THE MASSIE WIRELESS TELEGRAPH SYSTEM.

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A description of the chief characteristics of the Massie wireless telegraph system appeared in The Electrician, Vol IV, p.744. The equipment as used at the present time, however, possesses a number of improvements in detail, which are described in a recent issue of The Electrical World.

The operating circuits of the Massie system are arranged in three distinct, although somewhat interconnected, groups, which groups may be designated as the transmitting, the detecting and the receiving groups respectively.

A special controlling switch shown in the diagram of connection, Fig. 1, allows either one of the three groups to be used as the operator may desire. When the apparatus at a certain station is in use the switch is so constructed that the aerial will be eonnected to the receiving circuit or disconnected for transmitting, as the case may require. At all other times, however, the aerial is connected with the detecting apparatus, which contains a bell alarm in a relay circuit, so that the operator is relieved from the tedious task of " listening in," and yet no messages intended for the station will be overlooked.

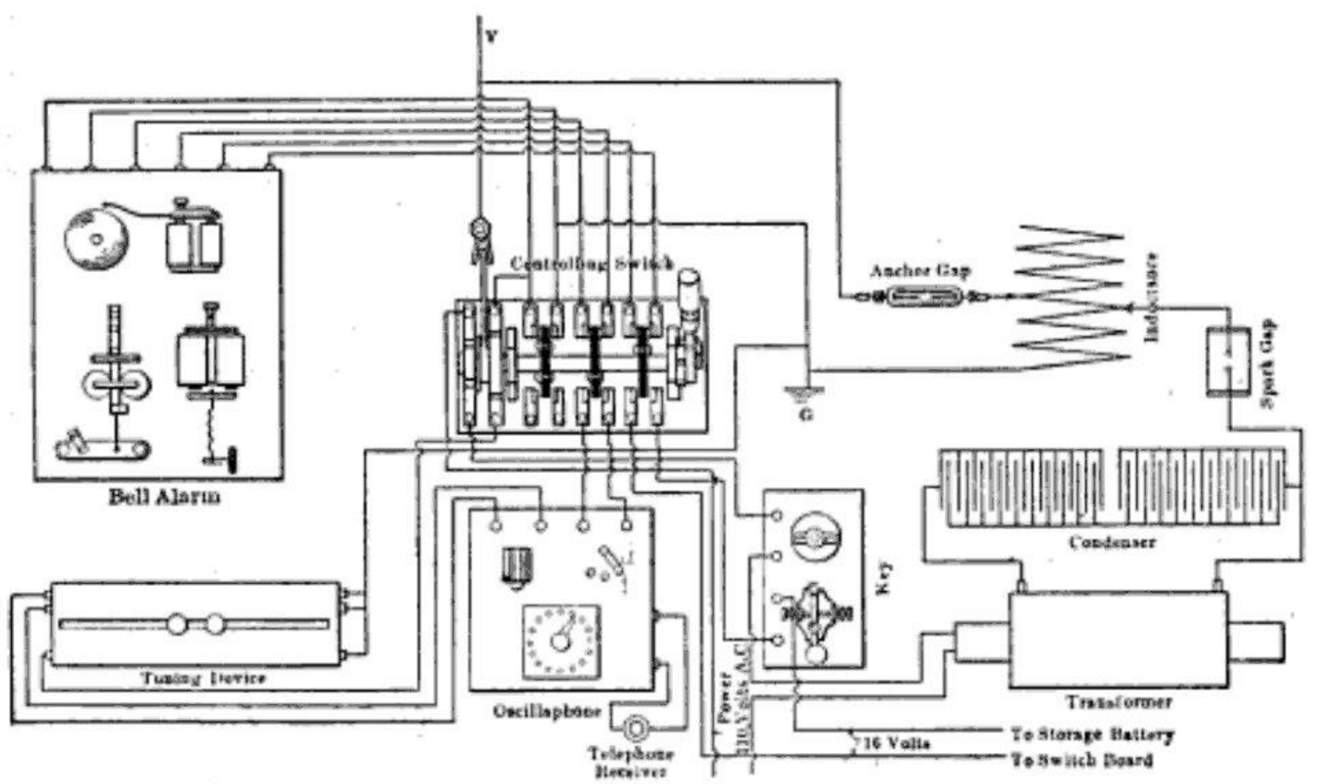

Fig. 1.—Diagram of Connections.

To use the powerful transmitting apparatus the switch must be placed in such a position that the delicate receiving equipment is entirely separate from the aerial and effectively insulated there-from, the battery circuits must be broken and the detectors short-circuited and grounded; when the switch is changed so as to put the receiving apparatus in an operative condition the transmitting circuit is broken. Thus the switch device effectively protects all the apparatus by making it impossible to send while the receiving circuits are closed and vice versa. The aerial connected to the receiving apparatus is separated from the transmitting apparatus by means of an insulated microscopic air gap termed an "arche gap," in the transmitter circuits; otherwise the antenna would be grounded through the inductance of the transmitting apparatus. Although this small gap is sufficient to insulate the vertical when receiving, it is practically a short-circuit for the high-tension lations produced when transmitting.

The transmitter equipment includes the usual spark-gap, inductance coil, condenser, high-potential transformer, interrupter, when direct current is used, and source of energy. Each of these parts possesses features of construction deserving special mention. The spark-gap is surrounded by a micanite tube, fitted with a window, which serves to deaden the excessive noise from the disruptures and yet allows the gap to be inspected at any time. It is placed within the inductance coil. The inductance of the coil may be varied by shifting the position of the connecting terminal along the turns, so that, in connection with the proper capacity in the condenser, the transmitting circuits may be adjusted to give forth any desired length of electrical wave. The turns on each coil are carefully calibrated and the inductance for each position of the sliding terminal is indicated on the framework, while the mechanical mounting of the coil is such as to allow any desired inductance to be found at once by merely revolving the coil.

Difficulty has frequently been experienced in causing a spark-gap to operate continuously and to repeat its performances indefinitely, a gradual change usually taking place in the behaviour of the gap. This change has been attributed to the heating and to the ionising of the air surrounding the gap, and a remedy for the difficulty has been found in cooling the terminals of the gap and removing the air from the immediate neighbourhood. In his latest equipments Mr. Massie builds the air gap terminals of tubing through which air is forced under pressure. The terminals themselves are cooled by the expansive action of the compressed air, while the ionised particles are removed before they have accumulated in sufficient quantities to affect the operation of the gap by exhausting the expanded air through small openings in the ends of the rods. The expanding compressed air in also allowed to flow through the hollow turns of the inductance coil in order that the coil may be kept at a temperature lower than that which would otherwise be produced in the windings by the high-frequency currents. Needle valves control the admission of the compressed air to the inductance coil and the spark-gap rods an electromechanically operated valve in the main supply pipe is connected to the main controlling switch, so that the valve is opened when the transmitting circuits are in use and is closed at all other times.

The condenser is built up of plates of glass on which are secured sheets of tin foil. The connections are so made that the glass itself becomes the dielectric, and the air is not depended upon either for insulation or for inductive capacity. Each glass plate with its two sheets, therefore, possesses a definite capacity, and the capacity in circuit depends upon the number of plates in use. The immediately near sheets of adjacent plates are connected together by means of a spring contact inserted between them.

These contacts are mounted on rods, and the alternate rode are joined in groups to bus bars, so that the active capacity of the condenser depends upon the number of rods which are "in" or "out." Since the air space separating adjacent plates is not subjected to any difference of potential, there is no possibility of a disruptive discharge between these plates. A leakage path through air is found, however, over the exposed sides and edges of each glass plate. For the purpose of improving the insulation and preventing the formation of corona, all of that portion of the glass not covered by the tin-foil and a limited section of the coil is given a coating of asphaltum varnish. This material is intended solely as an insulator and it contributes in no way to the inductive capacity of the condenser. It is used in preference to other varnishes as brash discharge is reduced to a minimum, thus producing a more defined period of oscillation and, therefore, sharp and true wave lengths.

The transmitting key is in each case similar to a telegraph-sender key, and the apparatus is of such a nature that anyone familiar with the Morse alphabet can send messages without additional instructions. With a small portable or boat set the key is connected directly in circuit with the primary of the high potential transformer. When the energy is obtained from a battery or a direct-current generator a mechanical interrupter is also inserted in the primary circuit, but when alternating current is used the interrupter is omitted. In a high-power land station where the heavy currents would tend to destroy the key, unless an extremely large and unwieldy one were used, the key is used merely to close a battery circuit to an electromagnetically-operated oil switch in the primary circuit of the high-potential transformer, as shown in Fig. 1,

The Massie, detector is of the filings cohere: type. The main axis of the device is placed in the vertical direction, so that the force of gravity assists in the action of the coherer. The coherer consists of a magnetised needle with its lower end supporting magnetic filings immediately above a mixture of non-magnetic filings—the former being of iron and the latter of silver. The filings are placed in a silver-lined cup which forms one terminal of the coherer, the magnetised needle being used as the other terminal. The needle causes the iron filings to be arranged in line just above the silver filings, with a minute film of air between them, thus forming an electrical path of high resistance. The effect of an electrical oscillation is to cohere the filings and to decrease the resistance and thus to allow a current to flow from a battery circuit through the coherer and a relay which in turn operates a bell alarm and a tapping device, which latter decoheres the filings and restores the resistance to its normal high value. The main features of this resistance to its normal high value. The main features of this coherer were discussed in the article referred to above. On a flexible braes strip is securely mounted the silver-lined cup, and to this is fastened a substantial glass tube which serves for holding the needle in place. The tapper strikes against the brass strip, but does not come in contact with the glass tube so that the breaking of a tube by the tapper is unknown. The filings are completely enclosed and the performance of the coherer is net affected by atmospheric changes, while the effect of external mechanical disturbances is negligible. When cohered the resistance is less than 50 ohms, often being less than 1 ohm, thus an inexpensive relay can be used, which is an important factor in the cost of manufacture. The coherer with its bell alarm remains in circuit at all times when messages are not being transmitted or received, and to it is given the task of announcing when a distant operator wishes to communicate with the home station.

After the coheres has announced that a message is to be sent from seine distant station, the operator at the home station moves the main circuit-controlling switch so as to connect the aerial to the receiving apparatus. The predominating feature of the receiver is its ability to withstand rough treatment. It is of the micro-phonic type, and, mechanically considered, is extremely simple. The oscillaphone," as the inventor terms the device, consists of a steel needle held in contact with two sharp edges of carbon by means of a small permanent magnet. The terminals of the oscillaphone are formed by the two carbon compound (carbon and paraffin) strips. The resistance of the two contacts between the carbon edges and the needle is normally about 40,000 ohms. When the contacts are included in the aerial circuit the resistance decreases to less than 1,000 ohms while electrical oscillations are being received, and it then automatically increases to its initial value when the oscillations cease. The oscillaphone is connected simultaneously in series in the aerial circuit and in a local battery circuit containing an ordinary telephone receiver wound to 1,400 ohms resistance, in order that the signals may easily be interpreted. The loudness of the signals received is adjusted by means of variable resistance inserted, in series in the local battery circuit or in shunt to the oacillaphone ; the effectiveness of the adjustment is ascertained by the use of a miniature electric wave producer, which consists of a pocket, size primary cell connected to a magnetic make-and-break contact device, so that the operator need not depend upon signals from other stations for testing the effectiveness and sensitiveness of the oscillaphone.

For the purpose of eliminating from the oscillaphone such messages as may not be intended for the particular station in question, an inductance coil is used in series with a condenser, the inductance and the capacity being so adjusted as to render the combined circuits resonant at the single frequency selected for this station. It is stated that messages which differ in frequency as much as 20 percent. from that for which the receiving apparatus is adjusted will not affect the oscillaphone. The resonant frequency depends largely upon the inductance and the capacity, and it varies only slightly with the resistance in circuit; the sharpness of the timing, however, depends to a great extent upon the resistance. It is desirable, there-fore, that the resistance be constant In order that the resonant frequency may not change, and it is necessary that the resistance be small in value lithe selectivity is to be absolute. In some of his latest equipments Mr. Massie has used a magnetic type of receiver in which the resistance in the oscillating circuit is constant and of a negligible value. In this device the telephone receiver circuit is inductively related to the oscillatory circuit. Through the common magnetic paths of the two circuits is moved slowly an iron wire which has been subjected to the influence of a permanent magnet. When a high, frequency current flows in the oscillatory circuit the iron wire suddenly loses its magnetism, and the great rate of change of magnetic lines inter-linked with the telephone receiver circuit generates therein an E.M.F., which causes the production of a sound in the receiver. The “iron wire," which is built up of overlapping and concentrically arranged spirals of wire, is moved along the face of the permanent magnets and through the coils by means of a driving mechanism similar to that used in a phonograph. The tuning obtained is claimed to be remarkably sharp and complete.

The Massie apparatus is used to some extent in the United States Navy and other American Government departments.