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TELEPHONE SYSTEM.

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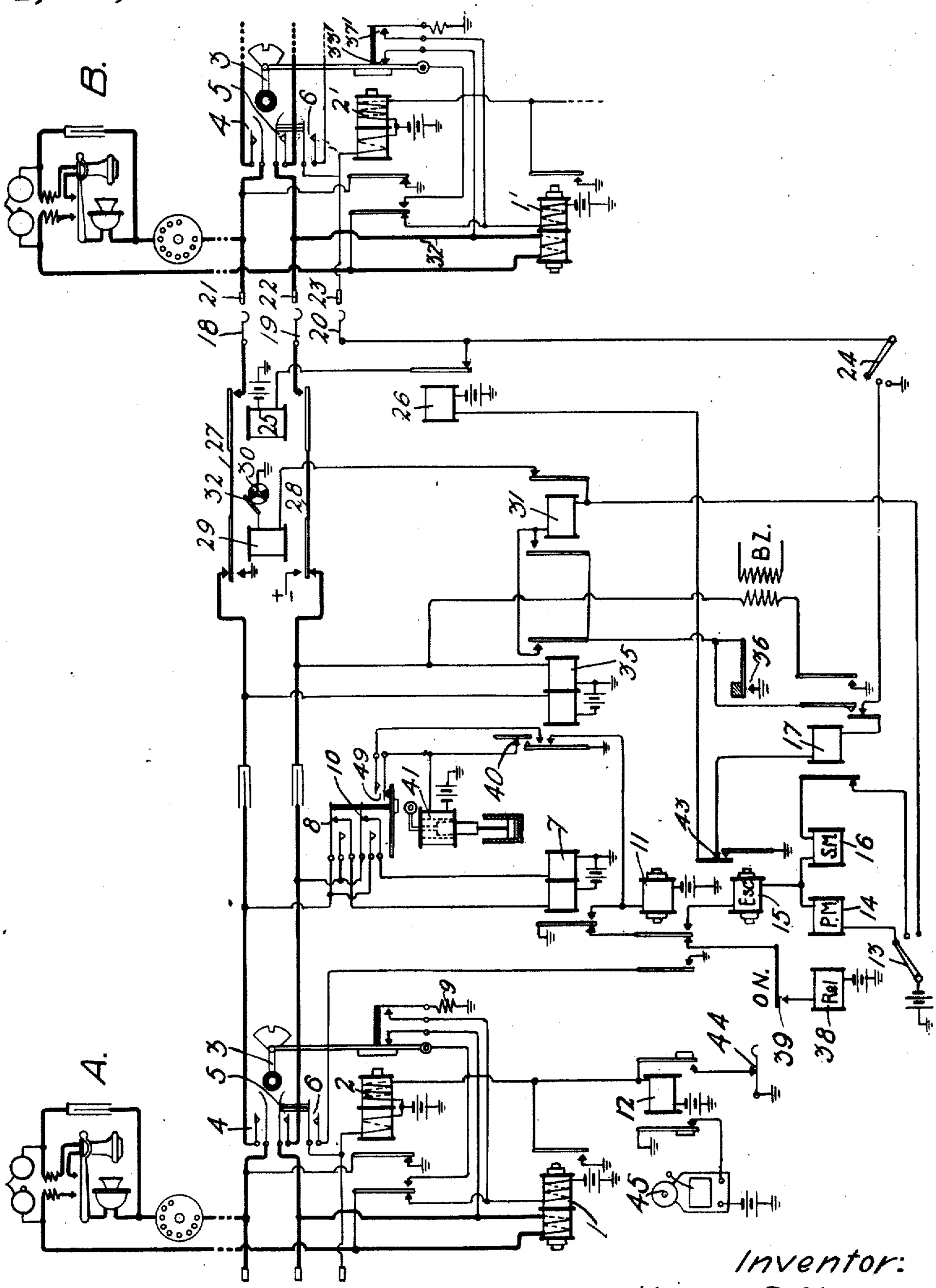

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,298,293. Specification of Letters Patent. Patented Mar. 25, 1919.

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To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States, residing at Mount Vernon, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

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

In automatic telephone systems means have been provided for permitting the called party, by performing some act, to tie up the connector switch attached to his line in such a way that the calling party, even though he replaces his receiver on the switch-hook, cannot become disassociated with the called party's line.

This same act performed by the called subscriber operates a signal at the central office for notifying an attendant thereat to trace back the connection and find the calling line. This sort of an arrangement is particularly useful in connection with fire calls, calls from lines in trouble, or for locating the source of calls maliciously originated.

Heretofore the means supplied have always consisted in setting up a special circuit condition in the connector switch which operates a signal associated with the connector switch. This results in considerable work in tracing back and locating the calling line in a multi-office system.

The object of this invention is to provide means for the called party to lock up the connection and cause the operation of a signal associated with a group of lines containing the calling line. In this way the calling line may be very quickly found by an attendant when he responds to the signal.

It is believed that the invention will be understood by tracing a call from a calling subscriber to a called subscriber, reference being made to the accompanying drawing, which diagrammatically represents circuits and apparatus involved in establishing such a connection. In order to simplify the disclosure only a calling and called subscriber's line, a line switch associated with each line and a connector switch are represented in the drawing, but to one skilled in the art it will be readily seen that any desired number of selector switches may be used to establish a connection between the two subscribers' lines without departing from the spirit of this invention.

When the subscriber at substation A removes his receiver from the switch-hook, a circuit is closed from grounded battery, right-hand winding of relay 1, outer left-hand armature and back contact of magnet 2, apparatus at substation A, inner left-hand armature and back contact of relay 2 to ground. Relay 1 completes a circuit from grounded battery, high-resistance right-hand winding of magnet 2, armature and front contact of relay 1 to ground. The energization of the high resistance winding of magnet 2 causes this magnet to attract all its armatures, thus operating the plunger 3 to close contact springs 4, 5 and 6 to connect the calling line with the connector switch.

As soon as the contact springs 4 and 5 are closed a circuit is closed from grounded battery, left-hand winding of relay 7, contact springs 8 and 4, apparatus at substation A, left-hand winding of relay 1, contact springs 5 and 10, right-hand winding of relay 7 to ground. Relay 7 becomes energized and completes a circuit from grounded battery, winding of relay 11, armature and front contact of relay 7 to ground. Relay 11 closes a holding circuit for magnet 2 from grounded battery, low resistance left-hand winding of magnet 2, contact springs 6, outer armature and front contact of relay 11 to ground.

The energization of magnet 2 opens the original energizing circuit of the right-hand winding of relay 1, but this winding is maintained energized by a circuit completed through the outer right-hand armature and front contact of magnet 2, resistance 9 to ground.

The relay 1 is differentially wound in such a manner that as soon as the circuit through its left-hand winding is closed, the two windings oppose each other, causing the relay to retract its armatures, thus opening a circuit for a group relay 12 which was closed upon the initial energization of the right-hand winding of relay 1. The relay 12 is common to a plurality of subscribers' lines and is made slow to attract its armatures. It takes such a long time for this relay to attract its

armatures that the relay 1 has time to attract and retract its armatures in the manner above mentioned before the relay 12 attracts its armatures.

The subscriber at substation A now sends out a set of impulses. In response to each impulse the relay 7 deënergizes and completes a circuit from grounded battery, side-switch arm 13, primary magnet 14, escapement magnet 15, inner armature and front contact of relay 11, armature and back contact of relay 7 to ground. Each energization of the primary magnet 14 moves the switch one step in its primary movement. Relay 11 and magnet 15 are so constructed as to remain energized during short interruptions in their energizing circuit and therefore do not release during the transmission of the impulses. After the last impulse, the relay 7 remains energized, thereby opening the circuit of escapement magnet 15 for a sufficient length of time to cause this magnet to deënergize and move the side-switch arms into their second positions.

A second series of impulses is now sent by the calling subscriber. Each impulse causes the deënergization of relay 7 in the same manner as before, which in turn closes a circuit from grounded battery, side-switch arm 13 (second position), outer left-hand armature and back contact of test relay 17, winding of secondary magnet 16, winding of escapement magnet 15, inner armature and front contact of relay 11, armature and back contact of relay 7 to ground. Each energization of the secondary magnet 16 moves the switch one step in its secondary movement.

After the last impulse of this series is transmitted, magnet 15 is deënergized in the same manner as before and the side-switch arms are moved into their third positions.

The brushes 18, 19 and 20 of the connector switch will now be in engagement with terminals 21, 22 and 23 of the desired line. We will first assume that the called line is idle.

As soon as the side-switch arm 24 reaches position 3, ground is connected to the test terminal 23 of the called line, thus rendering this line nonselectable by other connector switches. This ground also closes a circuit from grounded battery, low-resistance left-hand winding of magnet 2′ of the called substation B, terminal 23 to ground. The energization of this winding is sufficient to cause the magnet 2′ to attract its left-hand armatures but not to attract the plunger of the line switch associated with the called line. Magnet 2′ by attracting its outer left-hand armature places a shunt around the left-hand winding of relay 1′ and thus prevents this winding from becoming energized. Magnet 2′ by attracting its left-hand armatures opens the circuit through the right-hand winding of relay 1′ and therefore prevents this winding from becoming energized. It is therefore obvious that when a line is called, the line switch associated therewith cannot be operated by the called party removing his receiver in answering a call.

The side-switch arm 24 in moving into position 3 also closes a circuit from grounded battery, winding of relay 25, armature and back contact of relay 26, side-switch arm 24 to ground. Relay 25 by attracting its armatures connects the line conductors 27 and 28 to the called line. The side-switch arm 13 in moving into position 3 closed a circuit for the ringing relay 29 from grounded battery, side-switch arm 13, right-hand armature and back contact of relay 31, winding of ringing relay 29, brush 32, interrupter 30 to ground. Every time the brush 32 engages a conducting segment of the interrupter 30, current flows through this circuit and energizes ringing relay 29. This relay then closes a circuit from a grounded source of ringing current, lower armature and front contact of relay 29, line conductor 28, lower armature and front contact of relay 25, brush 19, terminal 22, conductor 32′, normal contact 33′ of the plunger associated with the called line, outer left-hand armature and front contact of magnet 2′, apparatus at substation B, terminal 21, brush 18, upper armature and front contact of relay 25, line conductor 27, upper armature and front contact of relay 29 to ground. This ringing current is intermittently applied to the called line by the operation of the ringing relay 29. As soon as the called party answers by removing his receiver, and the ringing relay 29 becomes deënergized, sufficient current flows through the line relay 35 to cause this relay to energize. This circuit may be traced from grounded battery, left-hand winding of relay 35, upper armature and back contact of ringing relay 29 over the ringing circuit previously described to conductor 28, then through the lower armature and back contact of ringing relay 29, right-hand winding of relay 35 to ground. Relay 35 by attracting its right-hand armature closes a circuit from grounded battery, side-switch arm 13, winding of relay 31, front contact and right-hand armature of relay 35, off-normal contact 36 to ground. Relay 31 becomes energized and closes at its left-hand armature and front contact, a locking circuit for itself. Relay 31 by attracting its right-hand armature opens the circuit of relay 29. The two subscribers are now connected for conversation.

At the end of conversation after both subscribers have replaced their receivers, line relays 7 and 35 become deënergized, thus opening the circuit for relay 11, which deënergizes and closes a circuit from grounded battery, winding of release magnet 38, off-normal contact 39, inner armature

and back contact of relay 11, armature and back contact of relay 7 to ground. Release magnet 38 becomes energized and returns the connector switch to normal in the well-known manner. The deënergization of relay 11 also opens the circuit through the holding winding of magnet 2, thus allowing the line switch associated with the calling line to release. The side-switch arm 24, in leaving its third position when the connector switch is being restored to normal, removes ground from the holding winding of magnet 2', thus allowing the armatures of magnet 2', associated with the called line, to release.

If the called line had been busy, ground would have been found on the test terminal thereof, so that when the escapement magnet 15 in position 2 deënergizes after the second series of impulses a circuit would have been completed from grounded battery, winding of relay 26, contact 43, winding of test relay 17, side-switch arm 24 (second position), brush 20, terminal 23 to ground. Test relay 17 becomes energized and closes a locking circuit to ground for itself at its inner right-hand armature and front contact. At its outer right-hand armature and front contact, it connects the busy signal to the lower line conductor, thus notifying the calling subscriber that the called line is busy. The conductors 27 and 28 are not connected to the desired line at this time due to the circuit of relay 25 being opened at the armature and back contact of relay 26. The calling subscriber receiving this busy signal hangs up the receiver and brings about the release of the switches in the manner above described.

We will now assume that while the subscribers are connected for conversation, the called party wishes to find out who is talking to him. The called party will then operate his dial, so as to send out a predetermined number of impulses. Each impulse causes the deënergization of relay 35, thus closing momentarily the make-before-break contact 40 to close a circuit through the slow-to-pull-up relay 41. This relay is so constructed that it has to receive a certain number of impulses within a certain period of time before it attracts its plunger sufficiently to close the contacts controlled thereby. We will assume that nine impulses have to be sent. Therefore the called subscriber B will dial 9. After the ninth impulse the relay 41 has attracted its armature sufficiently to close a locking circuit for itself from grounded battery, winding of relay 41, contact springs 49, left-hand armature and front contact of relay 35, to ground. If, while the impulses are being sent by the called subscriber, the calling subscriber should hang up and deënergize relay 7, the connection would not be broken down due to a circuit for relay 11 being intermittently closed at the outer left-hand armature and front contact of relay 35 while the impulses are being sent.

Relay 41 by operating its contacts reverses the direction of current flow to the calling line. If, therefore, the calling party still has his receiver off the hook, the current flowing through both windings of differential relay 1 will now be in such direction as to aid each other and cause it to attract its armature. Relay 1 will now remain energized a sufficient length of time to allow the slow-to-pull-up relay 12 to energize. As soon as this relay attracts its armature, it closes a locking circuit to ground for itself through its right-hand armature and front contact and key 44. At its left-hand armature and front contact it closes the circuit for the signal 45. The attendant at the central office hearing this signal is informed that a connection has been locked up and that the party initiating the call is in the group of lines with which the operated signal is associated. After the attendant has obtained the desired information, the signal is cleared out by depressing the key 44.

If the calling party should hang up his receiver after the relay 41 has operated, the relay 1 will still attract its armature due to the circuit through its right-hand winding being closed since the holding circuit of the magnet 2 is held closed at the outer armature and front contact of relay 11.

The connection is held locked up until the called party replaces his receiver, at which time relay 35 deënergizes and opens the circuits of relays 41 and 11, whereupon the switches are released in the same manner as above described.

What is claimed is:

1. In a telephone exchange system, a central office, a calling and a called subscriber's line terminating at said office, automatic switches for interconnecting said lines, a signal permanantly associated with said calling line, means for locking said switches in an actuated position to maintain an existing condition, and means to operate said signal when said locking means is actuated.

2. In a telephone exchange system, a central office, groups of calling subscribers' lines terminating at said office, called subscribers' lines, a signal associated with each group of calling lines, automatic switches for interconnecting said calling and called lines, means for locking said switches in an actuated position to maintain an existing condition, and means to operate the signal associated with a particular group of calling lines when said locking means is actuated to lock the switches connecting a calling line of said particular group with a called line.

3. In a telephone exchange system, a cen-

tral office, calling and called subscribers' lines terminating at said office, automatic switches for interconnecting said lines, a signal associated with said calling lines, a differential line relay normally associated with each of said calling lines for controlling said signal, means for locking said switches to maintain an existing connection between a calling and called line, and means for operating the differential relay of the calling line to operate said signal when said locking means is actuated.

4. In a telephone exchange system, a central office, calling and called subscribers' lines terminating at said office, automatic switches for interconnecting said lines, a signal at the central office associated with said calling lines, a differential line relay permanently associated with each of said calling lines for controlling said signal, means for locking said switches to maintain an existing connection between a calling and called line, and means for operating the differential relay of the calling line to operate said signal when said locking means is actuated.

5. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches for interconnecting said lines, a signal associated with said calling line, a differential line relay permanently associated with said calling line for controlling said signal, means under the control of the called subscriber for locking said switches to maintain a connection between said subscribers' lines, and means for operating said differential relay to operate said signal when said locking means is actuated.

6. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches for interconnecting said lines, a signal associated with said calling line, a differential line relay normally associated with said calling line for controlling said signal, means associated with said called line for transmitting impulses, means operated by the transmission of a predetermined number of impulses for locking said switches to maintain a connection between said subscribers' lines, and means for operating said differential relay to operate said signal when said locking means is actuated.

7. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches including a connector switch for interconnecting said lines, a signal associated with said calling line, a differential line relay normally associated with said calling line for controlling said signal, means associated with the called line for transmitting impulses, and a slow-to-pull-up relay at said connector switch operated by the transmission of a predetermined number of impulses for locking said switches to maintain a connection between said subscribers' lines, and for operating said differential relay to operate said signal.

8. In a telephone system, a calling subscriber's line, a called subscriber's line, a central office, automatic switches for interconnecting said lines, a signal associated with said calling line, means associated with the called line for transmitting impulses, means operated by the transmission of a predetermined number of impulses for locking said switches to maintain a connection between said subscribers' lines, and means for operating said signal when said locking means is actuated.

9. In a telephone exchange system, a calling and a called subscriber's line, switches for interconnecting said lines, means for locking said switches in an actuated position, variably operable means for controlling the last named means, and a signal actuated when said switches are locked.

10. In a telephone exchange system, groups of calling subscribers' lines, called subscribers' lines, a signal individual to each group of calling subscribers' lines, switches for interconnecting said calling and called subscribers' lines, means for locking said switches in an actuated position, and means for operating the signal individual to the group of calling subscribers' lines in which a calling line is located when said switches are locked.

11. In a telephone exchange system, groups of calling subscribers' lines, called subscribers' lines, a signal individual to each group of calling subscribers' lines, switches for interconnecting said calling and called subscribers' lines, means for locking said switches in an actuated position, variably operable means for controlling said locking means, and means for operating the signal individual to the group of calling subscribers' lines in which a calling line is located when said switches are locked.

12. In a telephone exchange system, a central office, groups of calling subscribers' lines, called subscribers' lines, switches for interconnecting said calling and called subscribers' lines, means for locking said switches in an actuated position, a signal at the central office individual to each group of calling subscribers' lines, means for operating the signal individual to the group of calling subscribers' lines in which a calling line is located, and means at the central office for rendering said signal ineffective.

13. In a telephone exchange system, a calling and a called subscriber's line, switches for interconnecting said lines, a signal associated with said calling line, a differential relay for controlling the operation of said signal, and means for locking said switches in an actuated position and for

reversing the current to said calling line whereby said relay is actuated to control said signal.

14. In a telephone exchange system, a calling and a called subscriber's line, switches for interconnecting said lines, a signal associated with said calling line, a differential relay for controlling the operation of said signal, means for locking said switches in an actuated position and for reversing the current to said calling line whereby said relay is actuated to control said signal, and variably operable means for controlling the last named means.

In witness whereof, I hereunto subscribe my name this 24th day of October A. D., 1917.

HENRY P. CLAUSEN.