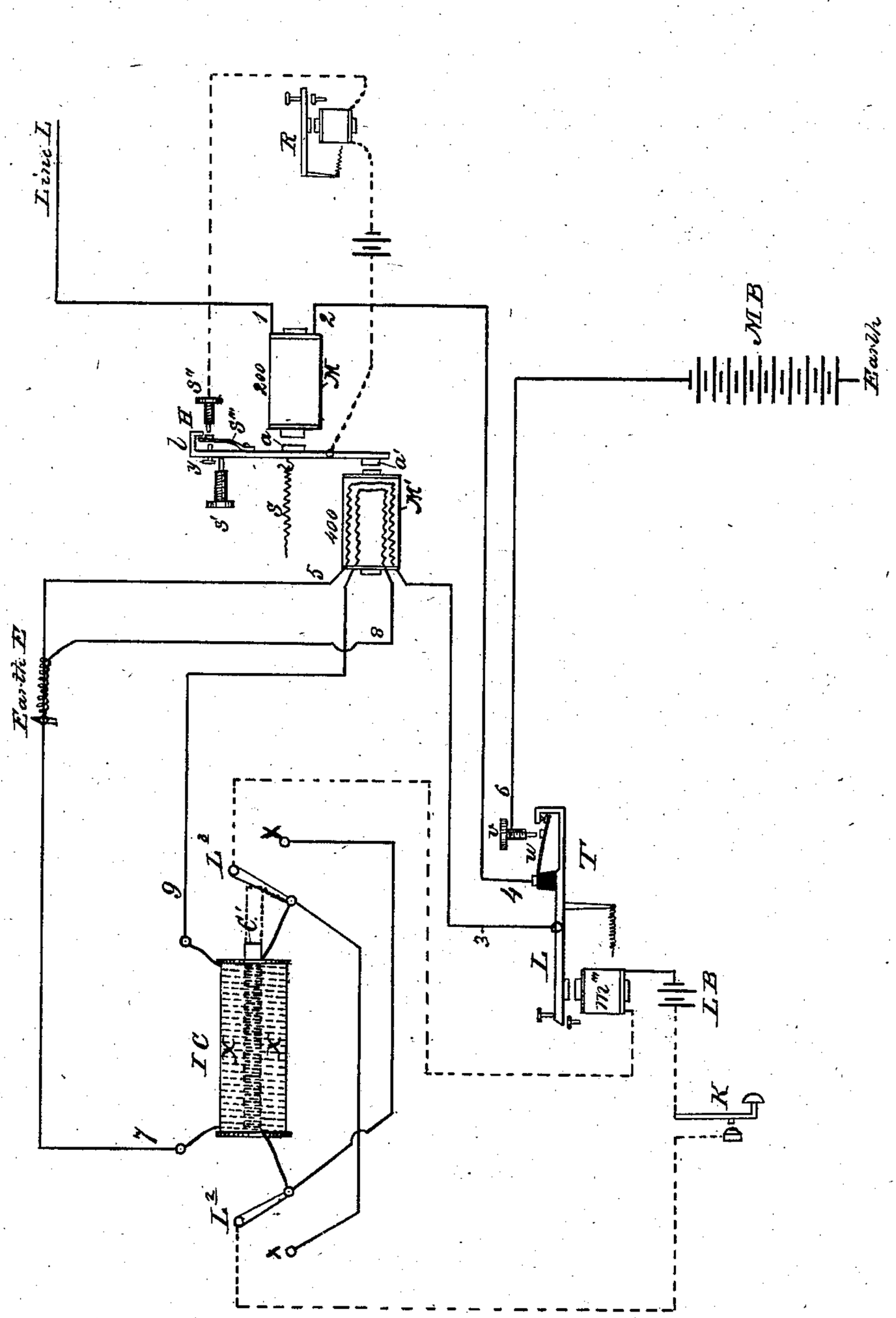
(No Model.)

B. F. DILLON & J. W. BROWN.

DUPLEX TELEGRAPH.

No. 259,106. Patented June 6, 1882.



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DUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 259,106, dated June 6, 1882.

Application filed August 22, 1881. (No model.)

To all whom it may concern:

Be it known that we, BENJAMIN F. DILLON, of Savannah, in the county of Chatham and State of Georgia, and JOHN W. BROWN, of Augusta, in the county of Richmond and State of Georgia, have invented a new and Improved Duplex-Telegraph Apparatus; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, forming part of this specification, in which the figure is a diagram view illustrating the invention.

Our invention relates to an improved duplex telegraph designed to work in double transmission without artificial resistances and to secure a perfect neutralization of the static discharge.

It consists in the peculiar construction and arrangement of parts and the disposition of the circuit, as will be hereinafter described.

Referring to the drawing, the receiving-instrument consists of two electro-magnets, M M′, one of which, M, is a simple or neutral relay, and the other of which, M′, is in the nature of a differential relay having two coils wound in opposite directions. The resistance of the electro-magnet M′ is twice as great as that of magnet M. Thus, if M′ is four hundred ohms, then M is two hundred ohms, so that M′ is more sensitive in its attractive energy. Both the magnets M′ and M are in practice made in the usual form—that is, with a pair of coils yoked in the rear, known as the "horseshoe." These magnets are so disposed on the base of the instrument that M attracts the upper armature, *a*, fastened to the lever *l*, and M′ attracts the lower armature, *a′*, fastened on the same lever. This lever *l* is pivoted, at or near the central point, between the armatures in the usual way. Its movements are governed by the force of the current in one direction and by the retractile spring S in the other direction, the movement being limited to the space allowed by the adjustable screws S′, S″, and *y*. On the lever *l* is placed a flat platina faced or pointed spring, S‴, with set-screw *y* to limit its play, through which the circuit of the sounder R is made and broken, as shown by the dotted lines.

The transmitting apparatus consists of a continuity-preserving key, or, preferably, a transmitter, T, such as is in general use in all practical methods of duplex or quadruplex telegraphing—viz., a lever, L, an insulated platina-faced spring, *u*, carried by lever L, platina-pointed screw *v*, and electro-magnet M‴, operated by local battery L B and key K.

For the sake of clearness we will here describe the operation of our instrument independently of the means for neutralizing the static discharge, and afterward explain how that is effected.

The diagram view represents the arrangement of the magnets and their connection as they exist at both ends of the line. Thus at each end the line enters magnet M at 1, then passes out at 2 to 4. The main battery M B is connected by wire 6 with the screw *v*, and the lever L is connected by wire 3 with one of the coils of the differential relay M′, and the other end of said coil is connected with wire 5, which is grounded at E. The local-battery circuit (shown in dotted lines) is made through the key K, magnet M‴, and the primary wire of an induction-coil, which latter for the present need not be considered.

Now, it being the primary function of a duplex telegraph that the signals from the distant station shall operate the receiving-instrument at the home station, while the signals from the home station shall not operate the home receiving-instrument, but shall operate the receiving-instrument of the distant station, these conditions are fulfilled in the present invention as follows: When the key K is closed armature-lever L is attracted to magnet M‴ and spring *u* brought in contact with screw *v*, throwing main battery M B into connection with *u*, 4, 2, magnet M, and the line. When the key K is open lever L recedes from magnet M‴ and simultaneously disconnects main battery from the line, as shown at *u v*, but connects the line 1 2 4, through *u*, to the lever L, thence through 3 to one of the coils of the differential relay M′, and thence through 5 to the earth. It will thus be seen that the line has an outlet to the ground at each station, alternately through the main battery and the differential relay, passing through the main battery when the key K is closed and through the

differential relay when the key K is open. Now, it will be remembered that the adjustment of spring S is such that the magnet M is not sufficient to overcome it and attract the armature when energized by a single battery, but is sufficient to overcome it and attract the armature when energized by double the electro-motive force or the batteries at both ends of the line. When, however, only one main battery is on the line, then the line-current passes through both the magnets M and M′ of the receiving-station, and the electro-motive force of a single battery is rendered sufficient to move the armature-lever *l* by reason of the combined energy of the two magnets M and M′. Now, we will suppose the key K of the station before us is open, as shown. Then impulses coming over the line pass through magnet M, from 2 to 4, through *u* to lever L, through 3 to one of the coils of M′, and thence through 5 to the earth. The single battery at the other end, then operating on both magnets M and M′, works the lever *l* and the sounder R. If, again, the key K is closed, then contact between *u* and *v* is made and between 4 and 3 is broken, and the impulses then coming over the line pass through magnet M alone, from 2 to 4, to *u*, to *v*, to 6, to the main battery, and the ground; but as there is double the current now on the line for this position of the instrument the single magnet M, being more strongly charged, is then able, without assistance, to attract the armature-lever *l*, and so operate the sounder R. Thus the reception of signals is made wholly independent of the position of the key K. For transmitting, the depression of key K throws the main battery M B through 6, *v*, *n*, 4, magnet M, and to the line, and as there is but the power of a single battery (the home battery) on the line the current only passes through the one magnet, M, and this is not sufficient to overcome the tension of spring S, and hence the transmission of signals has no effect on the instrument at the station from which said signals are sent.

It will be observed that, in transmitting, at the moment of opening key K (which cuts out main battery M B) there will be a static discharge or back flow of static charge on the line, which, passing back 1 2 4 3 into the magnet M′, will cause the lever *l* to "kick." To neutralize this static discharge we employ an induction-coil, I C, whose secondary circuit 7 8 9 is connected to the oppositely-wound coil of magnet M′, which I call the "differential relay" for convenience, and the primary circuit of this induction-coil is the circuit of the local battery, as shown in dotted lines. Now, at the instant that the local-battery circuit is opened and the main battery cut off the line, the back flow of the static charge of the main line is neutralized in magnet M′ by the counter flow of the secondary current from the induction-coil passing in the oppositely-wound coil of the differential magnet M′.

L^2 L^3 are switches, which may co-operate with the pole-points *x x* to reverse the polarity of the primary current, if desired. The induction-coil is made with an adjustable core, C′, which, by being drawn out, as shown in dotted lines, permits the strength of the secondary current to be adjusted to the amount of static discharge from the line, so as to vary the same with the varying amount of static discharge on different lengths of line.

It may be said that there will be an induced current sent through the differential relay M′ when the transmitter T is closed, which is true; but its electro-motive force is not so great as the opening current, and the momentary current from the main battery, while changing from 4 to 6, will neutralize it.

Should there be a tendency to falling off of the armature, and consequently a dropping out of the signals from the distant station, when the home station changes from battery to earth through the relay M′, this tendency will be overcome by the spring S‴, which must reach its limiting-hook H and leave screw S″ before a break can occur, and its prevention is further secured by doubling the resistance of relay M′ and adjusting it close to armature *a′*. To balance this duplex it is only necessary to first adjust M by spring S and remove coil M away from armature *a*, so that it will not respond to the key at the home station; then dot, and if the line is long adjust the induction-coil so as to neutralize the return charge. The switches L^2 L^3 will control the direction of the neutralizing-charge, and the core can be moved in or out until the desired object has been attained. Finally, let the distant station dot, and adjust relay M′ close enough to armature *a′* to produce firm signals from the distant-station battery. The apparatus is then ready for double working.

Now, in defining our invention with greater clearness we would state that we are aware of the patent to Prescott, May 15, 1877, No. 190,898, in which a differential magnet and a simple magnet are arranged upon opposite sides and the opposite ends of an armature-lever, the said differential magnet having one of its coils included in the main-line circuit constantly and the other in an artificial circuit constantly. Our invention differs from that in that our differential magnet is not always in the main-line circuit, but only alternately in the main line at the time of opening of the key, and at the closing of the key is entirely out of the main line; and, furthermore, our simple magnet M is always in the main-line circuit, while the simple magnet in the said patent is operated by a condenser, and while we utilize the differential relay to neutralize the static discharge said patent employs the simple relay.

We are also aware of the fact that an induction-coil has been used in the main line to prevent static effect; and we only claim the same when its secondary coil is connected to one of the coils of the differential relay the

primary wire of which is in the same circuit with and operated by the local battery that works the transmitter.

Having thus described our invention, what we claim as new is—

1. A duplex receiving-instrument consisting in the combination, with lever *l*, operating the sounder-circuit, of a magnet, M, arranged always in the main-line circuit, a second magnet, M′, operating in unison with magnet M on the same lever, the main battery, and a transmitter, T, interposed between the main battery and the magnet M′, and arranged, as described, to direct the main-line current alternately through the simple magnet M and main battery for one position of the home key, and to divert the main-line current through both the magnets M and M′ for the other positions of the key, whereby the receiving-instrument is operated alternately by the conjoint effect of both batteries on one magnet, M, and then by the single effect of one battery on the two magnets M and M′, as and for the purpose described.

2. The combination of the common armature-lever *l*, the simple magnet M, arranged in the main line, the differential magnet M′, acting in unison with the main battery, and the transmitter T, interposed between the main battery and differential magnet, and arranged to alternately divert the line-current through the main battery and the differential magnet, and an induction-coil having its primary wire in the circuit of the transmitter, and its secondary wire connected with the reversely-wound coil of the differential magnet for neutralizing static discharge, as set forth.

3. The combination, with the magnet M, differential magnet M′, the common lever *l*, the main battery, and the transmitter T, of the induction-coil having its primary wire in the transmitter-circuit and its secondary wire connected to the reversely-wound coil of the differential magnet, and provided with an adjustable core, C′, to regulate the secondary current to suit the amount of static discharge, as set forth.

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