

(No Model.)

4 Sheets—Sheet 1.

R. K. BOYLE.  
QUADRUPLEX TELEGRAPH.

No. 247,880.

Patented Oct. 4, 1881.

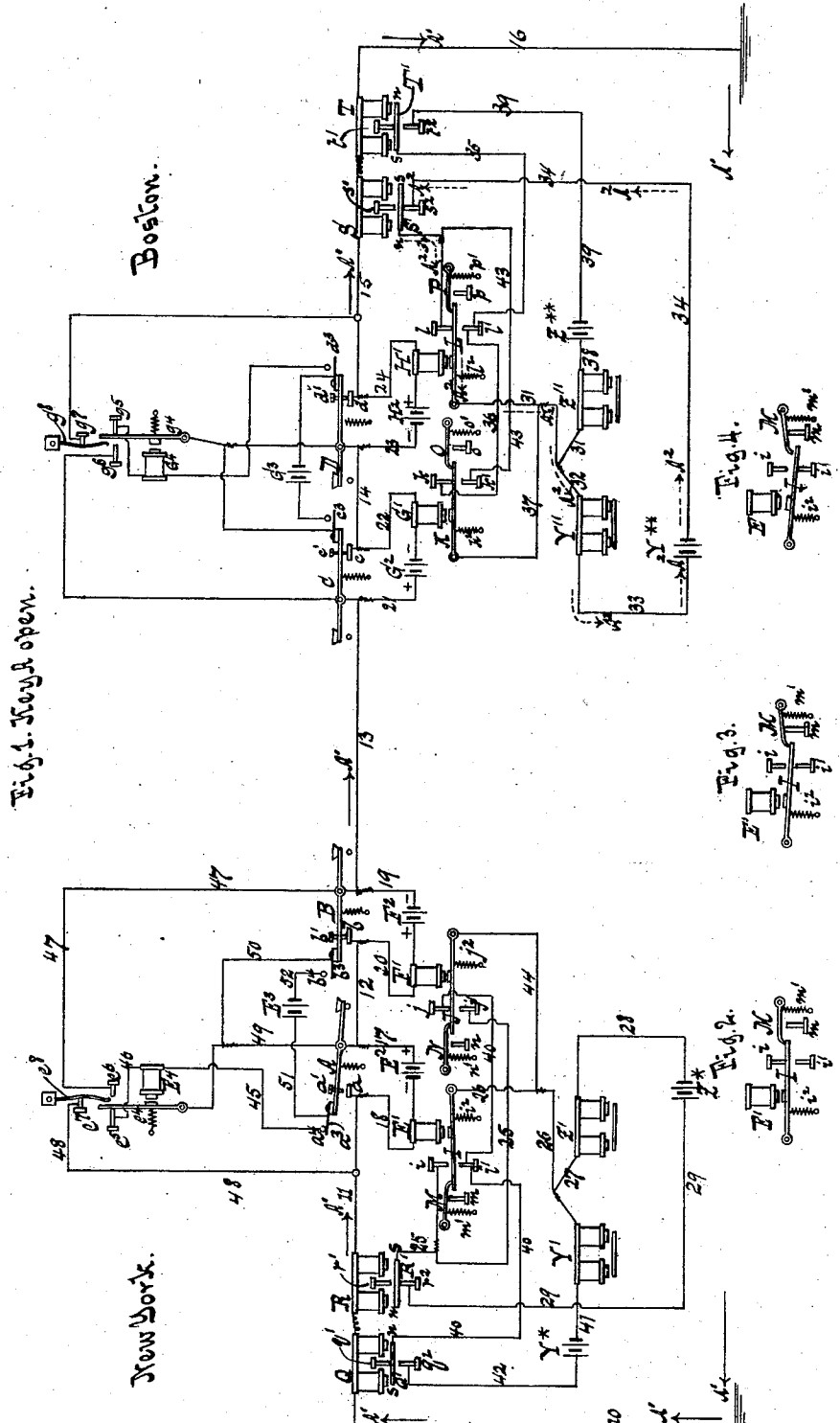


Fig. 1. Key & open.

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Inventor  
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*by Van Santvoord & Hauff* *Attorneys.*

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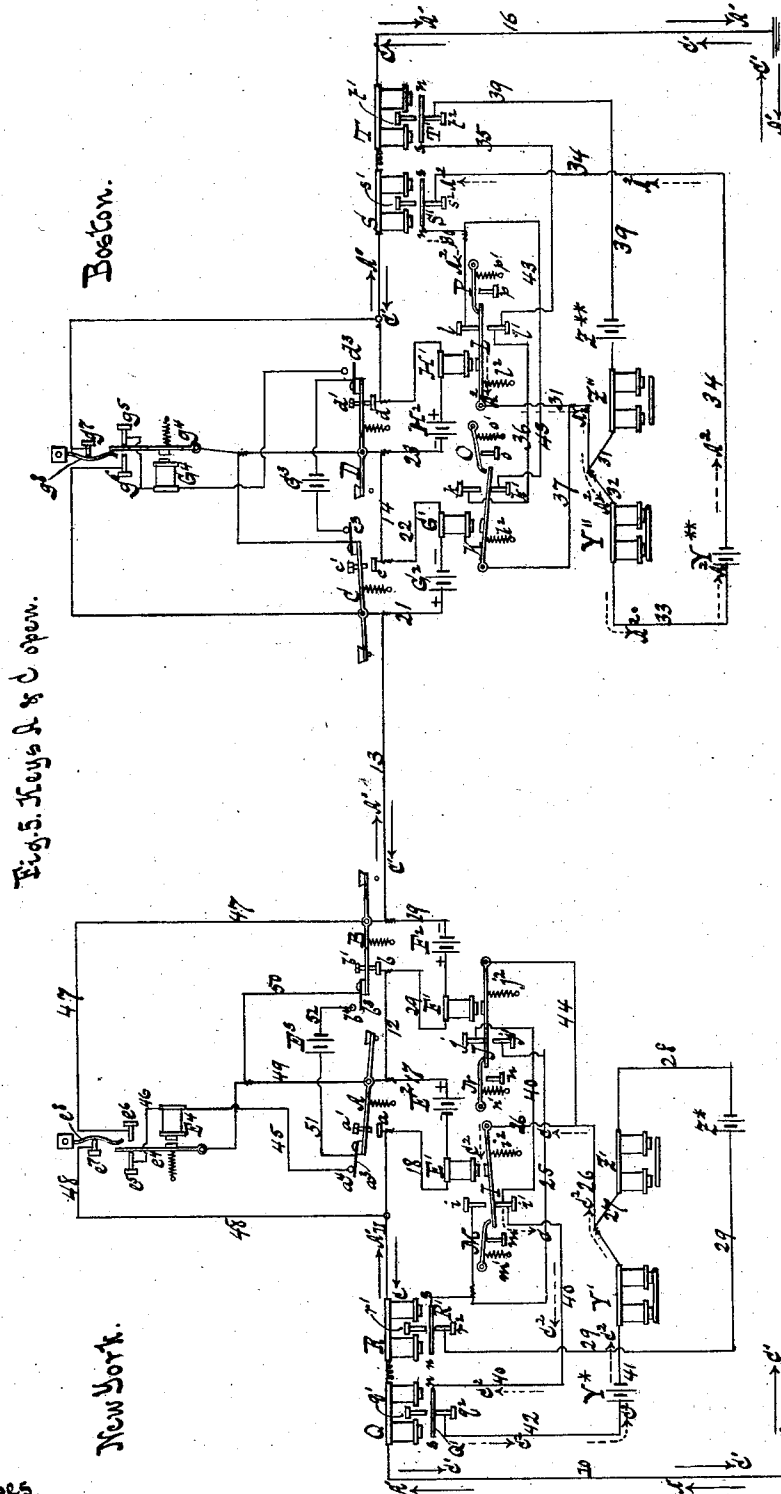


Fig. 5. Keys & c open.

Boston.

New York.

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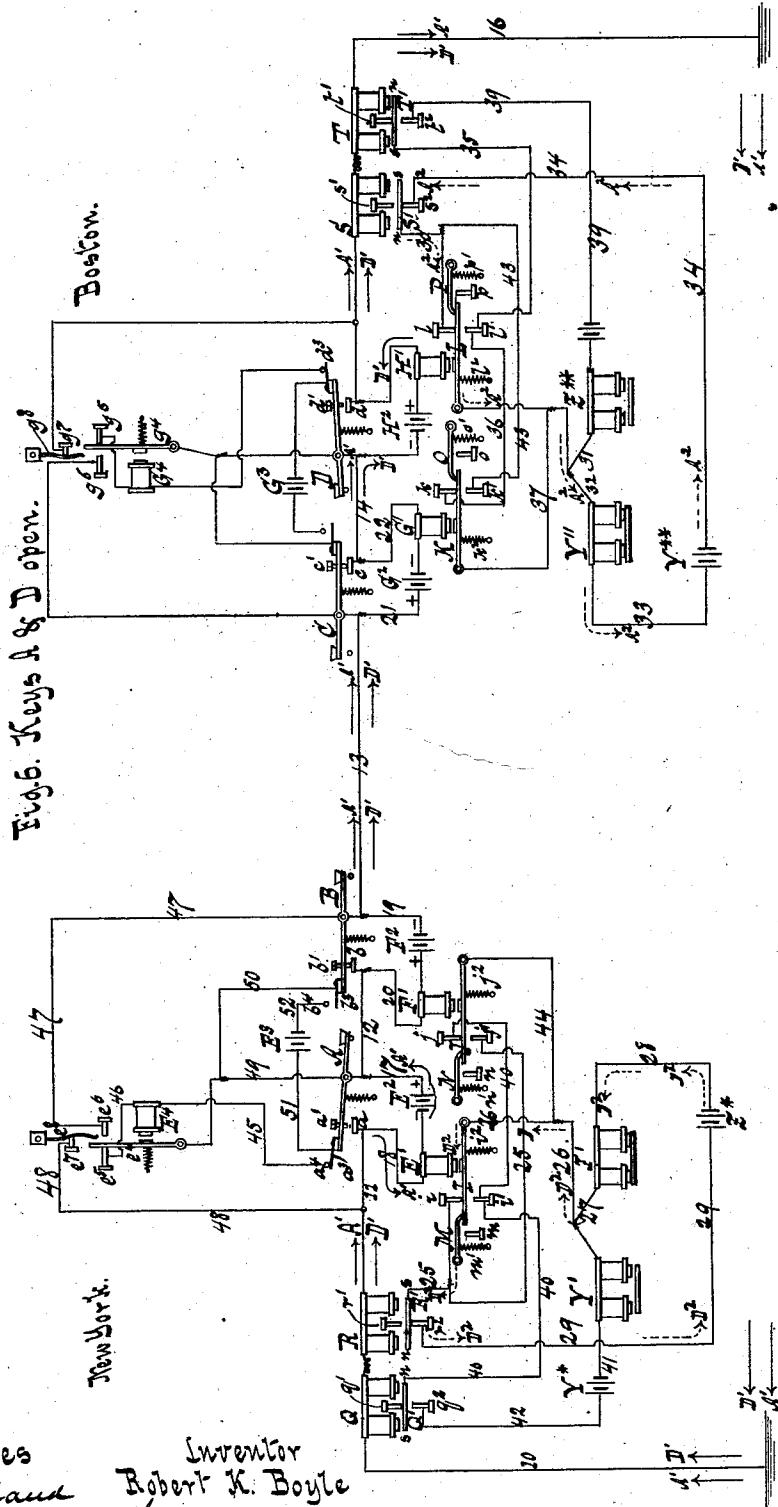
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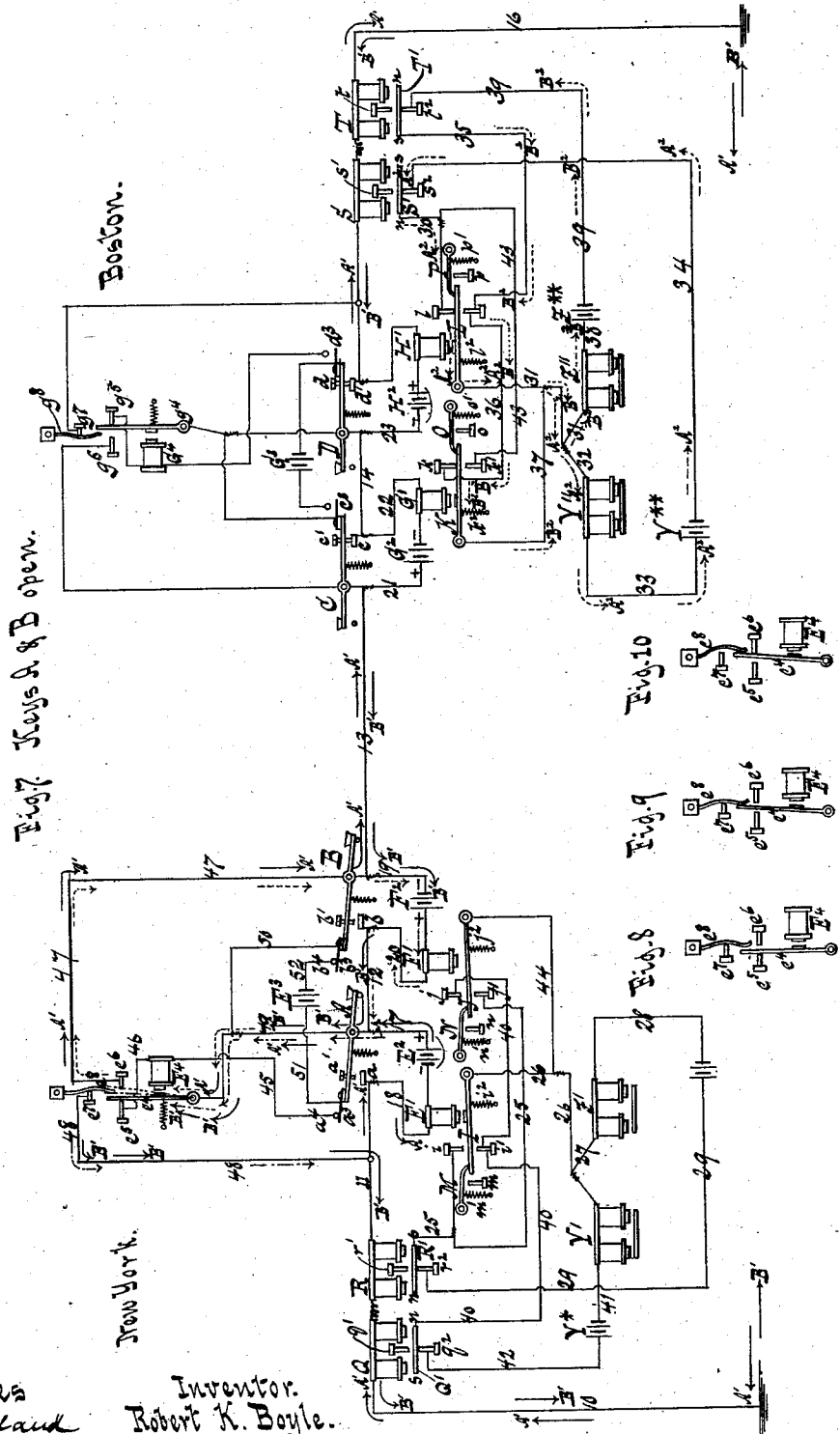
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# UNITED STATES PATENT OFFICE.

ROBERT K. BOYLE, OF NEW YORK, N. Y., ASSIGNOR TO JOSIAH C. REIFF,  
OF SAME PLACE.

## QUADRUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 247,880, dated October 4, 1881.

Application filed January 3, 1881. (No model.)

To all whom it may concern:

Be it known that I, ROBERT K. BOYLE, a subject of the Queen of Great Britain, residing at New York, in the county and State of New York, have invented new and useful Improvements in Quadruplex Telegraphs, of which the following is a specification.

This invention consists in certain novel combinations of parts, hereinafter fully described, and pointed out in the claims.

My invention is illustrated in the accompanying drawings, in which Figure 1 represents a diagram of two terminal stations of a telegraph-line with their connections and appurtenances constructed according to my system, showing the key A opened. Figs. 2, 3, and 4 are details, which will be referred to as the description progresses. Fig. 5 is a diagram similar to that represented by Fig. 1, showing the keys A and C open. Fig. 6 is a similar diagram, showing the keys A and D open. Fig. 7 is a similar diagram, showing the keys A and B open. Figs. 8, 9, and 10 are details, which will be referred to as the description progresses.

The two terminal stations, one of which I have designated "New York" and the other "Boston," are situated in an unbroken telegraph-line, which, when all the keys are closed, commences at the New York end and passes from the earth through wire 10 to and through relays Q R, thence through wire 11, key A, wire 12, key B, and line-wire 13, to Boston; then through key C, wire 14, key D, wire 15, to and through relays S T, and finally through wire 16 to earth.

Each of the terminal stations contains two batteries, those in the New York station being designated by letters E<sup>2</sup> and F<sup>2</sup> and those in the Boston station by letters G<sup>2</sup> and H<sup>2</sup>. The positive pole of the battery E<sup>2</sup> (New York station) connects by wire 17 with the key A, and the negative pole of said battery connects, through the helix of a relay, E', and wire 18, with a metal plate, a, which, when the key A is closed, is in metallic contact with the screw a', extending through said key. The wire 18 is also connected with the wire 11, and the

wire 17 with wire 12, which form part of the line, as already stated. The battery F<sup>2</sup> (New York station) is connected to the key B in a similar manner to that in which the battery E<sup>2</sup> is connected to the key A, with this difference, however, that the negative pole of the battery F<sup>2</sup> connects by wire 19 with the key B, and the positive pole of said battery connects, through the helix of a relay, F', and wire 20, with a metal plate, b, which, when the key is closed, is in metallic contact with a screw, b', extending through the key B. The wire 19 connects also with the line-wire 13, and the wire 20 with wire 12, which forms part of the line.

The connections of the batteries G<sup>2</sup> and H<sup>2</sup> in the Boston station, with their keys and with the line, are like those of the batteries E<sup>2</sup> and F<sup>2</sup> in the New York station, those of the battery G<sup>2</sup> being effected through wire 21, relay G', wire 22, metal plate c, and screw c', and those of the battery H<sup>2</sup> being made through wire 23, relay H', wire 24, metal plate d, and screw d', as will be readily understood from the several diagrams. If all the keys are closed, all the batteries are short-circuited, the current from battery E<sup>2</sup>, for instance, passing through wire 17, key A, screw a', wire 18, and relay E', back to the battery. Consequently neither of the batteries is on the line and no work is done. But if New York sends a message from key A, or, in other words, if key A is open, as shown in Fig. 1, the screw a' is out of contact with the plate a, the short circuit of battery E<sup>2</sup> is broken, and the current flows from this battery through wires 17 12, key B, line-wire 13, key C, wire 14, key D, wire 15, relays S T, and wire 16, to earth, through earth to wire 10, relays Q R, wires 11 and 18, and relay E', back to the battery, as indicated by full arrows marked A'.

The relays Q R S T are provided with polarized armatures Q' R' S' T', respectively, the poles of the armature Q' being placed in reversed position from the poles of the armature R', and the poles of the armature S' in a reversed position from those of the armature T', as indicated by the letters n s on the ends of

said armatures. When no current passes through the line and through the relays Q R S T, which form part of the line, all the polarized armatures are attracted by the cores of the relays, so that they rest against their back stops,  $q'$   $r'$   $s'$   $t'$ , respectively; but if a current is passed through the line from battery  $E^2$ , as above described, the armature  $R^2$  of relay R is repulsed and driven against its front stop,  $r^2$ , while the armature  $Q'$  of relay Q is held up more firmly against its back stop. As soon as the armature  $R'$  comes in contact with its front stop,  $r^2$ , the circuit of the local battery  $Z^*$  through the sounder  $Z'$  would be closed as follows: From the armature  $R'$  extends a wire, 25, to the back stop,  $i$ , of the armature I of the relay E', and this armature is connected by wires 26 and 27 with the helix of the sounder  $Z'$ , and through this helix and wire 28 with one pole of the local battery  $Z^*$ , the other pole of which connects by wire 29 with the front stop,  $r^2$ . The closing of this circuit, however, is prevented by the following means: The armature I of the relay E' is subjected to the action of a spring,  $i^2$ , and also of an arm, M, which is acted on by a spring,  $m'$ , that has a tendency to throw said arm against the stop  $m$ . If the battery  $E^2$  is short-circuited, so that its full force is thrown on the relay E', the attractive force of the relay overcomes the force of both the springs  $m'$  and  $i^2$  and the armature I is held in contact with its back stop,  $i$ , as shown in Fig. 2; but if the key A is depressed and the battery  $E^2$  is thrown on the line the force of said battery on the relay E' is reduced in proportion to the increased resistance offered by the line, and the springs  $m'$  and  $i^2$  draw the armature I away from its back stop, throwing the same in the position shown in Figs. 1 and 3, where the spring M is held down against its stop  $m$ , while the armature I is not in contact with either of its stops. The circuit of the local battery  $Z^*$  through the sounder  $Z'$  is not closed, and the depression of the key A produces no effect on either of the sounders in the home station. The same effect takes place when either of the other keys is depressed—that is to say, the sounders cannot be operated by the keys in the home stations. At the same time, when the key A is pressed down or opened a positive current flows from battery  $E^2$  through the line to the Boston station, and through the relays S T and wire 15 to the earth, as already stated, and shown by the full arrows marked A' in Fig. 1. By this current the polarized armature S' of relay S is repelled against its front stop,  $s^2$ , while the armature T' of relay T is more firmly held up against its back stop,  $t'$ . As the armature S' comes in contact with its front stop,  $s^2$ , a circuit is closed through the sounder  $Y''$ , as follows: from the armature S', through wire 30, back stop,  $l$ , of armature L, over said armature L, wires 31 and 33, helix of sounder  $Y''$ , and wire 33, to one pole of the local battery  $Y^{**}$ , and from the other pole of this battery, by wire 34,

to the front stop,  $s^2$ , as shown by dotted arrows marked A<sup>2</sup> in Fig. 1. In the same manner, if the key B in the New York station is depressed or opened, the sounder Y' in the home station is cut out by the balanced armature J of the relay F', while the circuit of the local battery  $Z^{**}$  is closed through the sounder  $Z''$  in the Boston station by the polarized armature T' being thrown in contact with its front stop,  $t^2$ , as follows: from the armature T', through wire 35, stop  $l'$ , wire 36, stop  $k$ , armature K, wires 37 and 31, helix of sounder  $Z''$ , and wire 38, to one pole of battery  $Z^{**}$ , the other pole of which connects by wire 39 with the front stop,  $t^2$ .

From this description it will be understood that messages can be transmitted simultaneously by means of both keys A B in the New York station, the key A producing signals by the sounder Y'' and the key B by the sounder Z'' in the Boston station, as will be hereinafter more fully explained.

If the key C in the Boston station should be open while the key A in the New York station is operating, as shown in Fig. 5, the positive current, which passes from battery  $E^2$  over the line whenever the key A is depressed, meets a positive current thrown on the line from battery  $G^2$ , the force of the relays E' and G' is neutralized, the three-stop armatures I and K are thrown against their front stops,  $i'$  and  $k'$ , (which position is shown in Fig. 5, and also in Fig. 4,) the polarized armatures Q' and S' of relays Q and S are repelled, and the local battery Y\* is closed on sounder Y' in New York and the local battery Y\*\* on sounder Y'' in Boston, as follows: from polarized armature Q', (New York station,) through wire 40, stop  $i'$ , armature I, wire 26, helix of sounder Y', and wire 41, to one pole of battery Y\*, the other pole of said battery being connected to front stop,  $q^2$ , of the polarized armature Q' by wire 42; and from polarized armature S', (Boston station,) wires 30 and 43, to front stop,  $l'$ , of armature K, through this armature, wires 31 31 32, helix of sounder Y'', and wire 33, to one pole of battery Y\*\*, the other pole of this battery being connected by wire 34 with the front stop,  $s^2$ , of the polarized armature S'. The different circuits in this figure are shown by full arrows and by dotted arrows, marked respectively A' A<sup>2</sup> and C' C<sup>2</sup>, the full arrows indicating the line-circuits and the dotted arrows the local circuits in the stations.

If key D in Boston station should be open while the key A in New York station is being operated, (see Fig. 6,) the positive current from battery  $E^2$ , which passes over the line whenever the key A is depressed, meets a negative current from the battery H<sup>2</sup>, both currents combine, so as to increase the force, the armatures I and L are attracted with full force against their back stops,  $i$  and  $l$ , respectively, (see Figs. 6 and 2,) the polarized armatures R' and S' are repelled against their front stops,  $r^2$  and  $s^2$ , respectively, and the circuits from the local batteries Y\*\* and Z\* are closed through the sound-

ers  $Y''$  and  $Z'$ , as follows: The circuit through the sounder  $Y''$  passes from the polarized armature  $S'$ , through wire 30, stop  $l$ , armature  $L$ , wires 31 32, helix of sounder  $Y''$ , wire 33, to one pole of battery  $Y^{**}$ , and from the other pole of this battery, through wire 34, to front stop,  $s^2$ , which at that moment is in contact with armature  $S'$ . The circuit through the sounder  $Z'$  passes from the polarized armature  $R'$ , wire 25, stop  $i$ , armature  $I$ , wires 26 and 27, helix of sounder  $Z'$ , and wire 28, to one pole of battery  $Z^*$ , and from the other pole of this battery, through wire 29, to the front stop,  $r^2$ , which at that moment is in contact with armature  $R'$ .

The different circuits are indicated in Fig. 6—the line-circuits by full arrows  $A'$  and  $D'$ , and the local circuits by dotted arrows marked  $A^2$  and  $D^2$ , respectively.

If the key  $C$  in Boston station is depressed while key  $B$  in New York station is being operated, the negative current from battery  $F^2$ , which is thrown on the line whenever the key  $B$  is depressed, is opposite to that of battery  $G^2$ , which is thrown on the line whenever the key  $C$  is depressed, the armatures  $J$  and  $K$  are attracted against their back stops,  $j$  and  $k$ , respectively, the polarized armatures  $Q'$  and  $T'$  are repelled against their front stops,  $q^2$  and  $t^2$ , respectively, and the circuits of the local batteries  $Y^*$  and  $Z^{**}$  through the sounders  $Y'$  and  $Z''$  are closed, as follows: The circuit through the sounder  $Y'$  passes from the armature  $Q'$ , wire 40, stop  $j$ , armature  $J$ , wires 44 26, helix of sounder  $Y'$ , and wire 41, to one pole of battery  $Y^*$ , the other pole of which connects by wire 42 with the stop  $q^2$ , which at that moment is in contact with the armature  $Q'$ . The circuit through the sounder  $Z''$  passes from the armature  $T'$ , through wires 35 36, stop  $k$ , armature  $K$ , wires 37 31, helix of sounder  $Z''$ , and wire 38, to one pole of battery  $Z^{**}$ , and from the other pole of this battery, through wire 39, to stop  $t^2$ , which at that moment is in contact with armature  $T'$ . If the key  $D$  in Boston station is depressed while key  $B$  in New York station is being operated, the currents from batteries  $F^2$  and  $H^2$  will neutralize each other, the armatures  $J$  and  $L$  fall on their front stops,  $j'$  and  $l'$ , respectively, the polarized armatures  $R'$  and  $T'$  are repelled against their front stops,  $r^2$  and  $t^2$ , respectively, and the circuits of the local batteries  $Z^*$  and  $Z^{**}$  are closed through the sounders  $Z'$  and  $Z''$ , respectively, as follows: The circuit through the sounder  $Z'$  passes from the armature  $R'$ , through wire 25, stop  $j'$ , armature  $J$ , wires 44 26 27, helix of sounder  $Z'$ , and wire 28, to one pole of battery  $Z^*$ , and from the other pole of this battery, wire 29, to the stop  $r^2$ , which at that moment is in contact with the armature  $R'$ . The circuit through the sounder  $Z''$  passes from the armature  $T'$ , through wire 35, stop  $l'$ , armature  $L$ , wire 31, helix of sounder  $Z''$ , and wire 38, to one pole of battery  $Z^{**}$ , and from the other pole of this battery, through wire 39, to stop  $t^2$ , which at that moment is in contact with the armature  $T'$ .

If both keys in either station are depressed at the same moment, a local circuit will be closed by the following means: Each of the keys  $A$   $B$   $C$   $D$  is provided with an insulated tail-spring,  $a^3$   $b^3$   $c^3$   $d^3$ , respectively, and when the keys are depressed these tail-springs come in contact with buttons  $a^4$   $b^4$   $c^4$   $d^4$ . The button  $a^4$  connects by a wire, 45, through the helix of an electro-magnet,  $E^4$ , and a wire, 46, with the outside stop,  $e^5$ , of the armature  $e^4$  of said electro-magnet. The inside stop,  $e^6$ , of this armature connects by a wire, 47, with the key  $B$ , and through it with the line-wire 13. Between the stops  $e^5$   $e^6$  is an intermediate stop,  $e^7$ , which connects by a wire, 48, with the line-wire 11. A light spring,  $e^8$ , bears against the intermediate stop,  $e^7$ . The armature  $e^4$  connects by a wire, 49, with the key  $A$ , and through it with the line-wire 12 and with wire 17, and by a wire, 50, with the insulated tail-spring  $b^3$  of the key  $B$ . The battery  $E^3$  connects at one pole, by a wire, 51, with the insulated tail-spring  $a^3$  of key  $A$ , and at its opposite pole, by a wire, 52, with the button  $b^4$ .

If both keys  $A$  and  $B$  are open at the same moment, as shown in Fig. 7, the circuit of the battery  $E^3$  is closed through the electro-magnet  $E^4$ , as follows: from battery  $E^3$ , through wire 51, tail-spring  $a^3$ , button  $a^4$ , wire 45, helix of electro-magnet  $E^4$ , wire 46, stop  $e^5$ , armature  $e^4$ , wire 50, tail-spring  $b^3$ , button  $b^4$ , and wire 52, back to the battery  $E^3$ , the armature  $e^4$  is attracted toward its inside stop,  $e^6$ , and as it leaves its outside stop,  $e^5$ , the circuit through the electro-magnet  $E^4$  is broken, the armature  $e^4$  falls back against its outside stop,  $e^5$ , the circuit through electro-magnet  $E^4$  is again closed, and thus the armature  $e^4$  is caused to vibrate rapidly between its two stops,  $e^5$   $e^6$ . At the moment the armature  $e^4$  leaves its outside stop, and when it touches the spring  $e^8$ , (which position is shown in Fig. 9 and indicated by a stroke and dotted line in Fig. 7,) the battery  $E^2$  is put on a loop-circuit through wires 17 49, armature  $e^4$ , spring  $e^8$ , intermediate stop,  $e^7$ , wires 48, 11, and 18, back to the battery, as indicated by stroke-and-dot arrows in Fig. 7.

The battery  $F^2$  is thrown on the line as follows: Its negative pole is connected to the line-wire 13, and its positive pole connects, by wires 20 12 49, armature  $e^4$ , spring  $e^8$ , stop  $e^7$ , and wire 48, with the line-wire 11, as indicated by full arrows  $B$  in Fig. 7, the polarized armature  $T'$  of electro-magnet  $T$  (Boston station) is repelled, and the circuit of battery  $Z^{**}$  in Boston station is closed through sounder  $Z''$ , as follows: from said battery, through wire 39, stop  $t^2$ , armature  $T'$ , wires 35 and 36, to stop  $k$ , armature  $K$ , wires 37 31, helix of sounder  $Z''$ , and wire 38, back to the battery, as indicated in dotted arrows  $B^2$  in Fig. 7, thereby giving a signal in the Boston station corresponding to the movement of the key  $B$  in the New York station. When the armature  $e^4$  reaches its inside stop,  $e^6$ , as shown in Fig. 10 and indicated in dotted line in Fig. 7, the battery  $F^2$  of key

B is placed on a loop-circuit, as follows: from said battery, through wires 20 12 49, armature  $c^4$ , stop  $e^6$ , and wires 47 19, back to the battery, as indicated by unlettered dotted arrows in Fig. 7; and the battery  $E^2$  of key A is thrown on the line, as follows: from this battery, through wires 17 49, armature  $c^4$ , stop  $e^6$ , wire 47, to line 13, and through line 11 and wire 18 back to the battery, as indicated in full arrows  $A'$  in Fig. 7, the polarized armature  $S'$  of electro-magnet  $S$  (Boston station) is repelled, and the circuit of battery  $Y^{**}$  through sounder  $Y''$  is closed, as follows: from the battery, through wire 34, armature  $S'$ , wire 30, armature  $L$ , wires 31 32, sounder  $Y''$ , and wire 33, back to the battery, as indicated by dotted arrows  $A$  in Fig. 7, thereby giving a signal in the Boston station corresponding to the movement of the key  $A$  in the New York station.

If both keys,  $C D$ , in Boston station are depressed at the same moment, the local battery  $G^3$ , electro-magnet  $G^4$ , and armature  $g^4$  will produce exactly the same effect as that described in the preceding paragraph—that is to say, by the vibration of the armature  $g^4$  between the stops  $g^5 g^6$  electrical impulses will be thrown in the line-wire from one of the line-batteries  $G^2 H^2$ , while at the same time the other of the said batteries is in a loop-circuit.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a telegraph-line, of two or more keys, one or more in each station, a battery and a relay for each key, a three-stop

armature for each of said relays, one or more batteries and one or more sounders (corresponding in numbers to the keys) in each station, and relays situated in and forming part of the line, and provided with polarized armatures, which, together with the three-stop armatures and the keys, control the circuits of the local batteries through the sounders, substantially in the manner shown and described.

2. The combination, with the keys  $A B$  and their batteries  $E^2 F^2$ , of insulated tail-springs  $a^3 b^3$ , a local battery,  $E^3$ , an electro-magnet,  $E^4$ , an armature,  $c^4$ , and suitable connections, such as shown, with the local battery and with the line-wire, for throwing alternating impulses from the batteries  $E^2 F^2$  on the line, when both keys are depressed at the same moment, substantially as described.

3. The combination, substantially as hereinbefore described, of four keys, two in each station, a loop-circuit containing a battery and the entire helix of a relay for each key, four additional polarized relays normally in the main-line circuit, one for each key, local batteries, sounders, and connections, and a line-wire connecting the two stations, as and for the purpose specified.

In testimony whereof I have hereunto set my hand and seal in the presence of two subscribing witnesses.

ROBERT KIRK BOYLE. [L. S.]

Witnesses:

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E. F. KASTENHUBER.