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TELEPHONE SYSTEM.

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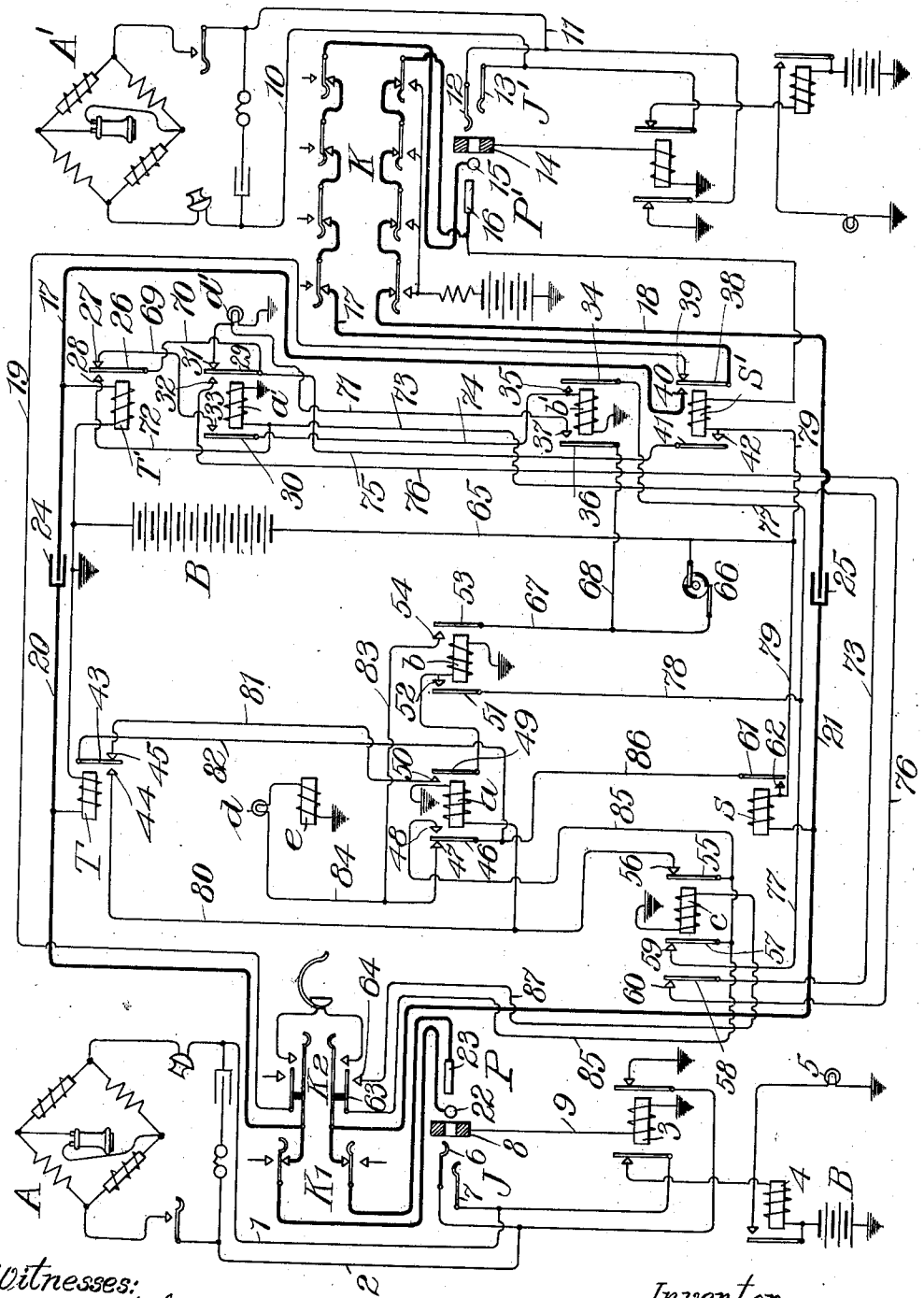

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,037,636. Specification of Letters Patent. Patented Sept. 3, 1912.

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To all whom it may concern:

Be it known that I, JAMES KENNEDY, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented a certain new and Improved Telephone System, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

The object of my invention is to produce an improved means for interconnecting telephone lines terminating at a telephone exchange, in order to facilitate the proper handling of calls coming from lines connected to the exchange. By my invention I provide that in connection with the cord circuit usually used for interconnecting telephone lines for conversation there is associated signaling means under the control of the connected telephone lines during their connection by which the continuance and termination of a conversation over the connection may be indicated to the operator at the exchange, and, further, that the indication given by this signaling apparatus for a disconnection of the telephone lines is of such a character that it may indicate either a requirement on the part of the calling subscriber for a second connection or that the calling subscriber has finished using the first connection; that is, the signal given for either condition is shown in the same manner on the signaling apparatus connected with the cord circuit.

In carrying out my invention, I preferably make use of lamp signaling apparatus by which a supervisory lamp connected with the calling end of the connecting cord is continuously illuminated during the ringing condition of the called subscriber's line, such supervisory signal being extinguished by the answering of the called subscriber. For this condition the supervisory lamps associated with both ends of the cord circuit are extinguished and at the close of the conversation apparatus is operated by the supervisory relays connected with the cord circuit by which one or both of the supervisory lamps are illuminated, depending upon whether one or both of the subscribers have hung up their receivers, and this illumination is of an intermittent character, such as might be given if the calling subscriber desiring a second connection were to repeatedly move his receiver hook up and down. For this condition, however, the supervisory signals are entirely removed from the control of the subscribers and can only be restored to the control of the subscribers by the operator listening in on the connection to determine whether a second connection is required by the calling subscriber.

The drawing illustrating my invention shows in diagram two line circuits and a cord circuit for interconnecting them.

As shown in the drawing, the substation A is connected by line wires 1 and 2 with springs 7 and 6, respectively, of the jack J at the telephone exchange. The usual apparatus is provided at the substation by which, when the receiver hook is raised, a circuit is completed through the substation and the line wires 1 and 2, and when the receiver hook is depressed this circuit is broken. A line relay 4 is shown connected with the line wire 1 and through the battery B to ground. This line relay 4 is adapted upon energization to illuminate the line signal lamp 5 through the battery B, as indicated. A cut-off relay 3 is also associated with the line wires 1 and 2 and serves to remove the line signal 4 from the circuit when battery is supplied to the ring 8 of the jack J. A second line circuit, consisting of the line wires 10 and 11 extending to a substation A′, is also shown, the line wires 10 and 11 terminating in the springs 13 and 12 of the jack J′, respectively. This line is equipped with line and cut-off relays and a line signal similar to those described for substation A. The cord circuit shown for connecting these substations consists in the sections of tip strand 17 and 20, extending from the tip 22 of the answering plug P through the condenser 24 to the tip 15 of the calling plug P′. The sleeve strand of this cord circuit consists in sections 18 and 21 extending from sleeve 23 of the answering plug P, through the condenser 25, to the sleeve 16 of the calling plug P′. Tip relays T and T′ have their energizing windings connected with the sections 20 and 17, the other terminals of these windings being con-

nected with battery B. The sleeve relays S and S′ have their energizing windings connected with the strands 21 and 18, the other terminals of these windings being connected through wires 79 and 65 with battery B. The armature 26 of relay T′ is connected through wire 70 with the armature 29 of relay *a′*. Contacts 27 and 28 adapted to be engaged by the armature 26 are connected through wires 69 and 72 with contact 33 and the energizing winding respectively of the relay *a′*. The other terminal of the energizing winding of the relay *a′* is grounded. The contact 28 is also connected through wire 73 with the armature 58 of the relay *c*. Armature 29 of relay *a′* is also connected by wire 75 with the armature 41 of the relay S′. Contacts 31 and 32, adapted to be engaged by the armature 29, are connected through wires 71 and 76 with contact 37 of relay *b′* and contact 60 of relay *c*, respectively. The contact 31 is also connected through the supervisory lamp *d′* to ground. Armature 30, adapted to engage contact 33, is connected through wire 74 with contact 35, adapted to be engaged by armature 34 of relay *b′*. Wire 74 also connects to one terminal of the winding of relay *b′*, the other terminal of this winding being grounded. The armature 34 is connected by wire 77 with contact 59 of relay *c*, and this wire 77 is also connected by wire 78 with armature 51 of relay *b*. The armature 36 of relay *b′*, adapted to engage contact 37, is connected by wire 68, through wire 67, with armature 53 of relay *b* and interrupter 66, the other terminal of such interrupter being connected by wire 65 with the battery B. The cord strands 17 and 18, extending from the tip 15 and 16, pass through a series of contacts on the ringing key K, which, since it forms no part of this invention, is not shown or described in detail. The strand 17, after passing through the key K, is connected with the armature 38 of relay S′, which armature is adapted to engage contacts 39 and 40, connected with the wire 19 and strand 17, respectively. Wire 19 extends to the operator's listening key K^2 and serves to complete the testing circuit through this operator's key when the operator listens in in making a connection. Since this testing circuit and its operation form no part of this invention, it is not shown or described in detail, any of the well known forms of testing being applicable in this connection. The armature 41 of the relay S′ is adapted to engage contact 42, which is connected in turn through wire 79 and wire 65 with battery B. The armature 43 of relay T is connected by wire 82 with the armature 46 of relay *a* and also by wire 86 with the armature 61 of relay S. The armature 43 is adapted to engage contacts 44 and 45 connected by wires 80 and 81 with contacts 56 and 50 of relays *c* and *a*, respectively. The wire 80 is also connected to one terminal of the energizing winding of the relay *a*, the other terminal of this winding being grounded. The armature 49 of the relay *a*, adapted to engage the contact 50, is connected to the contact 52 of the relay *b* and also to one terminal of the energizing winding of this relay, the other terminal of such winding being grounded. Contact 48 of the relay *a* is connected by wire 85 with armatures 55 and 57, of relay *c* and also to contact spring 63 of the listening key K^2. The energizing winding of relay *c* is connected by wire 87 to the contact 64 and adapted to be engaged by the contact spring 63, the other terminal of such energizing winding being grounded.

As a result of the circuit connections above described, when the subscriber A desires to be connected with subscriber A′ he signals the exchange operator by removing the receiver from the telephone hook, first closing a circuit through the line wires 1 and 2, as follows: battery B, line relay 4, line wire 1, substation A, line wire 2, to ground, and thus back to battery B. The line relay is energized and a circuit is closed from the battery B through the line signal 5, as indicated. In response to this signal, the operator inserts plug P of the connecting cord in the jack J, the tip 22 and sleeve 23 of such plug engaging the tip and sleeve springs 7 and 6, respectively. The sleeve of the plug also engages the ring 8, closing a circuit through the cut-off relay 3, as follows: battery B, wire 65, wire 79, sleeve relay S, cord strand 21, sleeve 23, ring 8, wire 9, cut-off relay 3, to ground, and thus back to battery B. The cut-off relay 3 is thus energized and interrupts the connection of the line wires 1 and 2 to the line relay 4 and ground, respectively. As a result of the circuit which is traced through the cut-off relay 3 the sleeve relay S is also energized and a circuit is closed between armatures 61 and its contact 62 for a purpose to be described. Since the receiver at substation A is off the receiver hook, the insertion of the plug P into the jack J closes a second circuit as follows: battery B, wire 65, wire 79, energizing winding of the sleeve relay S, cord strand 21, sleeve 23, spring 6, line wire 2, substation A, line wire 1, spring 7, tip 22, strand 20, energizing winding of the relay T, thence back to battery B. This causes the energization of relay T and moves its armature 43 from the back contact 45 to the front contact 44, thus closing the energizing circuit of the relay *a* as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, wire 82, armature 43, contact 44, wire 80, energizing wind-

ing of relay *a*, to ground and thus back to battery B. As a result of this, the armatures 46 and 49 make contact with their front contacts 48 and 50, respectively, and connection between the armature 46 and wire 84 is interrupted, whereby the burning of the supervisory lamp *d* is prevented. The energization of the relay *a* establishes a locking circuit for its energizing winding as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, armature 46, contact 48, wire 85, armature 55, contact 56, energizing winding of relay *a*, to ground, and thus back to battery B. From which it appears that the energizing circuit of the relay *a* will not be opened when the relay T is deënergized. This condition of the relays is maintained until the calling subscriber returns his receiver to the receiver hook, for which condition the energizing circuit of the relay T is interrupted and the armature 43 drops back to its contact 45, thereby energizing the relay *b* as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, wire 82, armature 43, contact 45, wire 81, contact 50, armature 49, energizing winding of relay *b* to ground, thus back to battery B. This causes the attraction of armatures 51 and 53 and closes a locking circuit for the relay *b* as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, armature 46, contact 48, wire 85, armature 57, contact 59, wire 77, wire 78, armature 51, contact 52, energizing winding of relay *b* to ground, and thus back to battery B. By the attraction of the armature 53 an operating circuit is closed for the supervisory lamp *d* as follows: battery B, wire 65, interrupter 66, wire 67, armature 53, contact 54, wire 83, wire 84, supervisory lamp *d*, signal *e*, to ground. The interrupter 66 is continuously rotated at such a speed as to flash the lamp *d* in much the same manner as it would be flashed were the calling subscriber to move his receiver hook up and down to attract the attention of the operator, and for this reason the energization of the supervisory lamp *d* at this time is an intermittent one. The signal *e* represents diagrammatically a pilot-controlling relay or similar device that may be used in connection with such supervisory signal. The circuit connections and their operation above described have been considered irrespective of the condition of the calling end of the cord, since the operation of the supervisory apparatus of the answering end of the cord does not depend in any way upon the condition of the calling end of the cord. When the subscriber A has directed that connection be made with the substation A′ the operator inserts plug P′ in the jack J′, which energizes the relay S′ and the cut-off relay connected with the line 10—11, through the following circuit: battery B, wire 65, wire 79, energizing winding of relay S′, cord strand 18, sleeve 16 of plug P′, ring 14, through the cut-off relay to ground, and thus back to battery B.

The energization of the cut-off relay leaves the line wires 10 and 11 connected through the springs 13 and 12 with tip 15 and sleeve 16 of the plug P′. The energization of the relay S′ moves the armature 38 from contact 39 to contact 40 and thus interrupts connection between the tip 15 through wire 19 with the testing apparatus and closes the strand 17 for supervisory and talking purposes. The energization of the relay S′ also closes a circuit from the battery as follows: battery B, wire 65, wire 79, contact 42, armature 41, wire 75, armature 29, contact 31, supervisory lamp *d′*, to ground, and thus back to battery B. From this it will appear that during the ringing condition of the calling end of the cord the supervisory lamp *d′* associated with such calling end is illuminated except during the act of ringing. The operator then signals substation A′ by means of the key K, and when the called subscriber responds by removing his receiver from the receiver hook a circuit is closed from the battery B as follows: battery B, wire 65, wire 79, energizing winding of relay S′, strand 18, sleeve 16, spring 12, line wire 11, substation A′, line wire 10, spring 13, tip 15, cord strand 17, energizing winding of relay T′, back to battery B. This causes the attraction of the armature 26 and closes a circuit as follows: battery B, wire 65, wire 79, contact 42, armature 41, wire 75, wire 70, armature 26, contact 28, wire 72, energizing winding of relay *a′*, to ground, and thus back to battery B. This causes the attraction of armature 29, which interrupts circuit through the supervisory lamp *d′*, thus extinguishing it, and closes a second circuit as follows: battery B, wire 65, wire 79, contact 42, armature 41, wire 75, armature 29, contact 32, wire 76, contact 60, armature 58, wire 73, to and through the energizing winding of the relay *a′*, to ground, and thus back to battery B. This serves as a locking circuit for relay *a′* and thus maintains the armatures 29 and 30 in attracted position, irrespective of the position of the armature 26 of the relay T′. This condition of the relays associated with the calling end of the cord is maintained until the subscriber A′ interrupts the circuit through the relay T′ by returning the receiver to the receiver hook. This causes a deënergization of the relay T′ and the return of the armature 26 to the contact 27, which closes a circuit as follows: battery B, wire 65, wire 79, contact 42, armature 41, wire 75, wire 70, armature 26, contact 27, wire 69,

contact 33, armature 30, wire 74, energizing winding of relay b', and thus back to battery B'. This energizes the relay b', which energizing circuit is locked as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, armature 46, contact 48, wire 85, armature 57, contact 59, wire 77, armature 34, contact 35, energizing winding of relay b', to ground, and thus back to battery B. The energizing of the relay b' closes a second circuit as follows: battery B, wire 65, interrupter 66, wire 68, armature 36, contact 37, wire 71, supervisory lamp d', to ground, and thus back to battery B. From this it appears that since the relay b' is locked in its energized condition the supervisory lamp d' will be flashed due to the operation of the interrupter 66, whatever operation may now be given the relay T' by the subscriber A'.

When the supervisory lamp d is flashed by the subscriber A hanging up his receiver, the operator, being unable to determine whether the disconnect signal is being given or the subscriber A desires a second connection, is obliged to listen in by operating the key K^2, thus closing contact between the springs 63 and contact 64, which operates relay c as follows: battery B, wire 65, wire 79, contact 62, armature 61, wire 86, armature 46, contact 48, wire 85, contact spring 63, contact 64, wire 87, energizing winding of relay c, to ground, and thus back to battery B. The energizing of the relay c results in attracting the armatures 55, 57 and 58, thus interrupting the locking circuits of the relays a, b and b', and a', respectively. Thus it will be seen that the operator, in determining whether the signal given by the supervisory lamp d is for disconnection or re-call places the supervisory apparatus of both answering and calling ends of the cord in condition to properly respond to the next connection, should the calling subscriber desire a second connection. If, on the other hand, a further connection is not desired, the plugs P and P' are removed from jacks J and J', respectively.

It will be understood that the locking circuits of the several relays are controlled by a relay c, purely as a matter of convenience, and that these locking circuits might all be closed through contacts on the listening key, if desired.

While I have shown my invention in the particular embodiment herein described, I do not limit myself to this construction, but desire to claim broadly any equivalent modification that will suggest itself to those skilled in the art.

What I claim is:

1. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means including an electric switch at the exchange for connecting the lines for conversation as desired, a lamp signal associated with one of such connecting means and adapted to indicate the talking and disconnect conditions of a calling substation connected by such connecting means, such disconnect indication serving also as a re-call indication, said signal being rendered independent of said switch after its first operation.

2. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means including an electric switch at the exchange for connecting the lines for conversation as desired, and a lamp signal associated with one of such connecting means and adapted to indicate the talking and disconnect conditions of a calling substation connected by such connecting means, such disconnect indication consisting in a flashing of the lamp signal constituting also a re-call signal, said signal being rendered independent of said switch after its first operation.

3. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means including an electric switch at the exchange for connecting the lines for conversation as desired, and a lamp signal associated with one of such connecting means and adapted to indicate the talking and disconnect conditions of a calling substation connected by such connecting means, such disconnect indication consisting in a flashing of the lamp signal constituting also a re-call signal, the setting of the disconnect signal serving to remove the control of the signal from the calling substation, whereby a re-call condition of the apparatus at such substation produces no effect upon such disconnect signal, said signal being rendered independent of said switch after its first operation.

4. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the deënergization of the first relay, and a supervisory signal under the control of the second relay, the energization of the second relay serving to lock it in operative condition whereby said signal is removed from the control of the first relay.

5. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means,

such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the deënergization of the first relay, a supervisory signal adapted to be energized by the energization of the second relay, and a locking circuit for the second relay closed by its energization whereby such signal is removed from the control of the first relay.

6. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the deënergization of the first relay, a supervisory signal adapted to be energized by the energization of the second relay, a locking circuit for the second relay closed by its energization whereby such signal is removed from the control of the first relay, and means under the control of the operator for restoring control of such second relay to the first relay without interrupting the connection.

7. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the deënergization of the first relay, a supervisory signal adapted to have its energizing circuit established through contacts closed by the energization of such second relay, and a locking circuit for the second relay closed by its energization whereby such signal is removed from the control of the first relay.

8. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the energization of such first relay, a locking circuit for such second relay closed by its energization, a third relay, the energization of such second relay serving to close one break in the normally open energizing circuit of the third relay, the deënergization of such first relay serving to complete the energizing circuit of the third relay when the second relay is energized, a locking circuit for the third relay closed by its energization, and a supervisory signal under the control of the third relay.

9. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the energization of such first relay, a locking circuit for such second relay closed by its energization, a third relay, the energization of such second relay serving to close one break in the normally open energizing circuit of the third relay, the deënergization of such first relay serving to complete the energizing circuit of the third relay when the second relay is energized, a supervisory signal adapted to have its energizing circuit established through contacts closed by the energization of such third relay, and a locking circuit for the third relay closed by its energization whereby such third relay is removed from the control of the first relay.

10. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, means at the exchange for connecting the lines for conversation as desired, a first relay associated with each of such connecting means, such first relay adapted to be controlled from a substation connected with such connecting means, a second relay adapted to be energized by the energization of such first relay, a locking circuit for such second relay closed by its energization, a third relay, the energization of such second relay serving to close one break in the normally open energizing circuit of the third relay, the deënergization of such first relay serving to complete the energizing circuit of the third relay when the second relay is energized, a supervisory signal adapted to have its energizing circuit established through contacts closed by the energization of such third relay, a locking circuit for the third relay closed by its energization whereby such third relay is removed from the control of the first relay, and means under the control of the operator for interrupting the locking circuits of the second and third relays without interrupting the connection.

11. In a telephone system, a plurality of telephone lines, means for connecting two lines together, a signal associated with said means adapted to be controlled from a substation, a switch for connecting said connecting means to a line, said signal being controlled by said switch, and means for re-

moving such signal from the control of said switch and substation when such signaling means are operated.

12. In a telephone system, a plurality of telephone lines, circuit connections for connecting said lines, signaling means in said circuit connections, a single circuit for said signaling means, means in said circuit to interrupt said circuit through said signal, means controlling said circuit adapted to be operated from a substation and means for removing said circuit from the control of the substation by such operation.

In witness whereof, I hereunto subscribe my name this 17th day of July A. D. 1908.

JAMES KENNEDY.

Witnesses:
A. J. SHANDS,
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