C. L. GOODRUM.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED JULY 28, 1917.

1,309,248.

Patented July 8, 1919.

2 SHEETS—SHEET 1.

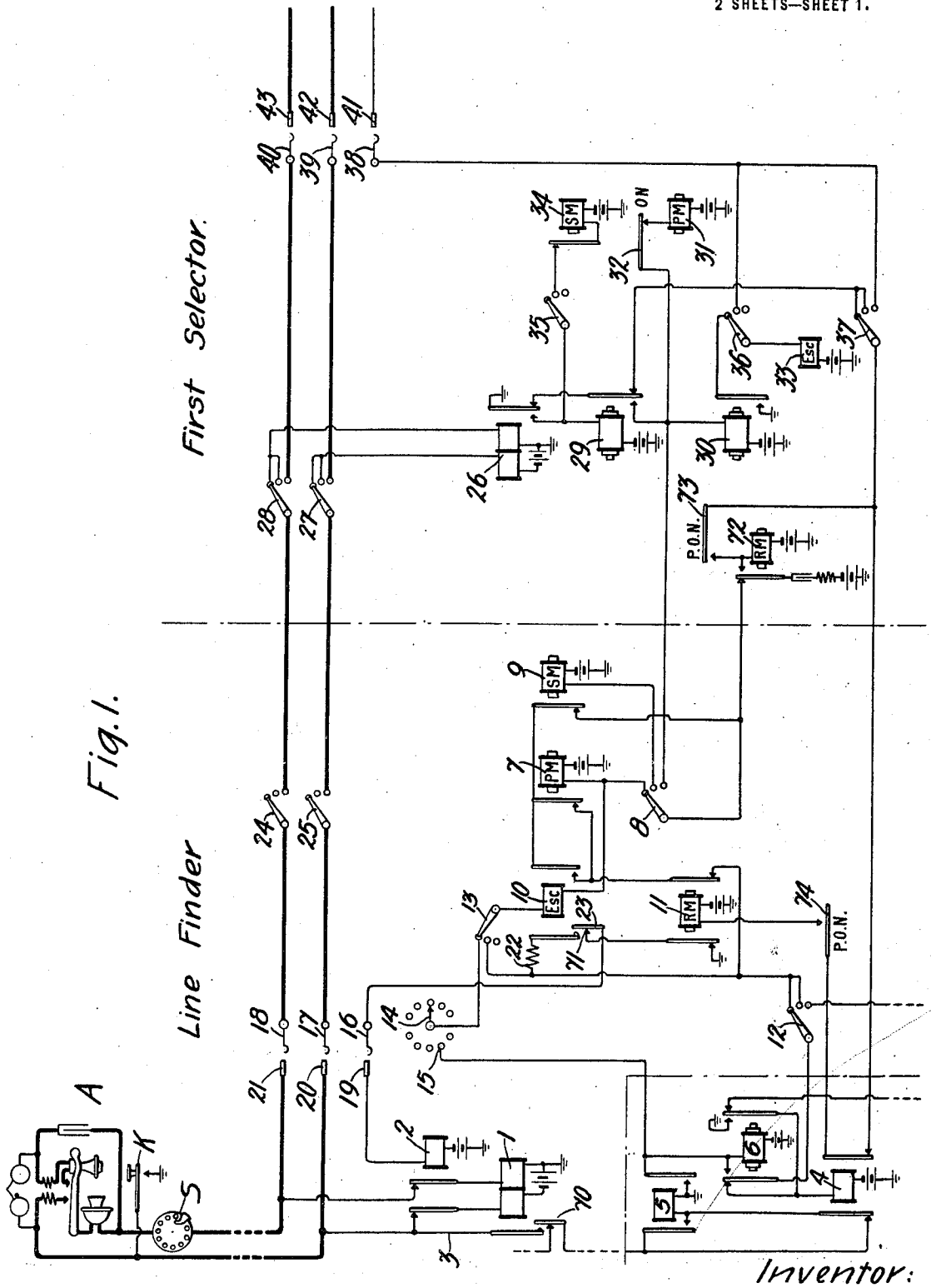


Fig. 1.

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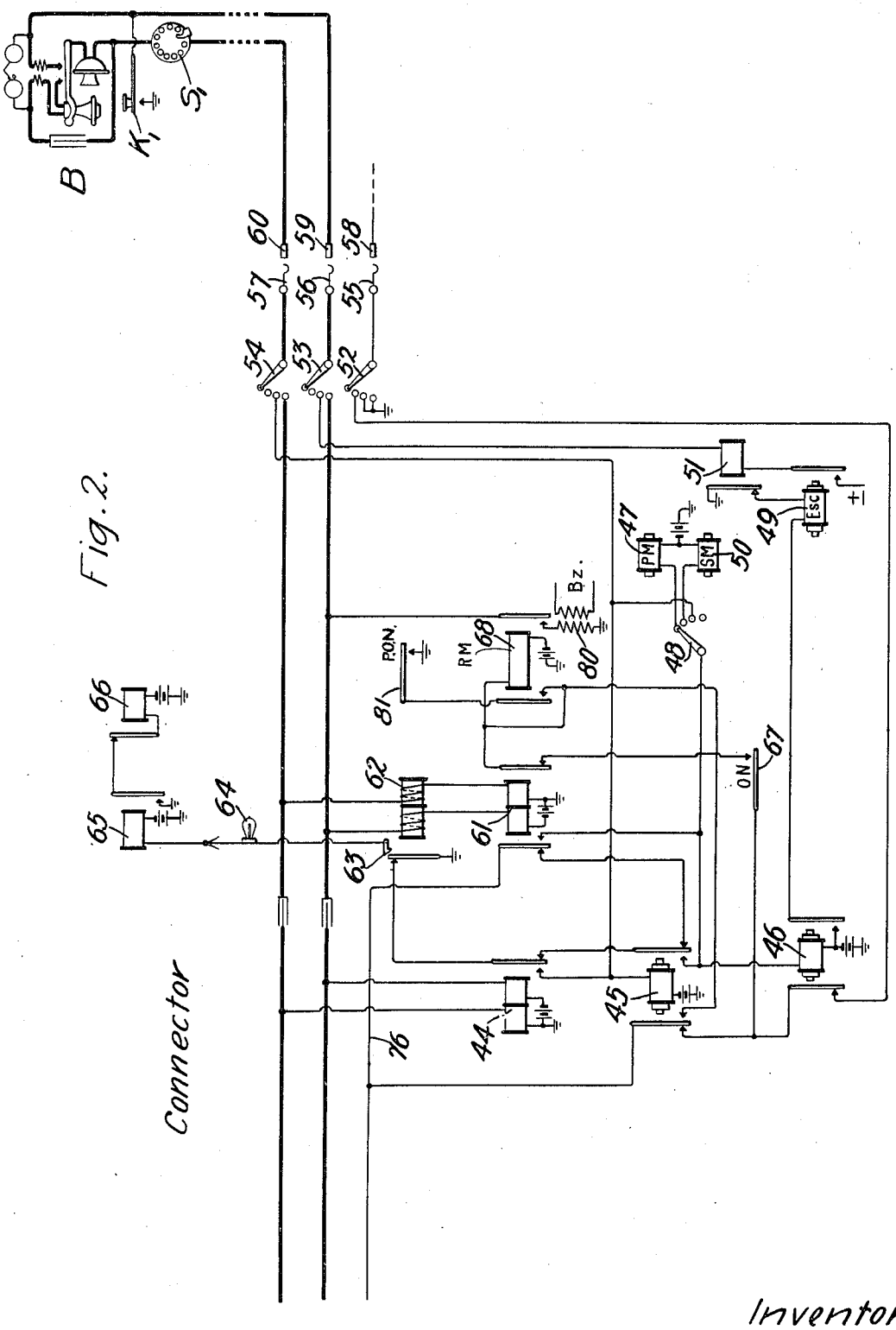


Fig. 2.

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Att'y.

UNITED STATES PATENT OFFICE.

CHARLES L. GOODRUM, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE SYSTEM.

1,309,248. Specification of Letters Patent. Patented July 8, 1919.

Application filed July 28, 1917. Serial No. 183,295.

To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to automatic telephone systems, and more particularly to circuits controlling the release of automatic selective switches used in such systems.

In automatic telephone systems, called subscribers are unable to find out where a call originated unless they are informed by the calling party. Frequently, subscribers are annoyed and insulted by people on account of their knowing that it is impossible for the called party to find out who is calling. It is, therefore, the object of this invention to provide means whereby a called subscriber can lock up the series of switches used to complete the connection from a calling line to his line, and also to cause an alarm to operate at the central office to notify an attendant thereat to trace the connection and determine the line upon which the call originated.

In accordance with this object, a differential relay is provided in the battery supply circuit of the connector switches, and a push button is provided at each subscriber's substation. When this button is pressed at a called substation, one winding of the differential relay of the connector switch connected thereto, is shunted, thereby causing the relay to become energized and attract its armature which is mechanically locked up. The attraction of the armature permanently opens the release circuit of switches used in completing the connection, and thereby prevents the release of these switches when either subscriber hangs up his receiver. The attraction of the armature of the differential relay also causes an alarm to operate at the central office. This alarm notifies an attendant at the central office that a called party has locked up a series of switches and that he must trace out the connection and determine the line upon which the call originated.

It is believed that the invention will best be understood by tracing a call from a calling subscriber to a called subscriber, reference being had to the accompanying drawings, in which Figure 1 diagrammatically shows a calling substation, a line finder switch and a first selector switch; and Fig. 2 diagrammatically shows a connector switch and a called substation.

When the subscriber at substation A removes his receiver from the hook, a circuit is completed from grounded battery, left-hand winding of relay 1, outer armature and back contact of relay 2, telephone apparatus at substation A, sender S, back contact and inner armature of relay 2, right-hand winding of relay 1 to ground. Relay 1, by attracting its armature, completes a circuit from grounded battery, left-hand winding of relay 1, outer armature and back contact of relay 2, conductor 3, armature and front contact of relay 1, contact spring 70, back contact and left-hand armature of relay 4, winding of relay 5 to ground. Relay 5, by attracting its left-hand armature, completes a locking circuit for itself which is independent of the armature and back contact of relay 4. Relay 5, by attracting its right-hand armature, completes a circuit from grounded battery, winding of relay 6, right-hand armature and front contact of relay 5 to ground. Relay 6 at its right-hand armature and front contact, completes a circuit from grounded battery, winding of relay 4, right-hand armature and front contact of relay 6 to ground. Relay 4 becomes energized and by attracting its right-hand armature maintains the release circuit of the line finder open during the operation of the line finder. Relay 6 at its left-hand armature and front contact, completes a circuit from grounded battery, winding of primary magnet 7, side-switch arm 8, back contact and armature of secondary magnet 9, armature and back contact of primary magnet 7, right-hand armature and back contact of release magnet 11, side-switch arm 12, left-hand armature and front contact of relay 6, right-hand armature and front contact of relay 5 to ground. Since the primary magnet 7 interrupts its own circuit, it continues to step until the arm 14 engages the contact 15 associated with the group of lines containing the calling subscriber's line. When the arm 14 engages this contact 15, ground will be found thereon, which completes the following cir-

cuit from grounded battery, winding of primary magnet 7, winding of escape magnet 10, side-switch arm 13, arm 14, contact 15, right-hand armature and front contact of relay 5 to ground. Primary magnet 7 is maintained energized by the current flowing through this circuit, thereby preventing further stepping of the switch. The escape magnet 10 is also energized by the current flowing through this circuit and upon its energization moves the side-switch arms into their second position.

In position 2 primary magnet 7 and the escape magnet 10 are maintained energized over the following circuit, from grounded battery, winding of primary magnet 7, winding of escape magnet 10, side-switch arm 13, side-switch arm 12. left-hand armature and front contact of relay 6, right-hand armature and front contact of relay 5 to ground. A stepping circuit is now closed for the secondary magnet 9 from grounded battery, winding of secondary magnet 9, side-switch arm 8, back contact and armature of secondary magnet 9, right-hand armature and front contact of escape magnet 10, right-hand armature and back contact of release magnet 11, side-switch arm 12, left-hand armature and front contact of relay 6, right-hand armature and front contact of relay 5 to ground. This stepping circuit for the secondary magnet 9 is maintained until the brushes 16, 17 and 18 of the line finder engage the terminals 19, 20 and 21 of the calling line, at which time a circuit is completed from grounded battery, winding of the cut-off relay 2, terminal 19, brush 16, contact spring 23, left-hand armature and front contact of escape magnet 10, resistance 22, side-switch arm 12, left-hand armature and front contact of relay 6, right-hand armature and front contact of relay 5 to ground. Relay 2 by attracting its armatures, opens the holding circuit of relay 5. Relay 5 becomes deënergized and opens the circuit of escape magnet 10, which deënergizes and moves the side-switch arms into their third position. Relay 2 is still maintained energized in position 3 over a circuit from grounded battery, winding of relay 2, terminal 19, brush 16, contact spring 23, make-before-break contact 7', left-hand armature and back contact of release magnet 11 to ground. As soon as the side-switch arms 24 and 25 move into their third position, the circuit is completed for line relay 26 of the first selector switch from grounded battery, left-hand winding of relay 26, side-switch arms 27 and 25, brush 17, terminal 20, telephone apparatus at substation A, sender S, terminal 21, brush 18, side-switch arms 24 and 23, right-hand winding of relay 26 to ground. Line relay 26 by attracting its armature, completes a circuit from grounded battery, winding of relay 29, front contact and armature of relay 26 to ground. The apparatus is now in a condition to receive the first series of impulses. In response to each impulse transmitted, the line relay 26 is momentarily denergized, thereby closing the circuit from grounded battery, winding of primary magnet 31, secondary off-normal contact 32, front contact and armature of relay 29, back contact and armature of relay 26 to ground. A circuit is also completed in parallel with primary magnet 31 from grounded battery, winding of relay 30, front contact and armature of relay 29, armature and back contact of relay 26 to ground. The energization of relay 30 completes the circuit from grounded battery, winding of escape magnet 33, side-switch arm 36, armature and front contact of relay 30 to ground. Relays 29 and 30 are arranged to maintain their armatures attracted during the transmission of the impulses. At the end of the first series of impulses the line relay 26 remains energized for a sufficient length of time to cause the deënergization of relay 30, which in turn causes the deënergization of escape magnet 33 to move the side-switch arms into their second position.

In position 2 a stepping circuit is closed for the secondary magnet 34 from grounded battery winding of secondary magnet 34, armature and back contact of this magnet, side-switch arm 35, front contact and armature of relay 26 to ground. Each energization of the secondary magnet 34 moves the brushes 38, 39 and 40 of the selector switch into engagement with the terminals of a trunk in the selected group. As long as busy trunks are engaged by the brush 38, no potential will be found upon the terminal 41, but as soon as the terminals of an idle trunk are engaged, ground will be found upon the test terminal 41, thereby completing a circuit from grounded battery, winding of escape magnet 33, side-switch arm 36, brush 38, terminal 41 to ground at the idle connector switch. Escape magnet 33 becomes energized and moves the side-switch arms into their third position.

Side-switch arms 27 and 28 by moving into their third position extend the calling line through to the connector switch. A circuit is then completed from grounded battery, right-hand winding of line relay 44, terminal 42, brush 39, side-switch arms 27 and 25, brush 17, terminal 20, telephone apparatus at substation A, sender S, terminal 21, brush 18, side-switch arms 24 and 28, brush 40, terminal 43, left-hand winding of line relay 44 to ground. The energization of relay 44 completes a circuit from grounded battery, winding of relay 45, armature and front contact of relay 44, back contact and armature of differential relay 62 to ground. The apparatus is now in condition for the second series of impulses.

In response to each impulse of this series the line relay 44 is momentarily deënergized, thereby completing a circuit from grounded battery, winding of primary magnet 47, side-switch arm 48, front contact and right-hand armature of relay 45, back contact and armature of relay 44, back contact and armature of differential relay 62 to ground. A circuit is also completed for relay 46 in parallel with primary magnet 47. Relays 45 and 46 are arranged to maintain their armatures attracted during the transmission of the impulses. The energization of relay 46 completes a circuit from grounded battery, front contact and right-hand armature of relay 46, winding of escape magnet 49, back contact and armature of relay 51 to ground. At the end of the second series of impulses, line relay 44 is maintained energized, thereby causing the deenergization of relay 46. Relay 46 by retracting its right-hand armature opens the circuit of escape magnet 49 which deënergizes and moves the side-switch arms into their second position.

In response to the third series of impulses the line relay 44 will be momentarily deënergized in the same manner as above, causing the following circuit to be completed from grounded battery, winding of secondary magnet 50, side-switch arm 48, front contact and right-hand armature of relay 45, back contact and armature of relay 44, back contact and armature of differential relay 62 to ground. A circuit is also completed for relay 46 in parallel with the secondary magnet 50. Relay 46 by attracting its right-hand armature again completes the energizing circuit of escape magnet 49 in the manner above described. At the end of the third series of impulses the line relay 44 is maintained energized, thereby causing the deenergization of relay 46. In response to the second series of impulses, brushes 55, 56 and 57 are moved into operative relation with the terminals of the group of lines containing the called subscriber. In response to the third series of impulses the brushes 55, 56 and 57 are moved into engagement with the terminals of the line extending to the called substation. We will first assume that the called line is busy and, therefore, ground will be found upon the test terminal 58. If this line is busy as a called line, this ground will be connected through side-switch arm 52 and brush 55 of the connector switch connected thereto, or if busy as a calling line, ground will be connected through the left-hand armature and back contact of release magnet 11, make-before-break contact 71, contact spring 23 and brush 16 of the line finder connected thereto. Therefore, when relay 46 deënergizes after the third series of impulses, a circuit will be completed for release magnet 68, provided the called line is busy, this circuit being traced from grounded battery, winding of release magnet 68, right-hand armature and back contact of relay 61, off-normal contact 67, left-hand armature and back contact of relay 46, side-switch arm 52, brush 55, terminal 58 to ground. Release magnet completes a locking circuit for itself from grounded battery, winding of release magnet 68, left-hand armature and front contact of this magnet, off-normal contact 81 to ground. Since the escape magnet 49 is made slow to retract its armatures, the circuit for the release magnet 68 will be closed before the side-switch armatures move into their third position. The energization of the release magnet 68 removes the holding pawls of the connector switch in the well known manner, thereby causing the switch to return to its normal position. The release magnet 68 at its right-hand armature and front contact connects the busy tone apparatus 80 to the lower line conductor, thereby notifying the calling subscriber that the called line is busy. The release magnet 68 at its left-hand armature and front contact completes the circuit of the release magnet 11 of the line finder switch from grounded battery, winding of the release magnet 11, primary off-normal contact 74, right-hand armature and back contact of relay 4, side-switch arm 37, brush 33, terminal 41, conductor 76, left-hand armature and front contact of relay 45, front contact and left-hand armature of release magnet 68, off-normal contact 81 to ground. A circuit is also completed in parallel with magnet 11 from grounded battery, winding of the release magnet 72 of the first selector switch and primary off-normal contact 73. The release magnets 11 and 72 become energized and return the line finder and the first selector respectively to their normal positions in the well-known manner.

If the called line had been idle at the time the brush 55 engaged the terminal 58, no ground would have been found thereon, so that the deënergization of relay 46 would have caused the deënergization of escape magnet 49 and the side-switch arms would have been moved into position 3.

In position 3 a circuit is completed from grounded battery, winding of relay 46, side-switch arm 48, front contact and armature of relay 44, back contact and armature of differential relay 62 to ground. Relay 46 becomes energized and again completes the energizing circuit of escape magnet 49. Escape magnet 49 by attracting its armature completes a circuit from ringing generator (not shown), front contact and armature of escape magnet 49, winding of marginal relay 51, side-switch arm 53, brush 56, terminal 59, telephone apparatus at substation B, sender S', terminal 60, brush 57, side-switch

arm 54, front contact and armature of relay 44 to ground. The current flowing through this circuit is not sufficient to operate marginal relay 51 at this time, but as soon as the subscriber at substation B removes his receiver from the hook, thereby shunting the ringer at his substation, sufficient current flows through the marginal relay 51 to cause it to attract its armature and open the circuit of the escape magnet 49. The escape magnet 49 deënergizes and moves the side-switch arms into their fourth position.

The subscribers are now connected for conversation, current being supplied to the called subscriber's line from grounded battery, left-hand winding of relay 61, left-hand winding of differential relay 62, side-switch arm 53, brush 56, terminal 59, telephone apparatus at substation B, sender S′, terminal 60, brush 57, side-switch arm 54, right-hand winding of differential relay 62, right-hand winding of relay 61 to ground. Differential relay 62 is not energized at this time, since both of its windings are energized.

When the subscribers are through talking and replace their receivers, line relays 44 and 61 are deënergized. The deënergization of relay 44 causes in turn the deënergization of relay 45. Ground is then connected to the release conductor 76 through armature and back contact of differential relay 62, armature and back contact of relay 44, right-hand armature and back contact of relay 45 and left-hand armature and back contact of relay 61. Circuits are then completed for release magnets 11, 72 and 68 over this conductor. It will be seen that after connection is once established the release of the switches used in completing the connection is controlled at the armature and back contact of the differential relay 62. If, however, the called party wishes to find out who is talking to him, he presses the key K_1 before the calling party hangs up. The pressing of this key connects ground directly to the left-hand winding of the differential relay 62. This shunts the right-hand winding of the relay and causes it to attract its armature. The armature is mechanically locked up in its attracted position by the catch 63. The engagement of the armature of relay 62 with the catch 63 completes a circuit from grounded battery, winding of the relay 65, lamp 64, catch 63, armature of relay 62 to ground. The current flowing through the circuit energizes the relay 65 and lights the lamp 64. Relay 65 by attracting its armature completes a circuit for the buzzer 66 from grounded battery, winding and armature and back contact of buzzer 66, armature and front contact of relay 65 to ground. The attendant at the central office hearing this buzzer, is informed that a certain series of switches has been locked up, and seeing the light 64 which is individual to a particular connector, knows that that particular connector and the switches connected thereto are the ones that should be traced to find out upon what line the call originated. The attraction of the armature of relay 62 removes ground from the release conductor 76 and thereby prevents the release of any of the switches when the called and calling parties hang up their receivers.

What is claimed is:

1. In a telephone system, a calling subscriber's line, a called subscriber's line, automatic switches, means for operating said switches to complete a connection between said subscribers' lines, releasing means for said switches normally under the control of said subscribers, and means under the control of the called subscriber for removing the control of said releasing means from both of said subscribers.

2. In a telephone system, a calling subscriber's line, a called subscriber's line, automatic switches, means for operating said switches to complete a connection between said subscribers' lines, a release magnet for each switch, circuits for said release magnets normally under the control of said subscribers, and means under the control of the called subscriber for permanently opening said release circuits to remove the control of said circuits from both of said subscribers.

3. In a telephone system, a calling subscriber's line, a called subscriber's line, automatic switches including a connector switch, means for operating said switches to complete a connection between said subscribers' lines, a differential relay at said connector switch, a release magnet for each of said switches, circuits for said release magnets controlled by said differential relay, and means under the control of the called subscriber for operating said relay to prevent the operation of any of said release magnets by either of said subscribers.

4. In a telephone system, a calling subscriber's line, a called subscriber's line, automatic switches including a connector switch, means for operating said switches to complete a connection between said subscribers' lines, a differential relay at said connector switch, a release magnet for each of said switches, circuits for said release magnets controlled by said differential relay, and means under the control of said called subscriber for shunting one winding of said relay to cause the operation thereof to prevent the operation of any of said release magnets by either of said subscribers.

5. In a telephone system, a calling subscriber's line, a called subscriber's line, automatic switches including a connector switch, means for operating said switches to complete a connection between said subscribers' lines, a differential relay at said connector

switch, a release magnet for each of said switches, circuits for said release magnets controlled by said differential relay, a manually operable device at the called subscriber's substation, and means operated in response to the operation of said device by the called subscriber for shunting one winding of said relay to cause the operation thereof to prevent the release of any of said switches of either of said subscribers.

6. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches thereat, means for operating said switches to complete a connection between said subscribers' lines, a releasing means for said switches normally under the control of said subscribers, an attendant's position at said central office, a signal at said position, and means under the control of the called subscriber for removing said releasing means from under the control of said subscribers, and for operating said signal at said position to notify the attendant to ascertain the calling subscriber's line, for the called subscriber.

7. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches thereat, means for operating said switches to complete a connection between said subscribers' lines, a release magnet for each switch, circuits for said release magnets normally under the control of said subscribers, an attendant's position at said central office, a signal at said position, and means under the control of the called subscriber for permanently opening said release circuits to remove said release magnets from under the control of said subscribers, and for closing a circuit for said signal to notify the attendant to ascertain the calling subscriber's line for the called subscriber.

8. In a telephone system, a calling line, a called line, a central office, automatic switches including a connector switch at said office, means for operating said switches to complete a connection between said lines, a differential relay at said connector switch, releasing means for said switches controlled by said relay, an attendant's position at said office, a signal at said position, and manually operable means at the called party's substation for causing said relay to operate to prevent the operation of said releasing means by either of said parties and to cause said signal to operate to notify the attendant to ascertain the calling line for the called party.

9. In a telephone exchange system, a central office, a signal thereat, calling and called subscribers' lines terminating at said central office, automatic switches for interconnecting said lines, means under the control of the called subscriber for locking said switches in an actuated condition to maintain an existing condition, and means to operate said signal when said locking means is actuated.

10. In a telephone exchange system, calling and called subscribers' lines, automatic switches for interconnecting said lines, means for releasing said automatic switches, and means under the exclusive control of the called subscriber for preventing the operation of said releasing means.

11. In a telephone exchange system, calling and called subscribers' lines, automatic switches for interconnecting said lines, means for releasing said automatic switches, and electromagnetic means under the exclusive control of the called subscriber for preventing the operation of said releasing means.

12. In a telephone exchange system, calling and called subscribers' lines, automatic switches for interconnecting said lines, means for releasing said automatic switches, and means operable at will by the called subscriber exclusively for preventing the operation of said releasing means.

13. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, means for releasing said automatic switches, a differential relay for controlling said releasing means, and means under the exclusive control of the called subscriber for causing said differential relay to prevent the operation of said releasing means.

14. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, means for releasing said automatic switches, a differential relay for controlling said releasing means, and means operable at will by the called subscriber exclusively for causing the differential relay to prevent the operation of said releasing means.

15. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, a differential relay, a circuit for releasing said switches including the armature of said differential relay when both of its coils are energized, and means operable at will for shunting one winding of said differential relay and thereby breaking the circuit for releasing the automatic switches.

16. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, a differential relay, a circuit for releasing said switches including the armature of said differential relay when both of its coils are energized, and means under control of the called subscriber for shunting one winding of said differential relay thereby breaking the circuit for releasing said automatic switches.

17. In a telephone system, a calling subscriber's line, a called subscriber's line,

automatic switches, means for operating said switches to complete a connection between said subscribers' lines, a differential relay, a release magnet for each of said switches, circuits for said release magnets controlled by said differential relay, and means under the control of the called subscriber for operating said relay to prevent the operation of any of said release magnets by either of said subscribers.

18. In a telephone system, a calling line, a called line, a central office, automatic switches at said office, means for operating said switches to complete a connection between said lines, a differential relay, releasing means for said switches controlled by said relay, an attendant's position at said office, a signal at said position, and manually operable means at the called party's substation for causing said relay to operate to prevent the operation of said releasing means by either of said parties to cause said signal to notify the attendant to ascertain the calling line for the called party.

19. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, a differential relay, a circuit for releasing said switches including the armature of said differential relay when both of its coils are energized, and means operable by the called subscriber for shunting one winding of said differential relay and causing said relay to attract its armature and thereby breaking the circuit for releasing the automatic switches, and means for latching the armature of said relay in its attracted position.

20. In a telephone exchange system, subscribers' lines, automatic switches for interconnecting said lines, a central office, a signal thereat, a differential relay, a circuit for releasing said switches including the armature of said differential relay when both of its coils are energized, means operable by the called subscriber for shunting one winding of said differential relay and thereby causing said relay to attract its armature for breaking the circuit for releasing the automatic switches, a latch for retaining the armature of the differential relay in its attracted position, and a circuit established through said armature and latch for operating said signal at the central office.

In witness whereof I hereunto subscribe my name this 21st day of July, A. D. 1917.

CHARLES L. GOODRUM.