Massie System of Wireless Telegraphy.

By A. Frederick Collins.

In striking contrast to the majority of patents issued in the class of wireless telegraphy are those granted to Walter W. Massie, of Providence, R. I., for instead of covering claims of a theoretical and even an imaginary nature, these patents relate exclusively to workable apparatus.

Different from nearly all other inventions in this line, Massie designs, builds and operates his electromechanisms first and then applies for governmental protection. If this mode of procedure were adhered to by his contemporaries, the number of patents would probably be reduced nine-tenths and transmission would be improved some 50 per cent.

In the apparatus to be described the chief features relate to the receptor and a controlling device for switching in and out simultaneously and with a single movement the bell alarm, the oscillophone, the transformer and the motor-generator, the connections of which are shown schematically in Fig. 1. The transmitting arrangement presents no new principles, but follows the specifications of the most recent practice. In sets built for one hundred miles and under the induction coil is utilized, but for transmission over greater distances the initial energy with which the transformer is supplied is taken direct from the street mains, or there is employed a small unit producing 25 amp. at 120 volts. In the first case, if the current is direct, it is converted by a motor-generator into a single-phase, 60-cycle current. The primary of the transformer takes 110 volts and the secondary delivers at its terminals the equivalent of 2.5 kw at a pressure of 60,000 volts. With this high tension there is charged a battery of adjustable plate glass condensers, which, disrupting the spark-gap, sets up the desired oscillation in the radiating system.

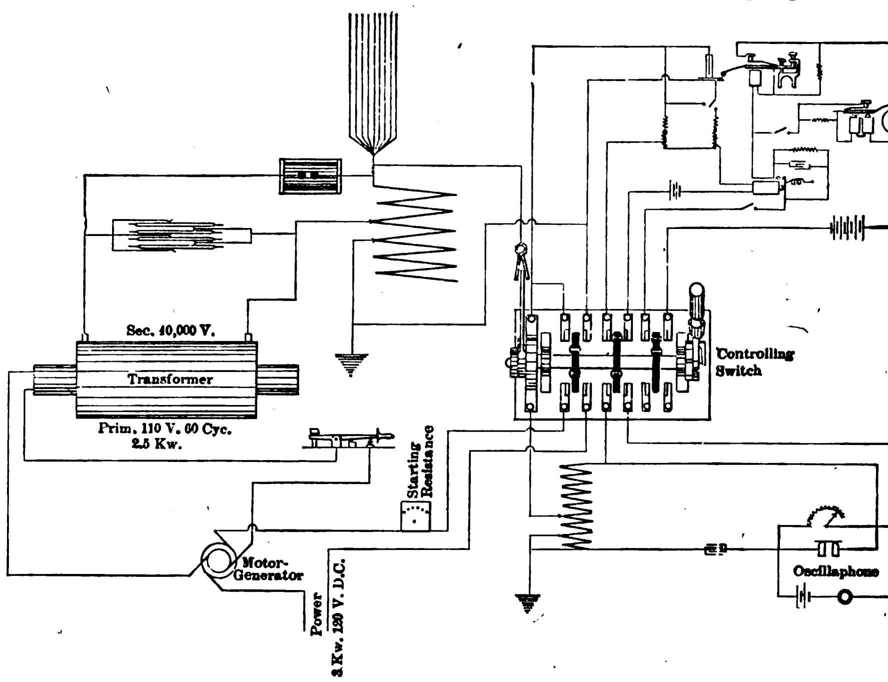

FIG. 1.—DIAGRAM OF CIRCUITS FOR A 250-MILE TRANSMISSION.

An objection to which all receptors employing a telephone receiver as a translator of the impressed oscillations have been subjected lies in the fact that the operator must either keep the 'phone to his ear all the time or frequently lose messages in part or in whole. The usual method for circumventing these conditions is by having the operators set a predetermined time when both shall be at their posts and the telegrams are to be transmitted.

This arbitrary and limiting scheme has been largely responsible for the ban that has been put on this type of receptor, and Massie has made a decided improvement by introducing what should have been done long ago, namely, a bell alarm. Naturally, an alarm demands the use of a filings coherer, and having the latter to contend with it may be asked why its functions should not extend a step further and a Morse register be operated. The reasons may be given in triplicate: since an apparatus merely for signaling and not the

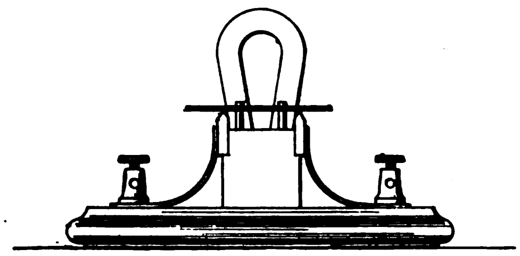

FIG. 2.—END VIEW OF THE OSCILLOPHONE.

alphabetic code entails no such careful adjustment as those for recording intelligence, the sending can be greatly increased in speed, and atmospheric disturbances considerably diminished.

The oscillophone, as the inventor has named his receptor, employs an improved form of microphonic contact and a telephone receiver. Its connections with the aerial and ground circuits through the medium of the controlling switch are graphically brought out in the diagram of Fig. 1.

An end view of the oscillophone detector is shown in Fig. 2. This wave responsive device is mounted on a base made of a suitable insulating material, which also constitutes a support for the terminals of the instruments; on this base is mounted a block of hard rubber or slate, the opposite sides having rabbets to receive the carbon terminals of the microphonic detector. The carbons are flat and are about 3 cm. in length, 1 cm. in width and 3 mm. in thickness; these are held in operative relation to each other by bowed springs, which also serve as conductors. The lower ends of the springs are attached to the binding posts to which the oscillophone is connected into the local circuit. The terminals are of a composition of carbon and heavy oil, the upper surfaces being ground to knife edges.

In preparing the edged terminals the carbon is ground up and mixed with heavy oil in suitable proportions to make a plastic mass, after which it is moulded in the desired form and then baked. A terminal conductor thus prepared possesses eminently satisfactory characteristics, in that it presents an anti-friction surface to the conducting bridging element or needle extending across the gap between them.

The bridging element for the terminals is made of steel, although some of the other metals have been found to work satisfactorily; steel is eminently adapted for use in the oscillophone detector, since it is possible to hold the needle against accidental displacement on the carbon knife edges by magnetic attraction; a permanent magnet of the familiar horseshoe type is so placed that its legs may be adjusted perpendicularly to the base, so that the lines of force through the bridging element may be made to act as strongly or weakly as desired. Its purpose is to sustain the position of the needle on the carbons magnetically, but absolute contact between the element and the magnet is effectually prevented by metallic stops, which project above the knife edges.

In the ordinary forms of microphonic wave detectors, the bridging element is subject to vibration, and under the action of the local current has a tendency to roll from place to place on the carbons, which not only impairs its efficiency, but renders the readings of the instrument inaccurate; in fact, these are the things that have prevented the extended use of the microphone detector heretofore.

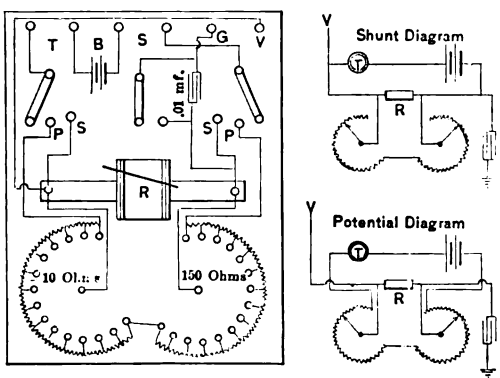

FIG. 3.—DIAGRAM OF OSCILLOPHONE CIRCUITS.

In the Massie oscillophone the needle is drawn gently to the pins and is held firmly against the edges of the carbons, and in this way the prior sources of trouble have been eliminated and, at the same time, its sensibility is increased many fold.

A diagram of the oscillophone circuits is shown in Fig. 3, while a photographic view of the oscillophone is given in Fig. 4. The detector of the oscillophone has a normal resistance of approximately 40,000 ohms, which, after cohesion is effected, drops to less than 700 ohms. The potentiometer, which is divided into two parts, is wound for 10-ohm and 150-ohm steps, respectively, and a condenser

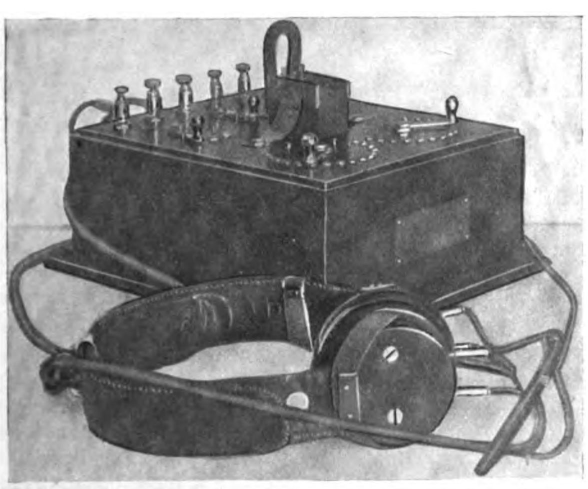

FIG. 4.—OSCILLOPHONE COMPLETE.

of .01 microfarad is connected in series with the earthed terminal, and thence through the system to the vertical wire. There is provided a switch to cut in and out the condenser. The oscillophone may be connected either in shunt or for potential, as the smaller diagrams in Fig. 3 illustrate. Either of these circuits may be used at will by means of the switches, the terminals marked *P* and *S* indicating potential and shunt respectively. The former is used for long-range and the latter for short-distance work.

In a separate circuit, cut in and out by the controlling switch, is the bell alarm for ringing up the operator. This adjunct comprises a modified form of coherer, a tapper, relay and bell. The novel feature of this arrangement is the coherer, the object of which is to facilitate cohering and thus increase the sensitiveness of the device. Coherers using a magnetized steel needle imbedded in the filings have been experimented with in the past, but in all devices prior to the one here described the oscillations had to cohere the whole mass of filings and overcome as well the weight or force of gravity on the filings in order to form a conducting bridge; further, in coherers of

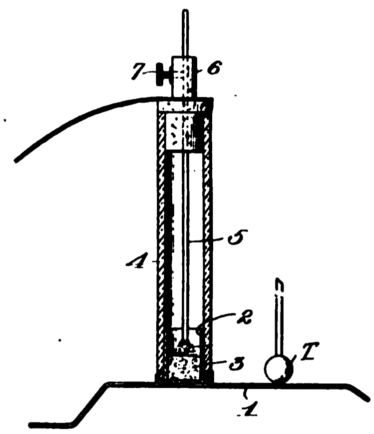

FIG. 5.—MASSIE COHERER.

this type the tapper must strike blows of considerable force to decohere the filings, while in practice these requirements decrease to no small extent the sensitiveness of the coherer.

To obviate these tendencies Massie has designed a coherer in which the magnetized needle is supported with its end out of or free of the non-magnetic filings as distinguished from being engaged with a mass of filings. In the cross-section shown in Fig. 5 a strip of metal, 1, constitutes one terminal of the coherer and supports a cup, 2, also of metal, which serves as a conductor, 3, as well as to contain a mass of silver or other non-magnetic filings; the containing cup is secured within the glass tube, 4. The magnetized needle, 5, may be adjusted in the collar, 6, and its position fixed by the screw, 7. In the diagram the letter *T* designates the tapper, which is of the usual electromagnetic type.

The mass of filings, 3, is placed in the cup, 2, and then the magnetic filings are put on top or superimposed so that when the needle is adjusted in proper proximity thereto the magnetic filings are attracted and held up by the needle and just in contact with the mass of filings in the cup. The magnetic filings are thus cohered at all times, leaving nothing for the oscillating current to do but to cohere the magnetic to the non-magnetic filings, the line dividing them constituting a surface having a multitude of small faces to facilitate the cohering action.

The non-magnetic filings may be of silver, nickel or other metal, and the magnetic filings are preferably of soft Norway iron. The difference in the structure of these metals gives rise to numerous sharp edges and minute forces forming an imperfect electrical contact having an infinitely thin insulating film of air between them. The effect of this superimposing the two different kinds of filings in a line at right angles to the surface of the earth is to produce an effect of cohesion by the electric oscillations and forces of gravitation in identical direction. For this reason it is obvious that the energy necessary to break down the minute air films and weld the edges of the filings together is much smaller than in coherers where the conductor plugs are parallel with the earth's surface.

The current in this coherer need not be directed through the magnetic filings, the surface presented by the top layer of such filings and the sides of the cup acting as conductors; further, the mass of non-magnetic filings shown in the drawings need not be, and, in fact, is not cohered, the cohesion of the magnetic filings to the many-faced surfaces being effected by the top layer of the non-magnetic filings, so that the oscillations have materially less work to perform than in other detectors that have sought to aid cohesion by magnetism. Fig. 6 is a photographic reproduction showing the magnetic coherer and bell alarm attachment, and Fig. 7 illustrates the coherer used in connection with a Morse register.

In his letters patent specification No. 787,780, Massie describes a very ingenious switch-controlling mechanism that is a wonderful improvement over the plugs formerly used and the multipole, double-throw switches that are now a familiar adjunct of every system. The advantages of the controlling switch will be apparent by referring again to the diagram (Fig. 1). Here it will be readily observed that the many different circuits are open and closed in se-

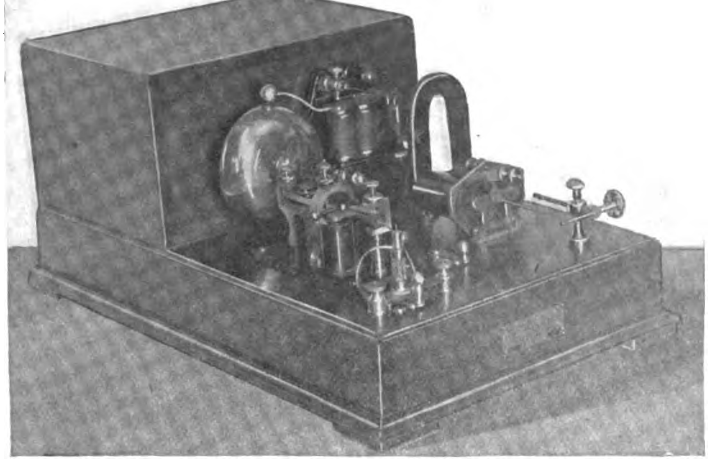

FIG. 6.—MAGNETIC COHERER AND BELL ALARM.

quence by a single movement of the lever. These circuits include those that carry the low-voltage, direct current of the motor and high-tension oscillations of the radiating system, and those operating the bell alarm, oscillophone and high-frequency currents set up in the resonator.

The sectional front elevation (Fig. 8) and the photograph (Fig. 9)

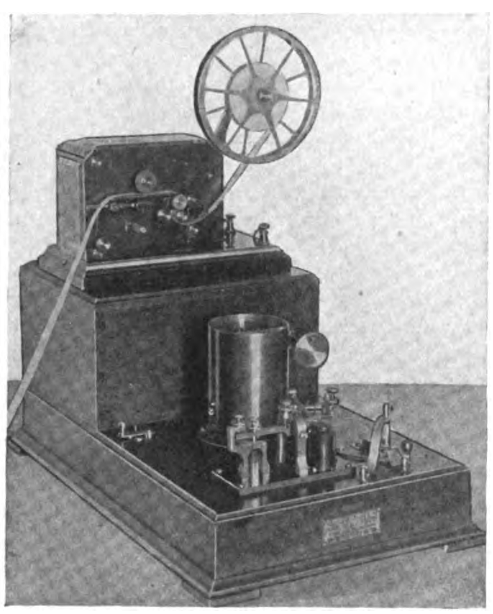

FIG. 7.—MAGNETIC COHERER AND MORSE REGISTER.

will serve to render its construction and operation apparent. The mechanism is mounted on a hard rubber block, and on opposite sides there are two rows of binding posts. Mounted rigidly on the bed are bearings supporting a rock shaft; over the rock shaft and between the bearings is an elongated sleeve made of brass; the shaft and sleeve are associated so that their turning movements are in unison. A peripherally indented disc, 22, is rigidly connected with one of the bearings, 18, and to one end of the shaft, the latter being attached to the hub of a hand lever, by which the rock shaft can be turned to bring it into three different positions. The lever is provided with a spring pawl, the effective portion of which is adapted to be thrust into any one of the three peripheral indentations in the disc 22 by the action of the spring of the pawl in order to positively but yieldingly maintain the shaft in its three positions.

The tension of the spring prevents the hand lever and shaft from accidentally shifting, though permitting them to be easily manipulated by the operator. Rigidly fastened to the sleeve are three discs made of a non-conducting material; these discs are arranged to turn between the contact strips, a view of which may be seen in Fig. 1, and which are connected to the binding posts.

By turning the lever carrying the rock shaft, twenty-three different combinations can be secured by causing the three circuit closers or bridging devices. alluded to to extend across and in contact with the upper sides of the several perpendicularly disposed contact strips. Movably connected with the shaft outside of the contact wheel, 28, is the hub of a knife; the hub is loosely carried by the shaft to

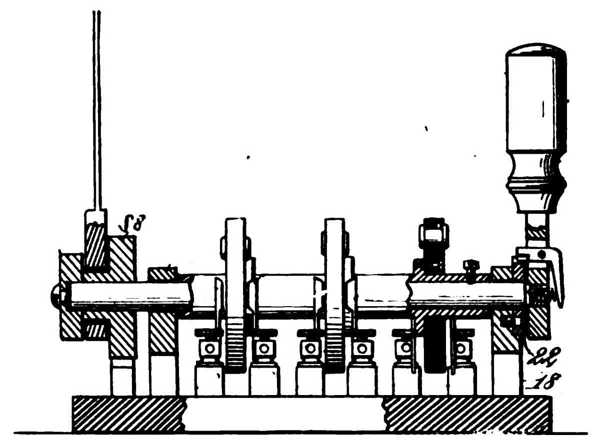

FIG. 8.—DETAILS OF CONTROLLING SWITCH.

secure a relative motion between the knife and shaft, the knife constituting a circuit controller.

From the above statement it will be apparent that when the sending circuit is closed ready for use both receiving circuits are open and grounded so that no injury can result to the operator or to the receiving instruments. By means of this arrangement the entire system is controlled by a single device and to change from the sending

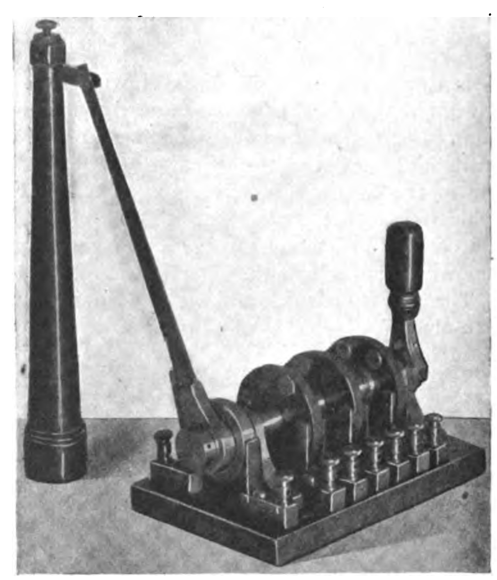

FIG. 9.—CONTROLLING SWITCH.

to the receiving circuits or vice versa a single movement is all that is required; in this way the speed in operating is greatly accelerated and its rapidity is comparable with the wire system of Morse.

The first practical installation of the Massie apparatus was at Block Island and Point Judith, where it replaced one of the older and better known systems. A more recent installation was made at Wilsons Point, a shore station, to be used in conjunction with the boats of the New York, New Haven & Hartford Railroad. The Massie system has been in the service of the company cited for over a year, and has been highly satisfactory to all concerned.

The sensitiveness of the oscillophone has been frequently tested by the operations at the Block Island station, where messages in times past were picked up the moment they commenced to signal to the Nantucket Shoals Lightship, 90 miles to the east of Block Island; then assuming the ships were working a distance of 60 miles, the message-bearing electric waves traversed 150 miles to the Rhode Island coast, where they were received and translated by the oscillophone and read by the operator in charge.