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"The Telautograph."

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THE telautograph, as its name implies, transmits facsimile writing to a distance. The accomplishment of this object has been sought for years, and other solutions of the problem have been found, but the telautograph must certainly be allowed to excel in simplicity and in the comparative smallness of its requirements. The transmitting agency is, of course, electricity; the distance may be several hundred miles and practically no time is occupied in transmission. One important advantage is that only two insulated lines are necessary—no more, in fact, than are now in use for every telephone circuit.

The credit for the conception of the principle of action of this instrument appears to be due to the late Mr. E. A. Cowper, M. Inst. C.E., who described it in the year 1879.[1] It was subsequently taken up by Professor Elisha Gray, who made many improvements, and it has finally been made a practical instrument by Mr. F. Ritchie.

The transmitting and receiving mechanism appears to have been suggested by the pantagraph, the system of jointed rods having been cut in half at the fixed points, one half being at the transmitting end, and the other half at the receiving end of the line. The articulated system of rods on the transmitter is connected with a pencil, and resolves the motion of this pencil into circular motions of two arms, carrying contact brushes pressing on rheostat arcs somewhat similar in construction to the commutator or collector of a continuous-current dynamo, but arranged in a plane arc instead of on the surface of a cylinder. These rheostats contain 496 segments, the total resistance in each rheostat amounting to 7,000 ohms. At the receiving end is an articulated system similar to the transmission system, except that the rods are made

[1] Journal of the Society of Telegraph Engineers, vol. viii. p. 141.

as light as possible; by means of this system the circular motions of two coils of wire, moving in strong magnetic fields, and connected to the system of rods, are compounded to give motion to a very light pen. The motive-power is provided by a battery of twelve accumulator cells at each end, and these are so connected as to oppose each other when the instruments are not in use, but when a message is to be sent the battery at the sending end is reversed by a switch actuated by the pencil. The electrical connections are indicated in the diagram, *Fig. 1.* It will be seen that current passes from earth at the transmitting end to earth at the receiving end, through the rheostat R, line (*a*), and moving coil C, and similarly through the other line (*b*) and through both batteries in series. The position of the pencil at the sending end determines that of each of the rheostat arms, and the position of the latter determines the current flowing in each line, and in consequence the angular displacement of each moving coil at the receiving end. By means of the articulated system of rods, the angular motion of the coils produces a motion of the pen over a strip of paper. In order that the movements of the receiving pen shall exactly correspond with those of the pencil at the transmitting end, it is necessary that the angle through which each coil moves in response to a movement of the corresponding rheostat-arm shall be exactly equal to the angular movement of the rheostat-arm itself.

The force experienced by the coil, in consequence of the current passing through it and the inclination of its axis to the strong magnetic field in which it is placed, is opposed by a flat-coil spring, and the forces are such that the friction of the moving parts is practically negligible. Hence, for a given current the position assumed by the coil is a perfectly definite one, and for a given electromotive force in the circuit the desired correspondence of movement can be secured by the adjustment of the resistances between the several contact-plates of the rheostat, provided that the other resistances in circuit are kept constant, or are so small compared with the rheostat resistance that their variation may be neglected. For use on ordinary circuits, the line resistance is made up to 300 ohms, and the resistance of the moving coil is 185 ohms, the battery resistance being quite negligible. Thus it will be seen that the rheostat resistance, which is 7,000 ohms when at the maximum, largely preponderates over the other resistances in the circuit. It is, moreover, constructed of metal having a very small variation in resistance with change of temperature.

Fig. 1.

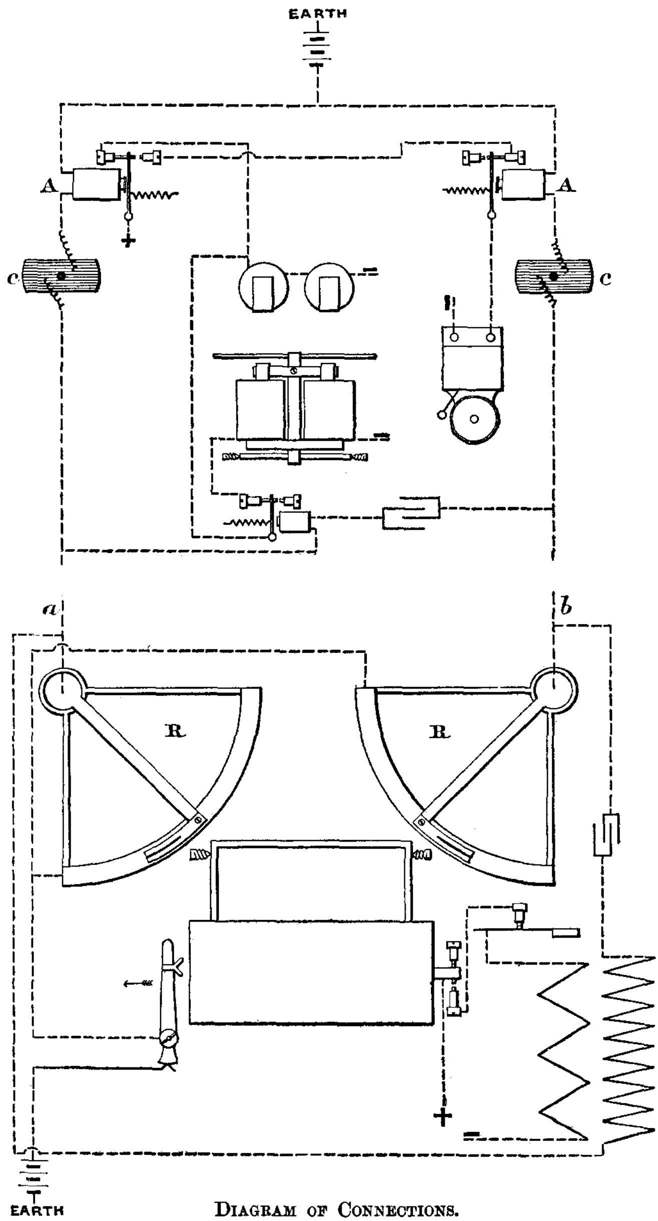

DIAGRAM OF CONNECTIONS.

All extra motions of the pencil beyond the absolute formation of the letters of the message, as, for instance, when the pencil is moved to start a new line, although followed by the receiving pen, are not recorded, and thus the received message is not confused or obliterated by unmeaning lines. This is accomplished in the following manner:—

The metallic plate supporting the paper at the transmitting end is hinged, so that, when the pencil presses on the paper, the plate is depressed through a small distance against a spring, and completes a local circuit, through the primary of an induction coil, and through a vibrating contact operated by the current. In this primary coil a vibrating current is thus set up, which gives rise to an alternating current in the secondary winding, and this alternating current is transmitted, through a condenser, to the lines, and, passing through a similar condenser at the receiving end, causes a vibration in the tongue of a small relay. This vibration throws sufficient resistance into a local circuit containing an electro-magnet to release the armature of the electro-magnet. This armature being mechanically connected to a stiff wire which crosses the paper, when the armature is attracted the wire slightly lifts the articulated rods and the pen from the paper, but when the armature is released the point of the pen rests on the paper. The friction of the rods on the wire is about the same as that of the pen on the paper, so that the motions are not interfered with although marking is prevented.

Another ingenious device is the provision for shifting the paper at both ends simultaneously. A mechanical arrangement is provided at the sending end, whereby the paper is fed forward, step by step, and at each step a switch is operated, which breaks the circuit from earth during the movement; this operates a relay at the receiving end, and, by means of an electro-magnet controlled by this relay and suitable mechanism, the paper at the receiving end is fed forward by a corresponding amount. A call-signal is also provided by means of a call-key. When a call is required, the instruments at both ends will be arranged for receiving, the pencils being in the position provided for them when not in use, this position being analogous to that of a telephone hanging on its switch-lever. The batteries are then in opposition to each other, and there is practically no current flowing in the lines. By means of the call-key, one of the lines can be connected to earth, causing a current from the battery at the other end to flow through the corresponding relay, and allowing local current to pass through its front contact, and through the back contact of the relay in the other line (which is inactive at this time) to the signal-bell.

In the diagram, *Fig. 1*, are shown only the sending arrangements at one station and the receiving arrangements at the other, for the sake of clearness, but it will be understood that the instruments at each end are exactly similar, and that while some of the appliances shown at one end are really cut out of circuit at the other end when not in use, others remain in circuit at all times.

The circuits of the operative currents may be traced from the following descriptions:—

Call circuit.—From earth at sending end, through line (*b*), relay A, and the battery at the receiving end to earth.

Paper-shifting circuit.—From earth at the sending end, through the battery at the sending end, by line (*a*) to the paper-shifting relay, battery, and earth at the receiving end.

Writing circuit.—From earth and battery at the sending end, splitting through the rheostats R R, lines (*a*) and (*b*), moving coils C C, and relays A A; thence reunited through the battery at the receiving end to earth.

Pen-lifting circuit.—Alternating currents from the secondary of the induction-coil at the sending end, by line (*a*) through the pen-lifter relay and the condenser at the receiving end, returning by line (*b*) to complete the circuit through the condenser.

The Paper is accompanied by a drawing, from which the Figure in the text has been prepared.