser was connected in shunt to the secondary coil. Possibly he may have used very close coupling between the primary and secondary circuit and a condenser was not therefore required.

### NEW OKLAHOMA ASSOCIATION

To THE EDITOR:—We take pleasure in announcing that on March 1st the Oklahoma State Wireless Association was reorganized, and, a week later, was incorporated under the laws of the State of Oklahoma.

The reorganization and incorporation were effected in order that we might erect a large club station and class rooms where beginners might get instruction and assistance in the art of radio communication, and to this end we have leased a large

tract of ground for a site, and plans for a large station are under way.

Application for special license is to be made soon, and until our operators take their examinations the work on the station will be mainly in the receiving.

We have found THE WIRELESS AGE a great source of help and inspiration in our previous experiments and it will be one of the most valuable additions to our library.

Very truly yours,

THE OKLAHOMA STATE WIRELESS ASSN.  
J. R. Jones, *President.*

# INSTRUCTION TO BOY SCOUTS



By A. B. COLE

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## CHAPTER XI

### A Receiving Set for Station Use

THE central meeting place of each Scout Troop should be equipped with a modern outfit suitable for operating over considerable distances, not only for purposes of instruction in operating, but also to enable communication to be maintained with other troops.

Most of the instruments needed for long distance reception of messages can be built without difficulty by members of the troop, and the rest, if purchased, should be of reliable make to insure satisfactory results.

The most approved form of station apparatus is that in which the instruments are mounted on a panel, which makes the set compact, and places the apparatus within easy reach of the operator. Fig. 65 illustrates the completed receiving set mounted in this way. The panel is of wood or hard rubber and measures 12 inches wide, 20 inches high, and  $\frac{3}{4}$  inch thick. It is supported in a vertical position by two brackets screwed to the back.

#### Receiving Transformer

The first instrument to be constructed is the receiving transformer; its windings, instead of being round, are square. The head A (Fig. 66) is of wood four inches square and  $\frac{3}{8}$  inch thick, and, as shown in Fig. 67, has its edges on one side raised  $\frac{1}{8}$  inch by the use of four wooden strips

$\frac{1}{4}$  inch wide, leaving a square hole in the center into which the core projects. The head H is also four inches square and  $\frac{3}{8}$  inch thick, but has a hole  $3\frac{1}{2}$  inches square cut out of its center, and the core of the primary is set inside this. The

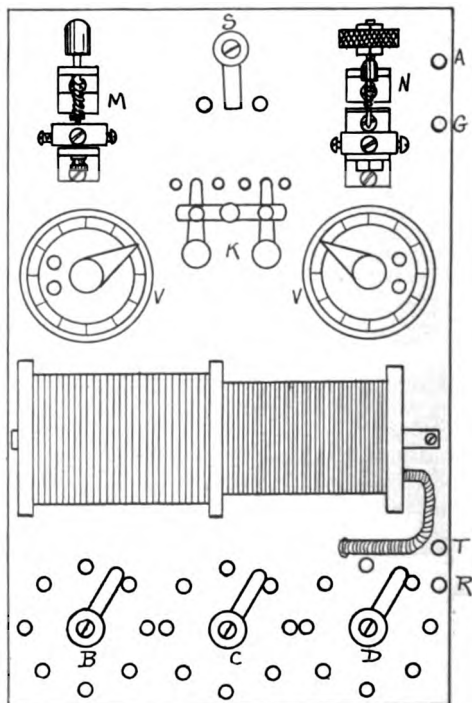


Fig. 65.—Complete receiving set



thin wood employed in parts of this receiving transformer may be taken from cigar boxes, which are made of cedar and very satisfactory for the purpose.

The small strips on the heads and also those forming the cores of the windings should be sandpapered first and then glued together, or small brass wire nails may be used, although the former method is preferable.

The core of the primary is  $4\frac{1}{4}$  inches long and  $3\frac{1}{2}$  inches square, outside, and is built of  $\frac{1}{8}$  inch wood strips. That of the secondary is  $4\frac{1}{4}$  inches long and 3 inches square outside, and is built of the same wood.

The head D of the secondary is  $3\frac{3}{4}$  inches square and  $\frac{3}{8}$  inch thick and has a square block C,  $\frac{1}{4}$  inch thick and  $2\frac{3}{4}$  inches square, set upon one side. This block fits snugly inside the core of the secondary. Another block E,  $2\frac{3}{4}$  inches square and  $\frac{1}{4}$  inch thick, is set inside the other end of the core of the secondary. A square hole is cut in head D, and also in block E,  $\frac{1}{8}$  inch square; and another  $\frac{1}{8}$  inch square in head A, by first drilling small circular holes and then cutting them out to the desired shape with a knife.

A thin square brass tube K,  $4\frac{3}{8}$  inches long and  $\frac{1}{8}$  inch square outside is set tightly in the holes in D and E and closely fits the brass rod F, which is  $\frac{1}{8}$  inch square and  $10\frac{1}{2}$  inches long. This rod is secured in head A by means of a washer and a machine screw entering it, and by a machine screw into G, which is a brass rod two inches high and  $\frac{1}{8}$  inch square.

The winding of the primary, or larger coil, is one even layer of No. 19 single cotton covered copper magnet wire. Taps, made in accordance with the directions given in Chapter X for the tuning coil, are brought out and are to be connected to a 9 conductor flexible telephone cable which will pass through the panel on which the receiving transformer is supported. The taps are taken off every half inch along the winding, and including the ends of the winding, will be 9 in number.

The secondary is composed of a single even layer of No. 28 single cotton covered magnet wire, in sections brought to taps, numbering 9 in all, as in the primary winding, to a nine conductor flexible tele-

phone cable which passes through head D for support. That conductor connected to the end of the winding nearest to the primary is a terminal of the winding, as shown in Fig. 72, and is the only one not connected to a switch point.

A flexible cable must be used to make these connections, as the secondary is moved toward or away from the primary and a cable of solid wires would resist the motion, and break before long.

The conductors of both the primary and secondary cables are led to switch points, with the exception of that mentioned before and the one connected to the end of the primary winding nearest head H, as these two are terminals of the windings, as illustrated in Fig. 72.

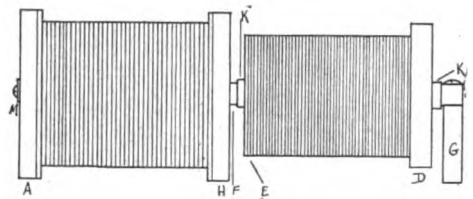


Fig. 66.—Receiving transformer

The other conductors are to be connected to switch points in two sets of 8 each, one set for the primary taps and the other for those of the secondary. The switch points are mounted on the panel as shown in Fig. 65, switch C controlling the primary and switch D the secondary. They should be connected in such a manner that the lever of either switch in revolving cuts in steps consecutively of the winding to which it is connected, starting from one end, and taking each step in proper rotation.

### Loading Coil

The purpose of the loading coil is to add sufficient inductance to the primary circuit of the receiving transformer to give it a sufficiently great natural period to permit tuning to the long wave-lengths transmitted by the Government and other high-power stations. This coil consists of two even layers of No. 19 single cotton covered magnet wire wound on a cardboard or wood core  $1\frac{1}{2}$  inches in diameter and ten inches long. As the wire is being wound on, four taps should be taken off each layer  $2\frac{1}{2}$  inches apart, and led to the points of switch B, mounted

on the panel (Fig. 65). The wire is wound in the manner of an electromagnet, starting at one end, which acts as a terminal of the coil, and winding continuously in the same direction.

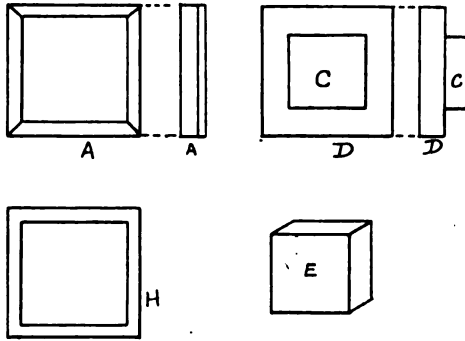


Fig. 67.—Parts of transformers

The loading coil may be supported on the back of the panel in any convenient way, but should be placed at least six inches above the receiving transformer so that the magnetic fields of these two instruments will not conflict. No iron should be used in the tuning apparatus or its supports, but brass or copper strips or screws may be employed.

**Detectors**

Two detectors are used in this set, and are so connected that the operator may change from one to the other quickly. As the sensitive substance one of these employs silicon and the other galena. These materials may be obtained from any large chemical house. Most crystals of silicon are of about the same sensitive qualities, but different crystals of the galena show different values for our purpose, and while a good piece of silicon will be obtained from an ounce or so, it is advisable to obtain a pound or two of galena to insure at least one extra sensitive piece. The size of the crystal seems to have no effect on the sensitiveness of the detector. Those handling the minerals should do so with care to prevent their becoming dirty or greasy.

In Fig. 65 the silicon detector is represented by M. It is shown in detail in Fig. 68, where A and F are brass strips  $\frac{3}{8}$  inch wide and  $\frac{1}{4}$  inch thick, bent at right angles so that they project  $1\frac{1}{4}$

inches from the front of the panel. A brass rod B,  $\frac{1}{8}$  inch in diameter and  $1\frac{1}{4}$  inches long, has a shoulder upon which a light spiral spring S of brass or phosphor bronze wire exerts a pressure. The upper end of the spring is soldered to F. The upper end of B is threaded to take the small hard rubber or fiber knob K.

The cup C may be of any convenient size between  $\frac{1}{2}$  and  $\frac{3}{4}$  inch diameter, and is arranged with three set screws through the side to hold the mineral in place. A hole is drilled through the bottom of the cup and is threaded to take a short brass rod which is threaded at both ends. A metal washer D is placed on the rod between the cup and A, in which a hole  $\frac{1}{4}$  inch in diameter is drilled as shown. A thumb nut N on the rod locks the cup in place in any desired position, so that B will touch any spot on the surface of the sensitive material.

A slot cut in A, as illustrated in the front view, permits vertical movement of this part which is locked at the best position by the screw holding it to the panel. The terminals of the detector are the two machine screws passing through the panel.

In Fig. 65, N represents the galena detector, which is shown more clearly in

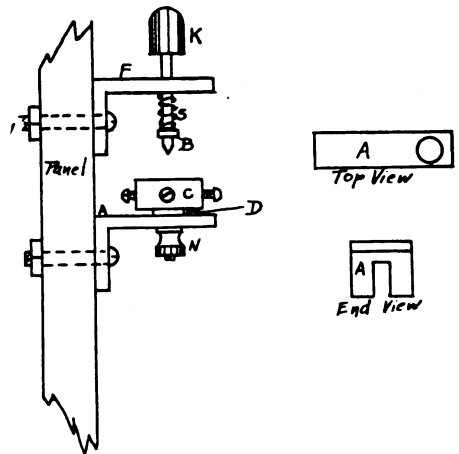


Fig. 68.—Silicon detector

Fig. 69. The hard rubber or fiber knob K is secured to the threaded brass rod B by means of two lock nuts A. K is  $\frac{1}{8}$  inch in diameter and  $\frac{1}{4}$  inch thick. B is  $\frac{1}{8}$  inch in diameter and  $1\frac{1}{4}$  inches long. Brackets C and H are made of strip brass

$\frac{3}{8}$  inch wide and  $\frac{1}{16}$  inch thick. C projects  $\frac{3}{4}$  inch from the front of the panel, and H is  $\frac{1}{2}$  inch longer. D is a leaf spring of light brass or phosphor bronze  $\frac{3}{8}$  inch wide and of the same length as H.

T is a small hard rubber or fiber knob threaded to take the small German silver rod W which is  $\frac{1}{8}$  inch in diameter and 1 inch long. It has a needle point which rests on the galena held in the brass cup F by means of three set screws. A fine spiral spring S is soldered to D and exerts a light pressure against T.

Cup F is held to bracket H by means of a brass rod threaded into its center and locked by nut E. The terminals of the detector are the machine screws held by nuts M and P.

This form of detector gives very good results on account of the extremely close adjustment which it provides, and it is least affected of any type by vibration. The rod W presses lightly upon the surface of the galena and any vibration is taken up by the combination of spring S and spring D. The pressure of the point on the mineral is regulated by knob K, and it will be noted that this gives a compound adjustment.

Condensers

Two large variable condensers V should be used in this set to provide a wide range of wave-lengths and to insure close tuning and long distance reception of messages. These condensers should be purchased, as they are difficult to construct and their cost is low. Reliable makes of variable condensers having a capacity of .003 to .005 M. F. can be bought for \$5 each, and it is suggested that no smaller size be used.

The fixed condenser, which is mounted on the back of the panel, is of the same dimensions as that described in the March, 1914, issue. This condenser should be placed in a wood case with binding post terminals, so that it may be secured properly to the panel.

Switches

The pole changing switch K (Fig. 65) may be purchased from any electrical house. It is taken apart and mounted less the base on the front of the panel as shown. This switch can be used to give the same results as a double pole double throw-knife switch and in this set is

arranged to place the variable condenser at the left either in series with the primary of the receiving transformer and the ground wire, or in parallel with the primary and the loading coil. The former

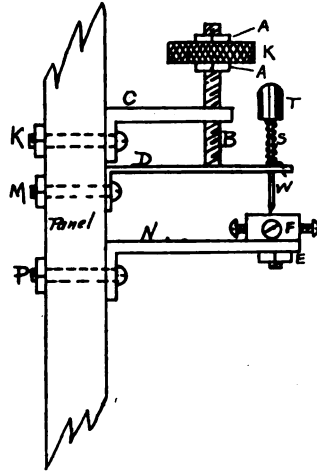


Fig. 69.—Galena detector

connection permits tuning to very short waves, such as are transmitted by amateur stations, and the latter aids in tuning to the long waves transmitted by government and other high power stations.

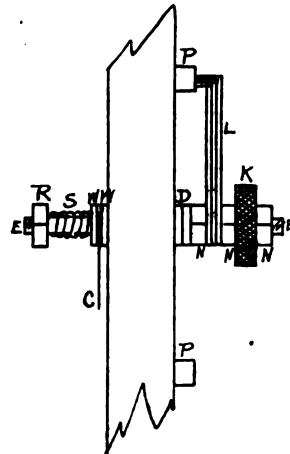


Fig. 70.—Switch lever

The contact points of all switches may be purchased, and this also applies to the switch levers, but if the builder has the necessary tools, it is advisable to make the levers after the type shown in Fig. 70,

so that adjustment from the center of the switch is possible. This is neater than the regular type of switch, and gives quick action with a minimum of effort.

In Fig. 70, the hard rubber or fiber knob K is secured to the brass rod E, which is threaded at both ends, by means of three locknuts N. The rod is  $\frac{1}{8}$  inch in diameter and is held toward the back of the panel by the pressure of a spiral spring S acting against nut R and two washers W, between which the wire C is placed and acts as a connection. Nut R is soldered to the rod to prevent turning. The washers D allow the rod to turn with a minimum of friction, but spring S insures a good electrical contact at all times.

The switch lever L is made of three strips of thin phosphor bronze, bent at right angles at one end and filed off to a rounded edge where it touches the contact points. This laminated lever provides flexibility and a good contact with the points. The switch points P are the ordinary type used in bell switches, and have slightly rounded heads. It is recommended that the levers of all four switches S, B, C and D be made in this way.

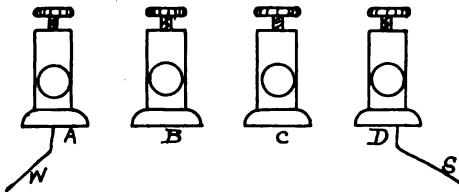


Fig. 71.—Receiver connections

Binding posts A and G are the aerial and ground terminals of the set, and the telephone receivers are to be connected to binding posts T and R. If several sets of receivers are to be used at the same time, they should all be of the same resistance and be connected in series, and to this end it would be well to arrange extra binding posts, connected as shown in Fig. 71, so that a number of head sets could be connected at once. W and S are the two wires of the set ordinarily connected to the receivers at posts T and R, and A, B, C and D are double binding posts. If one head set is to be used it is connected to posts A and D. When two sets are employed the first is connected in the upper holes in A and B and the second in the lower holes of B and D.

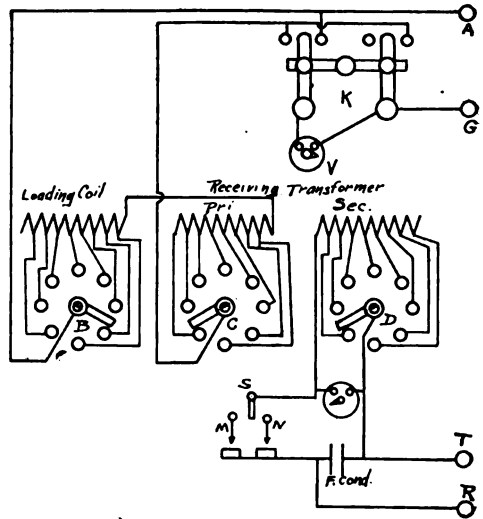


Fig. 72.—Wiring diagram

If three head sets are used, the first is connected in the upper holes of A and B, the second in the lower holes of B and C, and the third in the upper holes of C and D.

Binding posts A and D must always be in use as they are the receiver terminals of the set. In this way, any number of head sets may be provided for, but the more in use at one time, the weaker the received signals will be. When receivers are connected in series, those of the highest resistance will give louder signals with most detectors than those of lower resistance, providing they are of the same make and type.

### Wiring the Set

The wiring diagram of the set is shown in Fig. 72. The letters apply to the same parts as in Fig. 65, but some of the instruments are displaced in order that the diagram may be more readily understood. The condenser V at the right in Fig. 65 is connected across the secondary of the receiving transformer, while the other variable condenser is connected to the pole changing switch K as shown. This switch when thrown to the right places the latter condenser in parallel with the loading coil and the primary of the receiving transformer, and when thrown to the left, connects it in series with the primary of the receiving transformer and the ground connection.

In connecting the flexible 9 conductor cable to the secondary of the receiving transformer, sufficient slack should be left to allow it to be moved back and forth without difficulty.

All joints of conductors in the set should be soldered and taped if best results are desired.

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

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## NO DANGER FROM WIRELESS

A newspaper correspondent is alarmed by the "frequency of sparking in the rigging" which he states that he noticed on board the vessel in which he made a voyage recently, and he suggests that "here is a matter of some importance to ship owners and others, which would repay investigation."

Fire from the sparking in ships' rigging arising from the use of the wireless plant is a practically nonexistent danger. This was shown by exhaustive experiments made by the Marconi Company in April, 1912, at the instance of a firm of shipowners.

A quantity of naphtha was placed in a saucer and lodged as near as possible to a heavy spark, and a piece of waste saturated with naphtha was also placed close to the spark electrodes, but in neither case was the vapor ignited by the spark. A similar test was applied to the small sparks which obtain at minor parts of the apparatus, but it was not until a continuous spark was allowed for a very long period (which would not occur in actual practice) that the naphtha was eventually ignited.

The tests—which were all the more important as naphtha is one of the most inflammable cargoes carried—convinced the officials who carried them out—the superintending engineer of the shipping company and a representative of the Marconi Company—that fumes of naphtha would never be sufficiently dense inside the wireless cabin to permit of ignition. Outside the rigging this would be even more obvious.

Notwithstanding these tests, the Marconi Company has, at the request of some

shipowners, enclosed the sparks, which are a necessary part of the transmitting apparatus, either in glass tubes or with a covering of gauze.

The sparks which may occur outside the wireless cabin in the rigging, when they do occur, are produced by induction, and have such a small heat value that they would be totally incapable of igniting gas, even if it were possible for gas to accumulate in the open air in the neighborhood of a spark. For the same reason these sparks could not ignite the driest inflammable material.

It may be suggested that sparks might occur within the ship itself, but this has never been noticed, and, in fact, with the comparatively small power which is used in the wireless installations on merchant vessels, the possibility of any spark within the ship itself is difficult to conceive, as the holds would be screened by the metal plating of the ship from any induction effect produced by the transmitting apparatus.

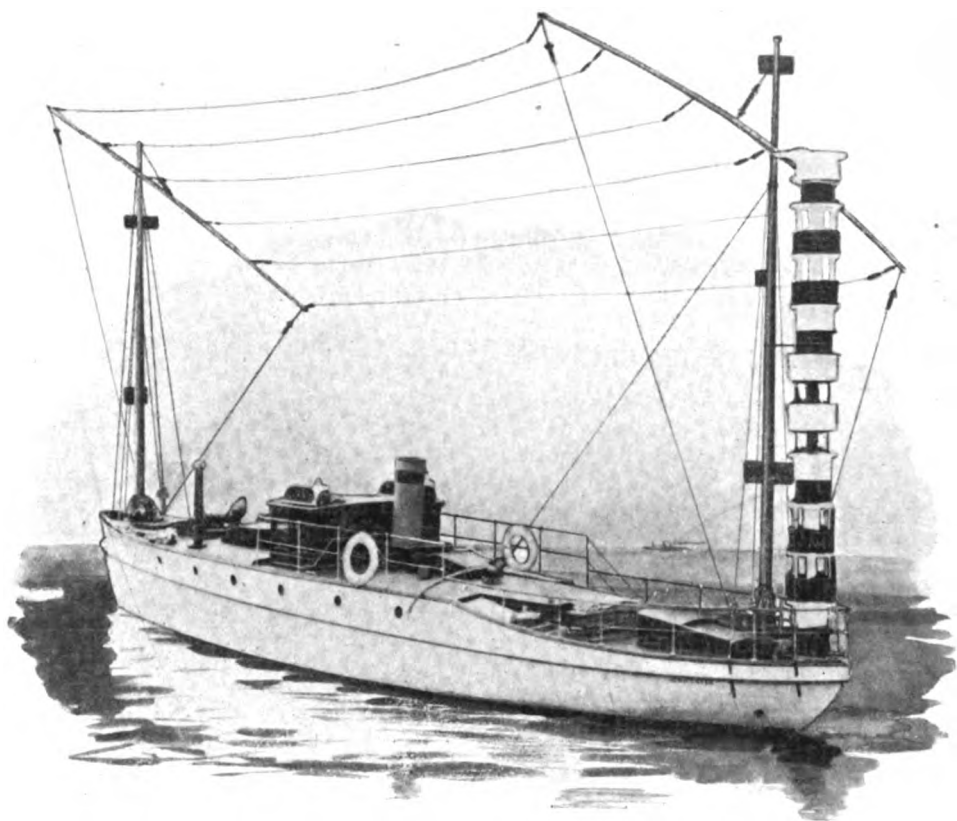
The foregoing statements refer to the high potential and high frequency portion of the wireless apparatus. There is also to be considered the low voltage circuit which supplies the transmitting apparatus with electric current from the ship's dynamo. All wiring, however, in connection with this is identical in every way to wiring carried out for electric lighting and motive power, so that no greater risk from fire arises, as far as the low voltage portion is concerned, than it does from the use on board of electric lamps and motors.

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## ENGAGING SERVANTS BY WIRELESS

The following paragraph appears in a report issued by the Dominions Royal Commission which recently met in London:

"The demand for female domestics, both in Australia and New Zealand, appears to be practically unlimited. In some cases, before a ship carrying women emigrants sights the land a large number of its passengers have been engaged by wireless telegraphy. In other cases would-be employers go out in tugs to meet it."



## Hammond's Wireless Controlled Boat

**J**OHAN HAYS HAMMOND, JR., son of the celebrated mining engineer, has for a number of years been experimenting with wireless telegraphy and adaptations of wireless to other purposes. On a wooded cliff near his father's summer home on the shore of Gloucester, Mass., Harbor, he has erected a wireless station, with two masts rising 360 feet high from a granite base. No higher wooden masts have ever been erected, and they have been insured at Lloyd's for \$10,000. From his lookout station on the cliff he can, by touching a key, start or stop and

steer his wireless controlled boat out and back along an 8-mile course filled with rocks, shoals and harbor craft at the speed of the swiftest cruiser.

Forty horsepower gasoline motors propel the craft, the wireless being used to start and stop her and to guide her in whatever course the operator elects. She has two masts each 40 feet high, one with alternate black and white painted cylinders on it. By these masts in the daytime he sights the craft at any distance. At night these are illuminated with clusters of electric lights.

The steering operator on the lookout platform touches a key and releases the energy emanating from the wireless antennæ of the aerials, supplied by a private power house near by. Mr. Hammond believes that only a millionth part of the power released from the aerials ever reaches the boat; the rest is dissipated into space. At night the beams of a powerful searchlight with a 5-foot parabolic mirror, more powerful than that of any battleship and the brilliancy of 186,000,000 candle power seven miles at sea, follows the boat as she zigzags about Gloucester harbor, uncanny in her avoidance of obstructions, sometimes with several experts aboard, and at others without a soul.

With a turn of his hand the operator on shore directs this immense light; a little crank lifts or lowers it; another moves it to left or right. These cranks are electrically connected with motors in the search lighthouse, and the beams do not cross the lookout platform at all. A tiny beam alone illuminates the operator's record pages.

The gentlest touch of his finger suffices to turn a vessel weighing five or six tons to any point of the compass at a distance of three to eight miles out at sea. The control is accomplished by allowing wireless waves from a shore station to act upon a system of receivers, relays and motors in the vessel, each motor exercising some control over engine or rudder. One turns the rudder to the left, another to the right; another sets the engines at half speed, another at full speed, and a third stops them. The current operating these motors comes from generators carried by the vessel itself. The wireless station ashore sends the power to start the motors or stop them. There are about five main controls, working on a dial, the wireless impulses working on these controls like invisible fingers. As the sending key is pressed in one way or another the moving hand stops at different places on the dial, actuating one motor after another, each move performing some definite piece of work.

With the help of his laboratory staff—for this young man has money enough to experiment to his heart's content with expert paid assistants—Mr. Hammond and an expert from Harvard have worked

an entire year devising a reliable detector to take the place of the coherers that failed him when he had proven his ability to steer the boat for two miles, and victory was almost in sight. He guards the secret of this detector carefully.

Greater efficiency was also gained by supplying his power house with the fastest electric generators, turning at the rate of 700 miles an hour. This means that if the generators were to run on tracks, in four hours they could cross the Atlantic, or in one hour cover the distance between Boston and Chicago.

Hammond's sending station is capable of transmitting a distance of 2,000 miles and is the most powerful private equipment in the world.

Solely because of the limitations of the lookout, who can see only seven miles, is the guidance of the boat restricted to that distance. The sending station could send out efficient impulses to about fifty miles. Thus from a military point of view one sending station is sufficient to guard 100 miles of coast line, after the coast has been fully equipped with lookout and sending stations. It may be that with the powerful range finders used in coast defense works the radius may be increased, just as the effectiveness of gun fire has been increased. If necessary, the sending station can be equipped with disappearing aerials, a device which young Hammond has patented.

For the wireless boat can be substituted a wireless torpedo, equipped with the two small aerials, its hull almost sunk beneath the surface and but a very small part of its whaleback shaped deck rising above the water. If one torpedo should be struck by an enemy's shot others could be sent out as fast as required. A dozen torpedoes would not cost one-tenth the price of a battleship.

Young Hammond is but 25 years old, and as a schoolboy made a written prediction, that he would some day control a moving body at a distance by the sound of his voice. He has already done this. Through a sound-amplifying device the vibrating energy of spoken words is made to do the work usually done by the pressure of the finger on the wireless key.

Mr. Hammond's new boat, now under construction, is to have a guaranteed speed of 33 miles an hour.

# From and For those who help themselves



## FIRST PRIZE, TEN DOLLARS

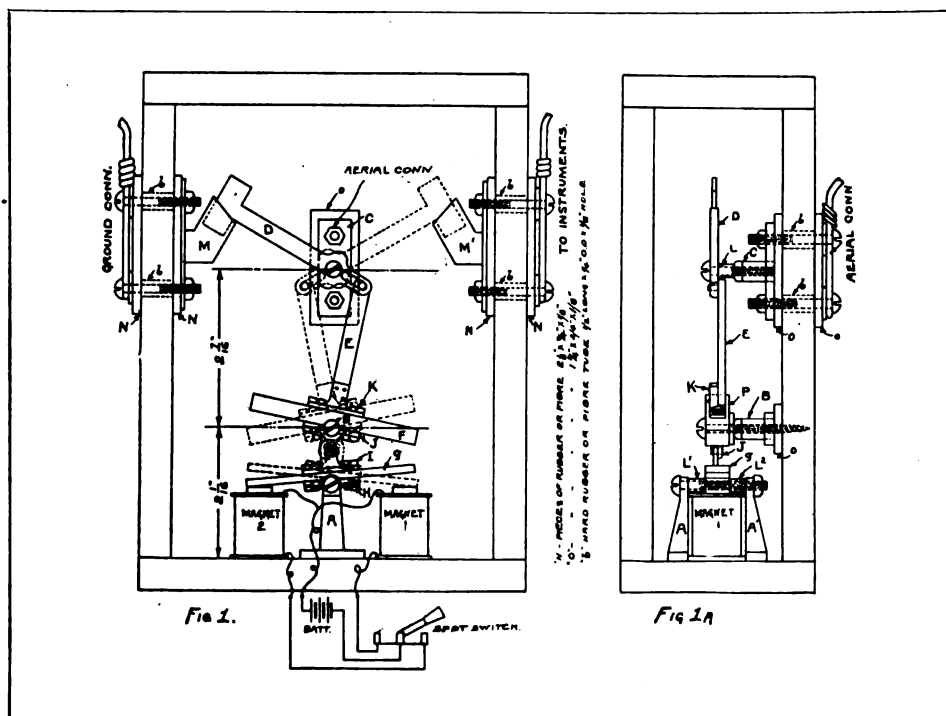
### *An Electro-Magnetic Aerial Switch*

I have recently designed an outside aerial switch of the distant control type operated by an electro-magnet, which, I believe, will fully comply with the under-writer's regulations.

The front elevation is shown in Fig. 1, a side elevation in Fig. 1a, and details of the various parts in Fig. 2. The entire apparatus after being assembled is mounted in a box as shown. This box may be of wood or hard rubber. It is preferably lined with asbestos and coated with water-

proof paint or waterproof varnish. The outside dimensions are 3 by 6 by 8 inches.

A detailed description of this device is not necessary as the construction should be plain from the drawings. It will be readily seen that a slight movement of the armature G produces a correspondingly large movement of the lever D; also, by throwing the battery switch one way or the other, the current is made to flow through either magnet No. 2 or No. 1. This throws the lever D in contact with either M or M1. Thus the aerial may be earthed or connected to the instruments as desired.



Diagram, First Prize Article



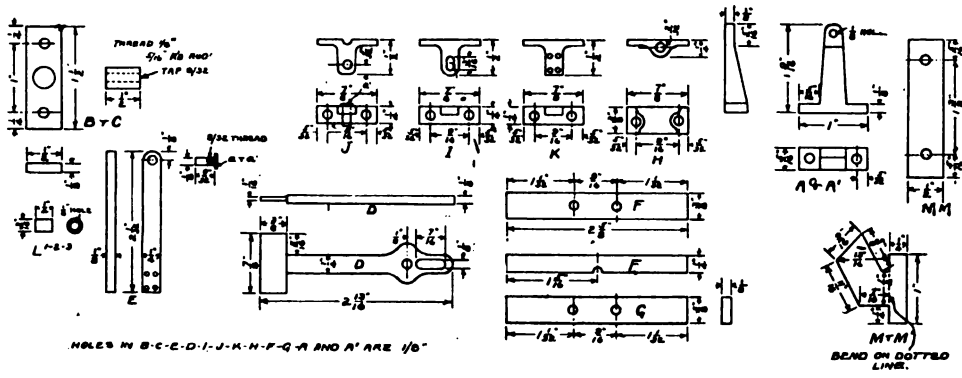


Fig. 2, First Prize Article

The magnets 1 and 2 are taken from large size electric bells; the armature G is of soft iron. The lever E is of hard rubber, and the remainder of the construction is of brass except where it is differently marked.

The bracket pieces B and C will be made stronger if a square piece, instead of the 1/8 of an inch round piece, is used. The corners should be turned off in a lathe to 1/8 of an inch and the rod threaded. The contact pieces M and M1 are bent along the dotted line and then riveted to N, N to form spring jaws as shown in the assembled sketch.

Three or four dry cells will give sufficient current for operation. If a larger break is desired lever D should be lengthened and E changed in proportion, shifting the jaws M and M1 to correspond.

A switch of this type possesses an advantage over the hand-operated type in that it can be operated from a distance and therefore the antenna can be effectively grounded externally to the wireless station.

J. E. PUGSLEY, New Jersey.

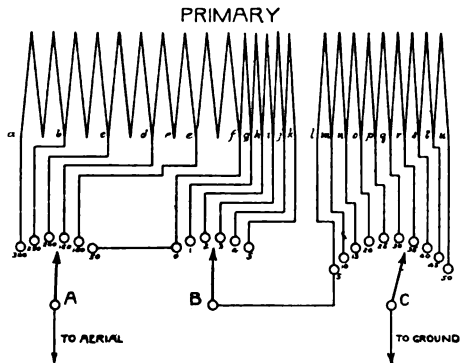
SECOND PRIZE, FIVE DOLLARS

*A New Method for Variation of Inductance in a Tuning Coil*

I have recently employed a new method for varying the amount of inductance in use in the primary winding of an inductively coupled receiving transformer, which may also be applied to any single tuning coil. While my method is somewhat similar to that employed in the

United States Navy tuners, yet I believe it possesses considerable advantage on account of the fact that the construction is not so difficult and that a smaller number of taps is required.

My sketch and article are based on an inductively coupled tuner having 300 turns of wire on the primary. My method requires but 22 taps in all, whereas in the



Diagram, Second Prize Article

Navy tuner of an equal number of turns, where the switch giving coarse adjustment of inductance contains a tap for every 15 turns, 35 taps are necessary. If a coarse adjustment switch containing a tap for every 10 turns were used 40 taps totally would be needed.

A coil of this type may be built in the following manner:

Three switches are required, two having six points and one having ten points. When the winding is begun, one end of the wire should be fastened in a small hole at the end of a tube. Fifty turns are wound

as evenly as possible, and a tap taken long enough to reach the multiple point switch. The same wire is then returned to the tuning coil, making a loop. This loop should be twisted just tight enough to prevent the wire on the form from becoming loose. If twisted too tightly it may break before the coil is completely set up and cause considerable trouble.

After six such taps a tap should be taken each turn for five complete turns. Before twisting the fifth tap, mark the leg coming from the tube, either by making a knot in it, or by removing the insulation for a short distance. This precaution is taken so that this leg may be distinguished from the leg returning to the tube. Next take a tap every five turns until nine taps have been covered.

In connecting the taps to the switch point it is best to begin with tap U. Connect it to point 50 of switch C. Tap T is connected to point 45 and so on until tap K is reached. The unmarked leg is connected to point 5 on switch C. The marked leg is connected to point 5, switch B. There should be no connection between point 5 on C and point 5 on D. The 1 turn taps are connected in order through the points on switch B. Tap F is connected to point O on switch B and extended to point 50 on switch A. The remaining taps are connected in order as shown. Switches A and C are connected to the aerial and ground respectively. Switch B is connected to point 5 on switch C.

WALTER GULDI, New York.

### THIRD PRIZE, THREE DOLLARS

#### *An Adjustable Condenser*

A condenser of the type here described is very useful for experimental purposes, especially in connection with wireless telegraphy and telephony. The total capacity of this condenser is obtained by the employment of a variety of connections between a set of fixed condensers. The changes of capacity are quickly made by means of a set of switches.

If the true capacity of each independent condenser is known the resultant capacity of any particular combination may be readily calculated by the use of the for-

mulae given in previous issues of *THE WIRELESS AGE*. One of these units which I have constructed is shown in Fig. 1. Six single-pole double-throw switches are mounted on the top of the box which in this case were connected to 5 condensers of one microfarad capacity within the box the connections for which are shown in Fig. 2.

The constructional details are optional with the builder. For instance, a common

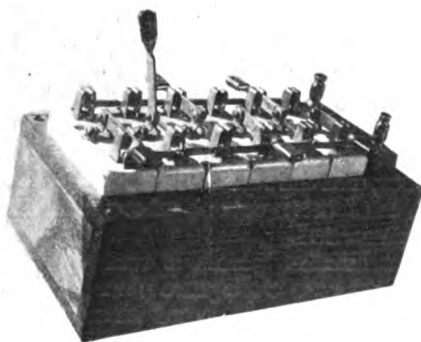


Fig. 1, Third Prize Article

2-point battery switch may be substituted for the single-pole double-throw knife-blade switch.

This condenser can be constructed for high voltages if desired, provided care is taken concerning the insulation. If it is to be used on low voltages, a dielectric composed of paraffined paper will suffice.

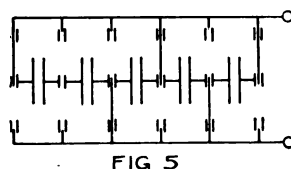
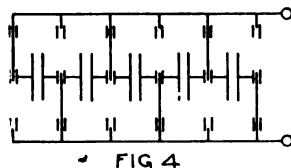
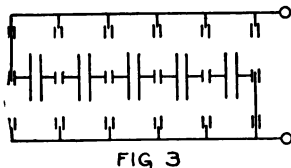
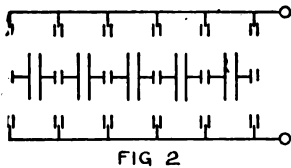
If the capacity of each condenser is to be 1 microfarad or over it is advisable to purchase them direct from a telephone company. The condensers used in telephone work I have found to be admirable for such purposes.

In conducting experiments with the musical arc, 20 1 M. F. condensers, consisting of four units (Fig. 1), were used.

It was connected in series with an inductance which formed an oscillatory circuit across the arc. By thus connecting the condensers in series a minimum capacity was obtained and when connected in parallel a maximum capacity was obtained.

Fig. 3 shows all the condensers connect-

ed in series, the 2 end switches only being used. Fig. 4 shows the condensers connected in parallel. In Fig. 5, two condensers are in series, and three condensers in parallel. These 2 sets are connected in parallel, the total capacity being equivalent to the sum of 3 condensers and a fraction. This combination is shown in the photograph, Fig. 1. In the same manner, many other combinations can be made.



Diagrams, Third Prize Article

An adjustable condenser of this type may be used in any wireless receiving circuit, providing the proper capacity is used in each independent condenser.

For quick work the builder can lay out a chart showing the resultant capacity of any combination. Thus, in experimenting, a glance at the chart will give the resultant capacity of the entire condenser.

L. R. JEWETT,  
Massachusetts.

### FOURTH PRIZE, SUBSCRIPTION TO "THE WIRELESS AGE"

#### Type "D" Receiving Outfit

The following is a description of a receiving tuner suitable for amateur use which should appeal to experimenters on account of the cheapness of construction. The total cost should not exceed \$2.50. If properly constructed it should prove the equal of a good many higher priced outfits.

This tuner is identical with the type used by the Marconi Company on many of the boats on inland waters with the exception that no potentiometer is employed. The set has been adapted for use with silicon, galena or other mineral detectors which do not require a battery.

Procure two wooden cylinders, 3 inches in diameter and 11 inches in length. These can be purchased at any lumber mill at a trifling cost. These cylinders are each wound with No. 24 enamel wire within 1/2 inch of each end. When starting the winding a small staple is driven over the end of the wire into the cylinder.

The wire should be wound tight and evenly. When the winding is completed it should be given a coating of shellac or ordinary fish glue, and then set away to dry. Of course the wire must be straight to allow contact for the slider. This may be done conveniently with a sharp-pointed knife.

After both cylinders have been wound work on the cabinet can be started. The inside dimensions of the cabinet (Fig. 2) are 11 by 9 inches, the height should be made to suit the necessary height of the slider above the coil. The top is made in 3 pieces and 1 of the sides in 2 pieces to make space for the sliders. This should be plain from the drawing. The cabinet need not necessarily be made of expensive

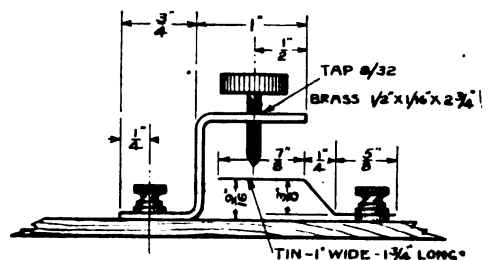


Fig. 1, Fourth Prize Article

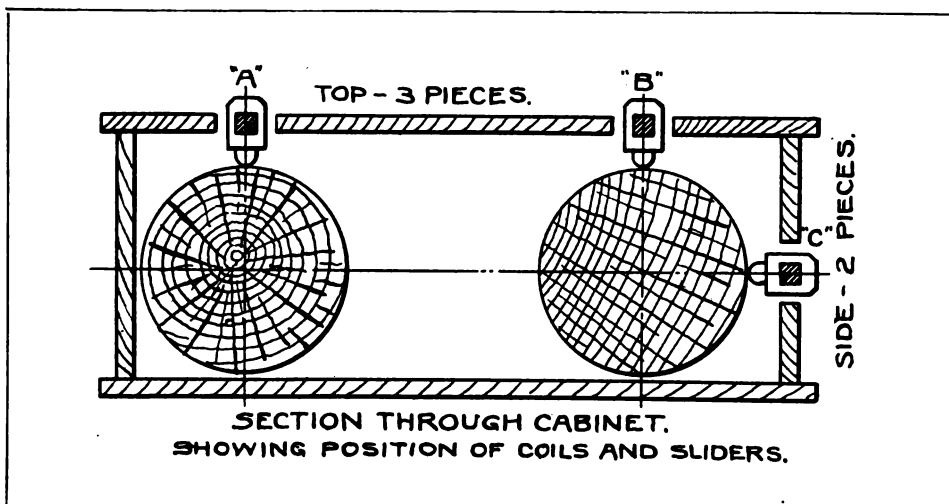


Fig. 2, Fourth Prize Article

wood as ordinary packing box lumber looks well when thoroughly sandpapered and stained.

The remaining apparatus required is: Three brass rods  $\frac{1}{4}$  of an inch square and 12 inches in length; 3 sliders, a fixed condenser, a detector, and the necessary binding posts. The rolling ball sliders sold by the E. I. Company will answer the purpose admirably and at the same time lend a very distinctive appearance to the set.

Any experimenter who does not care to purchase a detector and has the use of a drill and tap may construct a very good one after drawing Fig. 1, for about 25 cents or less. Secure a brass strip  $\frac{1}{7}$  of an inch in width,  $2\frac{3}{4}$  inches in length, bent, drilled and tapped to suit the drawing. Cut out a piece of tin as a base for the mineral as per the drawing. The binding post should be of the hard rubber kind as furnished by the E. I. Company. Any good fixed condenser may be used in connection with this set.

The outfit is now ready for assembling. The detector is mounted on the middle board near the rear so that the arm can be rested on the cabinet while it is being adjusted.

The fixed condenser is placed beneath the board and just in front of the detector. The two cylinders are then placed in their respective positions and a screw is put through the end of a cabinet into the ends of each cylinder to hold it in position.

The three brass rods are now ready to be placed in position and, after a slider is placed on each, they are fastened to the cabinet as shown in Fig. 1, 2 being placed on the top and 1 on the right-hand side.

The wiring is done after the diagram shown in Fig. 3. The connections are made with No. 18 insulated Bell wire.

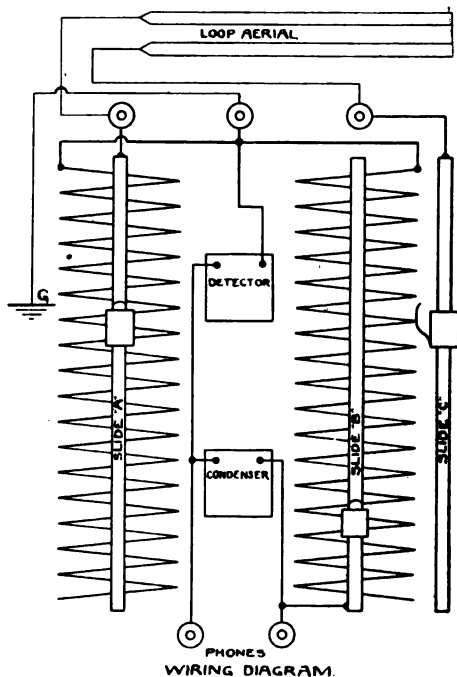


Fig. 3, Fourth Prize Article

Note that the 2 coils are connected together at one end and then to the earth post. Three binding posts are mounted on the rear end of the cabinet, the 2 outside ones being for the aerial connections, and the middle one for the earth connection. Two binding posts are then mounted on the front of the cabinet for connection to the head telephones.

The connections are made as per Fig. 3; i. e., sliders A and C are connected to the two sides of the antenna and slider B connected to one leg of the detector circuit. The fixed condenser is connected in series with the detector and the telephone shunted around the fixed condenser.

I wish to make it clear that this set is intended to be used only in connection with a loop antenna.

PHILLIP W. BOWMAN, Maryland.

### HONORABLE MENTION

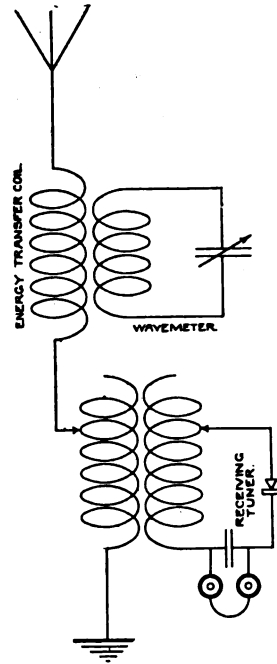
#### *A Simple Method of Using a Wave-meter*

The object of this article is to explain a simple method of using a wave-meter for determining the wave-length of a distant transmitting station at the receiving apparatus. As many experimenters are aware, the usual descriptions and diagrams of wave-meters include either a pair of head phones and a detector or buzzers employed to make the wave-meter a transmitter of predetermined wave-length.

Assuming that the experimenter possesses the usual type of loosely coupled receiving set and a wave-meter he may measure the wave-length of incoming oscillations in the following simple manner:

An energy transfer coil, consisting of 20 or 30 turns of coarse insulated wire, is connected in series with the aerial circuit as per the accompanying diagram. It is so placed that it can be set in inductive relation with the inductance coil of the wave-meter as desired. A distant station is then tuned in to the maximum strength of signals in the regular manner. The inductance coil of the wave-meter is then inductively-coupled to the energy transfer coil. The capacity of the wave-meter condenser is then altered until the signals are weakened or nearly disappear. At this adjustment the wave-meter and the incoming wave are of the same length. By reference to the wave-meter chart the wave-length of the distant station is obtained.

The explanation is very simple when it is remembered that a wave-meter will absorb the most energy when it is set at



Diagram, *Honorable Mention Article, Harry V. Roome*

the same wave-length as the circuit supplying the energy. It will be noted that with this method of using the wave-meter no extra detector or phones are needed, no exciting buzzer is used, the regular receiving hook-up is not disturbed in the slightest, and the station whose wave-length is to be determined can be heard all the time while the wave-length is being measured.

HARRY V. ROOME, California.

### HONORABLE MENTION

#### *An Amateur Receiving Set*

I recently constructed a wireless receiving set with which I obtain excellent results. While there is nothing distinctly new or novel about the "loading coil" or "loose coupler," other than being self-constructed, considerable advantage is derived from the fact that I use telephone pin jacks and cam switches for making a

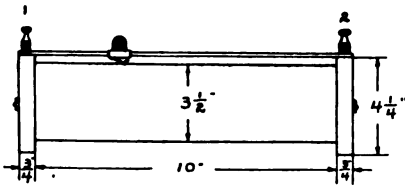


Fig. 1

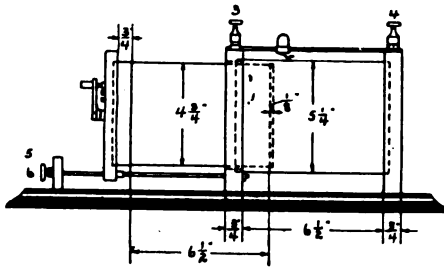


Fig. 2

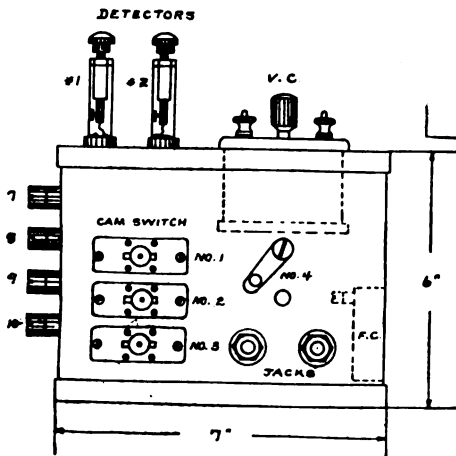


Fig. 3

Diagram, Honorable Mention Article,  
W. O. Powers, Jr.

variety of connections in the receiving tuner and its associated circuits, allowing complete rearrangements of the circuits to be made with considerable ease and facility.

I get such excellent results with the various combinations by simply moving the switches, that I thought the following description and sketches might be of some value to other amateurs. I had in mind particularly those desiring to con-

struct their own sets and obtain at the same time a permanently wired set with concealed wiring that will allow various combinations to be made without completely changing the wiring. This, to say the least, is slow work.

Fig. 1 shows the dimensions, etc., of the loading coil. The ends are made of mahogany and the metal parts are of brass. The core is made from a piece of fiber conduit smoothed up on the outside and wound with No. 22 enameled wire.

Fig. 2 shows the general makeup of the loose coupler with dimensions. Both heads of the primary are made of mahogany and the secondary head is made from a piece of hard rubber one half inch thick. The base is also made of mahogany and all metal parts are of brass. Both primary and secondary cores are made of fiber conduit. The primary is wound with No. 20 enameled wire and equipped with a single slide. The secondary is wound with No. 28 enameled wire and has ten taps, equally divided and brought through the inside of the core to studs on the head where is also mounted the radial adjusting switch.

Fig. 3 shows the position of the detectors, switches, etc., mounted on the box. All connections are made on the inside, according to the wiring diagram.

As will be seen by tracing out the circuits on the wiring diagram moving switch No. 1 which controls the detectors to the right cuts in No. 1 detector and to the left cuts in No. 2. This arrangement I find to be of great value as different minerals may be compared or minerals of the same kind readjusted to give maximum signals allowing one detector to be in operation while the other is being adjusted.

Moving switch No. 2 to the right places the phones around the fixed condenser; moving it to the left places them around either detector that may be in operation. I sometimes get better results from certain stations with them when connected around the fixed condenser and at other times signals from a different station come stronger when they are connected around the detector.

Moving switch No. 3 to the right connects the instruments for inductive coupling and when tuning in this manner switch No. 4 should be opened. Moving the switch to the left makes connections

for single slide tuning, using the loading coil and primary of the loose coupler; or if desired the loading coil and primary may be used separately; the one not wanted may be cut out by placing the slider at the zero value of inductance.

I use the single slide tuner to pick up stations, but, to eliminate interference, I change over to the inductively coupled tuner. When using the single slide hookup, switch No. 2 must be to the left and switch No. 4 closed.

All of these switching combinations can be made instantly by simply moving the switches to right or left.

The switches used are of the cam key type such as employed in telephone practice and can be had with various number of contacts, allowing the use of any number of "hookups" as desired. For those not familiar with this type of switch, a sketch is shown in Fig. 4.

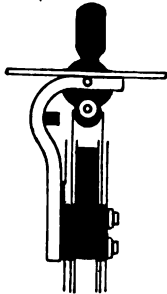


Fig. 4

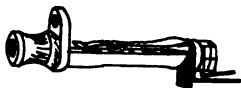
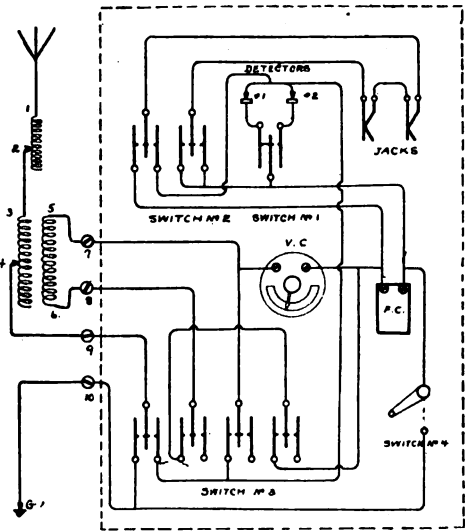


Fig. 5



Fig. 6

Diagram, Honorable Mention Article, W. O. Powers, Jr.



**WIRING DIAGRAM**  
ALL WIRING WITHIN DOTTED SQUARE DONE INSIDE OF BOX. THROWING CAM SWITCHES TO RIGHT CONNECTS CENTER WITH OUTSIDE CONTACT ON LEFT OF EACH GROUP AND VICE VERSA.

Wiring Diagram, W. O. Powers, Jr.

Switch No. 4 is a single pole radial switch. The pin jacks are of the type used in telephone and telegraph practice and can be obtained in several different styles to suit the experimenter. The one shown in Fig. 5 is of the series or closed circuit type and is adapted to mounting in wood by one wood screw through the hole in the top of the shoulder.

These jacks can be used to good advantage in wireless work. In this set I have two, wired in series, as shown, which permits a second set of head phones to be plugged in if two persons wish to listen in at one time.

Fig. 6 shows the type of plug to be connected to the double conductor cords of the phones and is known as the double plug; when inserted in the jack the tip, which is insulated from the body, connects with the spring of the jack which opens the jack circuit and closes it via the body of plug and the frame of the jack.

In the wiring diagram, the straight line represents the frame of the jack and the angled line the spring.

The cam switches, pin jacks and plugs used are catalogued and can be purchased from dealers in telephone apparatus and supplies.

W. O. POWERS, JR., New York.



*The men fought madly from one end of the cabin to the other*



# Hamilton Marron, Esquire

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An exciting tale of a belated passenger, a black bag, a charming bit of femininity and the outcome of a wireless room visit

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By GEORGE MABIE TODD

THE fellow who said the same spirit sent the knights of King Arthur's Round Table and wireless operators in search of adventure hit it about right. And there's just as much adventure in these days as there was in the times Tennyson wrote about. If you don't believe me just "listen in" while I pound out this story.

It was on one of my trips on the *Morania*, bound from New York to Liverpool. Steaming slowly down the river with flags waving and bands playing, we were feeling our way through the fleet of harbor craft blocking our way when I caught sight of a tug far astern. By the speed she was making I suspected that she was trying to catch the *Morania*, and it seemed more certain as I watched the way she dodged in and out among the vessels that were in her course. Once she grazed the bow of a ferryboat; again she narrowly escaped collision with a scow. She was hitting it up some, for the captain of the tug evidently knew that once we were well out of the harbor and our screws began turning it would be hopeless for him to try to overtake us.

The tug gained on us little by little and about off Beaver street she finally steamed alongside. The tardy passenger stood on her deck, a keen-featured man, carrying a small black bag. It was but the work of a few minutes to transfer him from the tug to the steamship and so frequent are these occurrences, had it not

been for the unconcerned manner in which he received the congratulations of the other passengers on the successful boarding of the liner the man would probably not have attracted my attention further.

I happened to be standing near by when he introduced himself to the purser as Hamilton Marron.

"Close squeak that time, eh purser?" he remarked. "I simply had to catch this boat, too."

The man had an ingratiating manner which was not without its effect on the purser.

"Take the gentleman's bag and put it in room 92," he directed a steward as he verified the ticket. The steward stepped forward, but Marron shook his head.

"You needn't mind, I'll look out for that," he said hastily, and drew the bag toward him as if fearful of losing it.

"Must be something valuable in that," remarked a passenger. Marron's sang-froid dropped like a flash.

"What do you mean?" he snapped. Then he saw that the other man was smiling and recovered himself.

"Oh, I see, a joke," he murmured, and followed the steward to his stateroom.

Our voyage for the next three days was uneventful and Marron passed almost out of my mind. I afterward learned that he had kept closely to his stateroom during that time; so busy was I with press and message traffic that I had no oppor-

tunity to speculate upon his agitation over the custody of the bag, or conjecture his possible whereabouts.

A steamship is bound to have some gossip, though, and we operators hear many things; it wasn't long before one of the stewards told me that Marron was unusually generous with his tips. Also a man of good taste for he had formed a friendship with the prettiest girl aboard, a Miss Randall, from Detroit, and when Marron was not in his stateroom he was always with the girl. None of this information had much interest for me at the time and I turned a deaf ear to the tattling of the fellow.

I was testing my apparatus the following day when Marron appeared for the first time in the doorway of the wireless cabin accompanied by Miss Randall. The few questions he asked showed that he had some knowledge of wireless and I guess I must have looked my surprise for he laughed and said:

"Oh, I'm pretty green, but once on a time I pounded a key myself. That was many years ago in a broker's office. I picked up a little smattering of wireless a while ago when one of my neighbors put up a station on his house."

Miss Randall joked with him about his proficiency as an operator and we spent an agreeable quarter-hour. He had the gift of making himself especially entertaining and I invited him to visit the wireless cabin again.

That night we had an exceptionally heavy batch of commercial business; when a lull finally came I was suffering from a severe headache and left the wireless room to get a breath of fresh air. The brisk wind was soothing and I remained away from the apparatus longer than I had intended to.

As I made my way back to the wireless room, something, I don't know what, prompted me to pause on the threshold and peek inside the cabin before I entered. I drew back startled. Seated at the table with the phones to his ears, elbows



*He drew the bag toward him as if fearful of losing it*

on table and intently listening, was the figure of a man. The lights had been turned off and I could not see distinctly, but I was sure it was not that of Bill Evans, the second operator.

Resolved to give the intruder a scare that he would remember, I crept softly toward him. His cap was pulled so far down over his eyes that it was impossible to distinguish his face. As I made another step forward the figure at the table suddenly sprang to its feet; a fist shot out and I sank into unconsciousness.

They found me on the floor of the cabin where I had been felled, and for a day I was pretty quiet.

The captain ordered an investigation, but nothing came of it; after a while I became tired of puzzling my brain about the identity of my assailant and laughed when the subject was brought up. But my aching jaw reminded me of the reality of the attack, nevertheless.

The news of my unpleasant experience became noised about the ship and I was bothered with visitors. I dodged the limelight by telling them my duties would not permit me to relate to each and every one the details of the occurrence. Marron and Miss Randall visited me several times and were very solicitous in their inquiries. "I suppose you'll have a guard with you after this?" Marron laughingly observed.

I replied that I didn't believe it would happen again and that I felt able to take care of myself. I don't know what made me so confident; I found out later—in fact that very night—that my statement should have been revised considerably.

Traffic was light and the hours slipped away slowly. At midnight I was so fearful of falling asleep that I rang for a cup of coffee. No one came; and deciding that the buzzer was out of commission I left the cabin to hunt up a steward. On my way back to my set I felt a touch on my arm and turned about to find myself facing Miss Randall. She explained that she had lost a ring in the earlier part of the evening and, having just discovered the loss, had returned to find it. While she was making her search she had seen a man enter the wireless cabin; his stealthy actions and the fact that he did not wear a uniform had aroused her suspicions. I told her to return to her stateroom and not to mention to the other passengers what she had seen.

Not a sound came from the wireless room when I reached the door. The place was in darkness, as I had left it, but I felt instinctively that the man whom Miss Randall had seen was still there. As quietly as possible I felt for the electric light switch. Click! went the key and the room was suddenly illuminated.

Seated at the instruments was a familiar figure—Marron!

It has been my lot to meet with many surprises and adventures during my life, for these are part of the experiences that men in my business expect. But so little had I anticipated finding in the cabin this man . . . well, I just stood still and gasped.

If Marron was concerned he did not show it. The head phones were at his ears and he was deeply absorbed.

As I approached he turned, laid the phones on the table and smiled.

"Just took the liberty of listening in," he said engagingly.

"Anything worth while?" I asked, assuming an air of nonchalance, although I was doing some rapid thinking. "Nothing much," he replied. I slipped on the phones and adjusted the tuner; at the same time I kept a watchful eye on Marron. New York had been sending, I gathered from the desultory words that buzzed in my ears. So I sent out a call for a repetition of the message. Marron started.

This is the marconigram I copied with him looking intently over my shoulder:

To Captain Johnson,  
S.S. Morania, at Sea:

Arrest Thomas Jennings, alias Gentleman Tom; sometimes assumes the name of Hamilton Marron. Believed to be aboard the Morania. Wanted here for forging \$125,000 draft on the Anchorage Bank. Medium height, gray hair, scar on back of right hand. Believed to have \$125,000 cash in small black bag. Turn over to our operative believed to be on boat.

Martin Detective Agency,  
New York.

I turned about and looked at Marron as coolly as I could. I glanced at his hand; the scar showed plainly. He had stopped smiling, and as I watched him his whole expression changed and revealed him in his true light—a criminal, forced into a corner and ready to fight for his freedom.

I had suspected what was coming and almost before he reached out to grapple with me I had slipped out of his reach. He rushed toward me. I met his charge with a shower of blows; he fell back for a minute, but quickly recovered and again sprang toward me. As we grappled with each other my hand reached his throat. Down to the floor we fell with a crash, Marron underneath. My advantage was only temporary, however, for as we struggled his knee locked mine and he threw me to one side; smash! came a staggering blow and I felt my teeth loosen. Then, quickly recovering, I grappled with him again and we fought madly from one end of the cabin to the other.

A rough-and-tumble fighter of experience, Marron proved to be more than my equal. We crashed against the door.

I felt myself growing exhausted. The thought of calling for help flashed into my mind then, but he grasped my throat with a vicious grip and forced me back against the wall of the room. Everything began to black before my eyes.

What the outcome of the struggle would have been I cannot tell, but just as consciousness began to leave me I came to a sudden realization that my antagonist's grip had relaxed.

Then I heard a girl's voice and looked up to see Marron with his hands raised above his head and the exquisite Miss Randall pointing a revolver at him.

"I'm from the Martin agency," she replied to my look of amazement. "I recognized this man from the first. Been trailing him a month."

With Marron before her she turned to go out of the cabin. At the door she paused.

"Oh, by the way, I've got the bag out of his cabin. The money's there all right. Some of it'll come to you, too."

"Me?" I exclaimed.

"Yes, half of the \$1,000 reward for this man's capture. We'll share, you see."

Then she nodded, smiled easily and marched away with her prisoner.

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### SENT REPORT OF HIS OWN DEATH

An operator recently returned from Havana tells a story of a man who sent a wireless message that he had died.

Dionisio Rodriguez was the supposed deceased, but when the Ward Line steamer *Saratoga* arrived the reported corpse was found very much alive. The mourning family had the pleasure of embracing him with the spirit still intact in his body and the funeral arrangements were called off. Señor Rodriguez, who was one of the partners in a large cigar factory, had been at Liberty, N. Y., undergoing treatment for tuberculosis. He did not improve, and left for Havana in a very serious state of health. So sick was he that he was sure he was going to die before he arrived at Havana and ordered a number of wireless messages to his family stating that he was at the point of death.

Finally Señor Rodriguez had a fainting spell and was thought at first to be dead.

When he came to and the ship surgeon told him of his fears, Rodriguez recalled the interest of the physicians at the sanatorium in his case, and fearing that the end was near ordered that a wireless message be sent reporting his death. The sanatorium accepted it in good faith and cabled the news to the family in Havana.

On receipt of the cable the family made all arrangements for the funeral. A burial permit was obtained and also permission from the department of sanitation to disembark the body immediately upon the arrival of the steamer. Arrangements were made to have the hearse at the wharf, and the family procession was to form there and proceed to the cemetery at once.

When all these details had been arranged it occurred to the family that it would be well to order their relative embalmed, and a marconigram to that effect was dispatched to the *Saratoga*. On receipt of the message Captain Miller refused counsel on the question of embalming a live man and confined his answer to the detail that there was no one aboard sufficiently dead to embalm. This gave the stricken family a momentary ray of hope, but it was quickly followed by the thought that perhaps Rodriguez was buried at sea. This thought resulted in another marconigram which brought the reassurance that he was alive although very sick.

After the rush of passengers on the ship entering port was over, a rejuvenated and smiling Rodriguez walked gaily off the gangplank into the arms of his joyful family.

He stated before leaving that the marconigrams would be kept as souvenirs.

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### A FLYING BOAT AND WIRELESS

The hydro-aeroplane entered a field of usefulness when a Curtiss flying boat, the *Edith*, was used to overtake a ship at sea to deliver important mail. The steamship *Miami* had left Nassau, but owing to a low tide lay-to inside the bar, three miles off Cape Florida. A high wind arose and swept the water on the bar further out to sea, leaving the ship unable to proceed. By wireless the captain communicated his position to *Miami*, and the aviator then set out on his mission, which he successfully accomplished.

# 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

H. A. F., Kansas City, Mo.:

KAL is the large station of the Telefunken Company, at Nauen, Germany. CTG is the Telefunken station located at Cartagena, United States of Colombia. The call letters of the Marconi station at Glace Bay are GB. We do not know the call letters of the Eiffel Tower station in Paris. They are not listed in the International book.

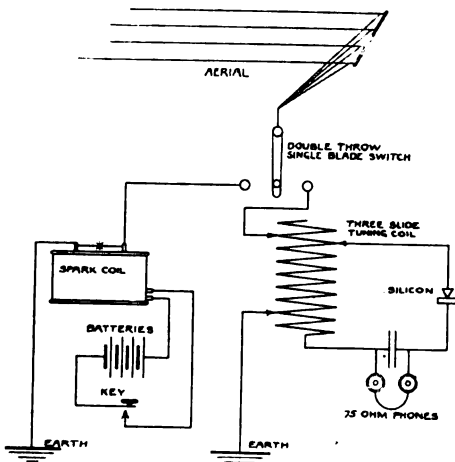
Answer to second query: If the soil surrounding your earth plate is dry, considerable advantage will be secured by surrounding the earth plate with coke.

\* \* \*

E. T. E., Harrison, N. Y., inquires:

Will you kindly send me by mail the best hook up for the following apparatus: Receiving set Inverted L aerial, ground 2-slide tuning coil (Bunnell); fixed condenser, 75-ohm receiver and silicon detector. Sending spark coil, 3 binding posts, spark gaps, key and batteries, aerial and ground.

Ans.—(1) We do not answer queries by mail. Previous issues of *THE WIRELESS AGE* contain diagrams of connections that could be applied to this set. For your convenience, however, we publish the accompanying diagram containing a complete sketch which explains itself.



D. I. S., St. Johns, Kas.:

We suggest that you get in touch with the makers of your amateur apparatus and have

them supply you with a full set of diagrams showing the most efficient hook-up to be used. In the Queries Answered Department of the May issue of *THE WIRELESS AGE* is shown a diagram of receiving connections applicable to your apparatus. Other issues of *THE WIRELESS AGE* contain circuit diagrams of standard transmitting sets which will help you out. You have not stated with whom you desire to communicate. Do you intend to interchange signals with local amateur stations, or are you attempting to receive from very far distant stations? Keep in mind that long distance receiving done by certain stations in the Middle West can be accomplished at night time only, the winter months being more favorable than other seasons for this kind of work. Why not get in touch with some amateur in your vicinity who is familiar with receiving and transmitting hook-ups?

\* \* \*

J. E. F., Brooklyn, N. Y.:

Your two queries concerning a receiving transformer suitable for the audion detector are fully covered in the article entitled "How to Conduct a Radio Club," published in the January issue of *THE WIRELESS AGE*.

Answer to query No. 3: Pyron crystals may be obtained from The Wireless Specialty Apparatus Company, Boston, Mass. This detector gives very good results and you are quite right in believing that it is extensively used by the United States Navy. A piece of sharp pointed spring steel wire may be used for contact. It is connected in the receiving circuits in the same manner as silicon, galena, and parikon.

\* \* \*

Mr. A. A. A., Sandy Hook, N. J., writes:

Ques.—(1) How many wireless stations on the east Atlantic Coast send free press to all ships and stations?

Ans.—(1) Press matter is sent out by the Marconi stations at Cape Cod, Mass.; Cape May, N. J.; Hatteras, N. C.; Savannah, Ga.; Virginia Beach, Va.; Tampa, Fla. and by the Telefunken station at Sayville, L. I. This matter is not sent free of charge, but is intended in some cases for the use of the steamship companies and in other cases for the use of the Marconi Company.

Ques.—(2) In the official list of radio telegraph stations, published by the International Telegraph Bureau, Berne, the statement is made that at WSL, the wireless station at Sayville, L. I., daily news bulletins are transmitted free of charge from 9:15 P.M. to 10:15 P.M. Are

operators at land stations prohibited from copying this press news?

Ans.—(2) Yes. This matter is intended only for the ships to which it is directed.

\* \* \*

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

Ques.—(1) What is the size of a condenser made of plates of glass 8 by 10 inches, covered with No. 38 brass sheeting, to be used in connection with a  $\frac{1}{4}$  K. W. Blitzen Transformer and a rotary gap?

Ans.—(1) Assuming that the set is to be operated from a 60-cycle source of current supply, the condenser should consist of 18 plates of glass, 8 by 10 inches, covered with sheets of brass foil, 6 by 8 inches. The glass should be at least  $\frac{1}{8}$  of an inch in thickness. If the set is to be used in connection with the rotary gap, it will then be necessary to use a condenser of less capacity, the actual size depending upon the number of discharges at the spark gap. A little experimenting will determine the correct value.

Ques.—(2) What are some good books telling about the theory of wireless telegraphy and the use and description of the instruments?

Ans.—(2) See the article, "How to Conduct a Radio Club," in the January issue.

Ques.—(3) Is there any way to cut out interference due to electric light lines except by changing your antenna?

Ans.—(3) A complete answer to this question will be found in one of the articles on "How to Conduct a Radio Club," to appear in an early issue of this magazine.

\* \* \*

F. R., New York:

We have no direct information concerning your first query, but we understand that Sayville at certain times does communicate directly with high power stations located in Germany.

Ques.—(2) Please show in a diagram the best way to shunt a "loose-coupler" with a variable condenser in order to receive long wave-lengths.

Ans.—(2) A diagram is not necessary. The variable condenser should be connected in shunt to the secondary winding, and a loading coil or aerial tuning inductance inserted in series with a primary winding.

\* \* \*

K. M. W., South Framingham, Mass.:

Audions may be purchased from the Radio Telephone and Telegraph Company, 309 Broadway, New York.

The data for the construction of The Marconi Multiple Tuner is not available for publication.

There are several methods for producing quenched effects on a rotary gap, a complete description of which would require too much space. Quenched effects are sometimes produced by heavy air blasts played upon the discharge points. In other types the quenched effects are obtained by completely redesigning the entire transmitting apparatus from the generator up. Another type, such as manufactured by the Clapp-Eastham Company, is rotated simply to bring the oscillations within the limits of audibility.

In order to secure quenched effects with the amateur rotary gap, two or three plates of the ordinary quenched gap are often connected in

series with the rotary gap, producing quenched effects which cannot be obtained by the rotary gap alone. The musical qualities of the rotary gap are then combined with the quenching effects of the series gap.

\* \* \*

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

Ques.—(1) At what speed must one be able to receive in order to pass an examination as a first-class wireless operator, and what else must he be posted on?

Ans.—(1) To pass the examinations of The Marconi Company a speed of 25 words per minute in the Continental Morse Code is required. The Department of Commerce examinations for government license certificates require a speed of 20 words per minute for a first-grade certificate and 12 words per minute for a second-grade certificate.

To secure a commercial extra first grade government license the applicant must be able to receive 30 words per minute in the Continental Morse and 25 words per minute in American Morse. The applicant must also be thoroughly familiar with the complete commercial transmitting and receiving apparatus, including motors, generators, storage cells, etc. He is also required to have knowledge of the International Regulations governing wireless communication and the United States laws pertaining to wireless telegraphy.

Ques.—(2) Where and when are such examinations taken?

Ans.—(2) At the United States Navy Yards at Boston, Mass., Brooklyn, N. Y. and Philadelphia, Pa.; and at the customhouses at New Orleans, La., San Francisco, Cal., Seattle, Wash.; Cleveland, Ohio, and Chicago, Ill.

\* \* \*

B. E. K., Grand Rapids, Mich., asks:

Please give me data on a  $\frac{1}{2}$  K. W. closed core transformer for wireless purposes to operate on 110 volts, 30 cycles, secondary voltage—20,000.

Ans.—(1) The length of the core outside measurements should be 10 inches. The width  $7\frac{1}{2}$  inches. Thickness of the core,  $1\frac{1}{4}$  inches. The primary winding should consist of 22 layers of No. 14 D. C. C. wire. The primary should be separated from the secondary winding by several layers of empire cloth. The secondary winding should consist of 7 sections separated by paraffined cardboard insulation  $\frac{1}{8}$  of an inch in thickness. Each section of the winding should be  $\frac{1}{4}$  of an inch in thickness and five inches in diameter. The winding should be of No. 34 enameled wire. The secondary should be insulated from the core by several layers of empire cloth. This transformer is intended to be used with a reactance regulator.

Ques.—(2) Using a rotary spark gap having 12 points and a speed of 3000 R.P.M., how many glass plates 10 by 14 inches, 0.15 of an inch thick, with tinfoil 8 by 12 inches on each side, will be required for a condenser for this transformer to operate on a 200-meter wave-length.

Ans.—(2) You will require 3 plates covered with foil 8 by 12 inches. The capacity of the condenser will then be .0041 MFD. If you wish to use two banks in series, you will require 6 plates in parallel in each bank.

H. V. R., Los Angeles, Cal.:

A complete answer for your first query would require more space than we could give in this department. A mathematical discussion is given in *The Electrician* for February, 1913, by Cohen.

Ques.—(2) Which would be the more efficient serial for sending and receiving: A long single wire or a shorter antenna having several wires in parallel, assuming that both antennæ have the same height (flat top antennæ) and the same natural wave-lengths?

Ans.—(2) For sending we prefer the multiple wire aerial on account of its comparatively small value of resistance. For a given wave-length the same statement may be made in reference to receiving, as it is always desirable to have a receiving antenna of the least possible resistance. A long single wire, however, will give good results in receiving and yet may be very inefficient for sending.

Ques.—(3) Does increasing the number of wires in parallel in an antenna increase the inductance or the capacity or both the inductance and capacity of the antenna?

Ans.—(3) Increasing the number of wires decreases the value of inductance, but increases the value of capacity.

Ques.—(4) Please give the natural wave-length of the sending antenna of the new Marconi high-power station in New Jersey.

Ans.—(4) The natural wave-length of the receiving antenna at Belmar is about 12,000 meters.

\* \* \*

D. R. C., San Francisco, Cal.

We make the following suggestions in the design of your  $1\frac{1}{2}$  K. W. transformer. The core may be 36 inches in length and  $3\frac{1}{4}$  inches in diameter. It should be wound with 2 layers of No. 10 D. C. wire up to within 1 inch of either end. The secondary winding should have 40 "pan cakes," each  $\frac{1}{8}$  of an inch in thickness, having 1,000 turns per "pan cake." The winding is preferably made of No. 30 S. C. C. wire.

It is preferable, as you suggest, to narrow down the winding of the secondary. It should not extend the entire length of the core.

Answer to last query: Eighty per cent of the commercial transformers in use are of the open core type. While the closed core transformer having a variable magnetic leakage gives about equal results, still, for various other reasons, the open core transformer is preferred.

\* \* \*

E. B. H., Belleville, Ill., writes:

Ques.—(1) Will you kindly inform me where I can obtain data concerning to wireless telephony?

Ans.—(1) There is no great amount of literature on this subject. See Fleming's "Elementary Manual of Radio Telegraphy and Radio Telephony," "Operator's Wireless Telegraph Handbook," by V. H. Laughter, and "Wireless Telegraphy and Wireless Telephony," by Kennelly. In the installment of "The Engineering Measurements of Radio Telegraphy," published in the February issue of *THE WIRELESS AGE*, a complete description of the Poulsen arc, which is generally used in connection with wireless telephone work, is given. We know of no

books devoted distinctly to a description of the wireless telephone. Such information is generally a part of all books on wireless telegraphy.

Ques.—(2) I often hear Sayville call KAL and CTG. What are these stations?

Ans.—(2) This question is answered under H. A. F.'s query in this issue.

Ques.—(3) To what stations does Sayville send when transmitting in German?

Ans.—(3) It is in communication with either Berlin, Cartagena, or Naura, a naval base near the Caroline Islands.

Ques.—(4) I have often heard Key West talk with XNT. Can you tell me what station this is?

Ans.—(4) XNT is not listed in the Berne Book. It is very likely a Mexican station.

\* \* \*

M. F., Vineland, N. J., asks:

Ques.—(1) On occasions during evenings when I have been intensely interested in copying a distant ship or land station I have been greatly surprised to observe the signals gradually growing fainter and finally dying out altogether. A few minutes later they would gradually come back until they were fairly loud. This has happened for the most part when I have been listening to stations using rotary spark gaps, although it has occurred once in listening to Colon (NAX). Can you explain this?

Ans.—(1) This phenomenon has never been fully explained, but has been known for eight or ten years. If your station was within the daylight sending radius of the Colon (Panama), station, the effect would not be observed. It is only noticeable when receiving at night beyond the daylight radius. The effects are more likely to be observed at night during the winter months. At one time it was supposed that this effect was due to a poorly designed transmitter; this theory, however, has been disproved.

Ques.—(2) One evening at half past seven o'clock, with the weather fairly clear outside, I heard Colon (NAX) very faintly, in fact, too faint to copy. About half past ten, on the same evening, when it was snowing hard outside, I heard this station very much louder; in fact I heard it loud enough to be read with the phones 2 inches from the ears. Can you explain this phenomenon?

Ans.—(2) No. It is simply a continuance of the effect noted in your first question.

Ques.—(3) Can you give any information concerning the system, power and frequency used at the new trans-Atlantic station at Tuckerton, N. J.? Can the average amateur hear this station by the use of a tikker? Has trans-Atlantic communication been carried on and if so at what wave-length?

Ans.—(3) We have not been advised that the Tuckertown station is engaged in the transmission of signals, but to date has been employed simply for receiving purposes. The system used is the Goldschmitt high frequency alternator, giving undamped oscillations at a frequency of 50,000 cycles. The power to be used is 50 K. W.; the wave-length is 6,000 meters. You should be able to hear the signals on a properly constructed tikker in connection with a tuner that will allow adjustment to wave-lengths of this order.

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