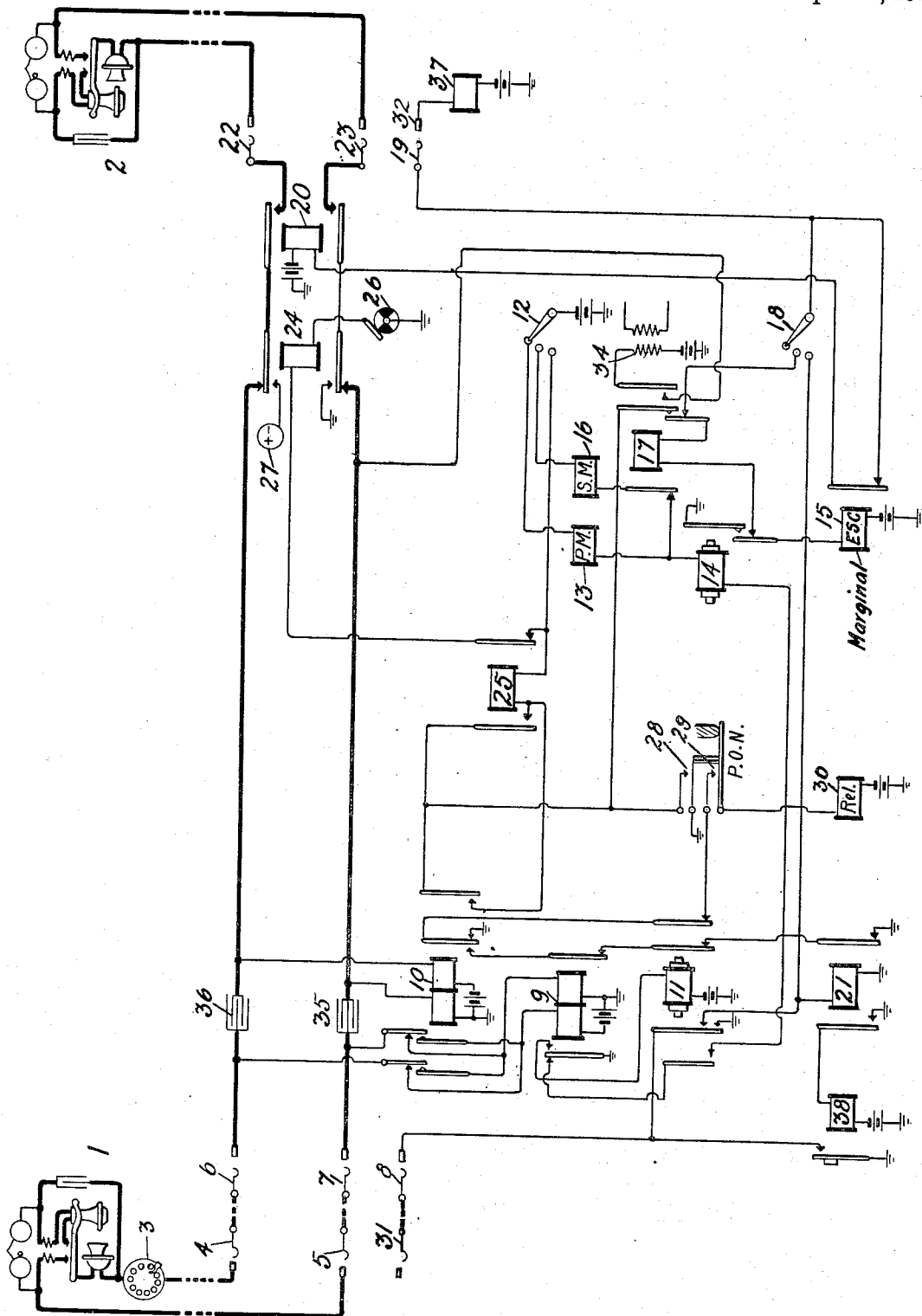


H. P. CLAUSEN.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED DEC. 29, 1916.

1,279,841.

Patented Sept. 24, 1918.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,279,841.

Specification of Letters Patent. Patented Sept. 24, 1918.

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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-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems and more particularly to systems in which automatic switches are used in establishing connections, either wholly or in part.

In systems in which the release of a train of switches used in setting up a connection is controlled wholly by the calling subscriber, an undesirable condition will arise if the calling subscriber is the first to replace his receiver. In this case the entire train of switches would be released, but, due to the fact that the called subscriber still has his receiver off the hook, his line relay would become energized and operate a line switch to seize a first selector. To obviate this difficulty, systems in which the release of the connector switches is controlled jointly by the calling and called subscribers have been devised. However, in systems of the last mentioned type, if the calling subscriber accidentally disconnects by operating his switchhook and thus releases the switches, with the exception of the connector, it would be impossible for him to again establish a connection to the called subscriber unless in the meantime the called subscriber replaced his receiver and thereby released the connector.

It is the object of the present invention to provide means whereby a calling subscriber, having accidentally broken down the connection, may obtain connection to the called party through another connector switch, means being necessarily present to prevent the called line from testing busy.

It is an additional object of the invention to render the connector switch inaccessible to other selectors while awaiting the re-establishment of the connection.

A further object of the invention is to provide means whereby the first connector will be released as soon as the connection is reestablished.

A feature of the invention is the use of a relay which is normally shunted out, but

which, upon disconnection by the calling subscriber, is allowed to energize. This relay when operated serves to replace ground on the terminal over which ground was supplied to the release trunk. This relay will deenergize when connection is reestablished, since it is shunted by a direct ground at the connector switch which was used when reestablishing the connection. Upon its deenergization in this case, the relay completes a circuit to allow the release of the connector switch with which it is associated.

It is thought the invention will best be understood from the following detailed description, reference being had to the accompanying drawing.

In the drawing is shown a connector circuit embodying the features of the present invention.

The switches used in the present disclosure are of the step-by-step, up-and-around type, substantially similar in structure to those disclosed in Patent No. 815,176. Any desired form of switch may, however, be used, since the invention is applicable to a variety of systems employing various types of switches.

It has been assumed that the calling subscriber's line is arranged to be extended to the connector by means of a line finder, the brushes of which are indicated at 4, 5 and 31, and a first selector, brushes of which are indicated at 6, 7 and 8.

The subscriber at sub-station 1 desiring a connection with a subscriber at sub-station 2, removes his receiver from the hook, whereupon his line will be extended to a selector by means of the line finder whose brushes are shown at 4, 5 and 31, and which operates in the well-known manner. The first selector is then operated in response to the first set of impulses sent out by the calling subscriber by means of an impulse dial 3, and operates in a well-known manner to extend the calling line to the connector shown in the drawing.

As soon as the calling line has been extended to the connector, relay 9 is energized over a circuit from grounded battery, left-hand winding of relay 9, outer left-hand armature and back contact of relay 10, the substation loop of the calling subscriber's line, inner left-hand armature and back contact of relay 10, and the right-hand winding of relay 9 to ground. Relay 9 upon energization

zation completes a circuit from grounded battery, winding of slow release relay 11, front contact and left-hand armature of relay 9 to ground.

5 The subscriber now operates his impulse transmitter to send the second series of impulses. The first interruption of the line circuit causes the deenergization of relay 9, and completes a circuit from grounded bat-
10 tery, side-switch wiper 12 and its first contact, winding of primary stepping magnet 13, slow release relay 14, outer left-hand armature and front contact of relay 11, left-hand armature and back contact of relay
15 9 to ground. Slow release relay 14 is energized in this circuit, and completes a circuit from grounded battery, winding of escape magnet 15, armature and front contact of slow release relay 14 to ground. Relays
20 11 and 14 being slow to release, remain energized during the sending of this series of impulses. Relay 11 at its inner left-hand armature and front contact maintains ground on the release trunk over selector
25 brush 8 and finder brush 31 to prevent the release of these switches.

Stepping magnet 13 is alternately energized and deenergized, in response to the impulses, to move the brush shaft a desired
30 number of steps in a primary direction. Upon the termination of impulses relay 9 remains energized for a comparatively long time, and slow release relay 14 is deenergized and opens the circuit of escape magnet 15, which deenergizes and releases the
35 side switch into its second position.

When the final series of impulses is sent, the first deenergization of relay 9 completes a circuit from grounded battery, side-switch
40 wiper 12 and its second contact, winding of secondary stepping magnet 16, left-hand armature and back contact of busy relay 17, winding of slow release relay 14, outer left-hand armature and front contact of relay
45 11, and the left-hand armature and back contact of relay 9 to ground. Relay 14 completes a circuit for escape magnet 15 as before, and remains energized during the sending of impulses, while stepping magnet 16
50 advances the brush shaft in a secondary direction in response to the interruptions in the line circuit.

At the conclusion of the final series of impulses slow release relay 14 is again de-
55 energized, and provides a test circuit for the escape magnet. This circuit extends from grounded battery, winding of escape magnet 15, armature and back contact of relay 14, winding of busy relay 17, right-hand armature and back contact of relay 17,
60 side-switch wiper 18 and its second contact, to test brush 19.

If we assume that busy lines are characterized by the presence of direct ground
65 on their multiple test terminals, and that

idle lines are characterized by battery potential on their multiple test terminals, the marginal escape magnet 15 will be deenergized if the called line is idle and will release the side-switch wipers into their third
70 positions.

In the third position of the side-switch, a circuit will be completed for relay 20 from grounded battery, winding of relay 20, armature and back contact of escape magnet
75 15, side-switch wiper 18 and its third contact, the inner left-hand armature and front contact of relay 11 to ground. A branch path of this circuit extends through relay 21, but only relay 20 will be energized in
80 this circuit, since relay 21 is shunted by the direct ground at the contacts of relay 11. A ground is also supplied to test brush 19 from ground at the contacts of relay 11, through side-switch wiper 18 and its third
85 contact, to render the test terminals of the called line busy to other calling lines.

Relay 20 at its armatures connects the line conductors to the connector brushes 22
90 and 23.

A circuit is now completed for ringing relay 24 from grounded battery, side-switch wiper 12 and its third contact, right-hand armature and back contact of ringing cut-off relay 25, winding of ringing relay 24, in-
95 terrupter 26 to ground. When the brushes of the interrupter 26 are on conducting segments, the relay 24 will be energized and completes a ringing circuit to the called substation. This circuit extends from a source
100 of alternating current indicated at 27, upper armatures and front contact of relays 24 and 20, brush 22 and its associated contact, the loop of the called subscriber's line including the substation bells, connector brush
105 23 and its associated contact, lower armatures and front contacts of relays 20 and 24 to ground. The intermittent operation of relay 24 results in the projection of ringing current over the line at desired time intervals.
110

When the called subscriber answers and removes his receiver from the hook, an energizing circuit for relay 10 will be completed as soon as relay 24 is in a deenergized condition. This circuit extends from grounded
115 battery, right-hand winding of relay 10, upper armature and back contact of relay 20, connector brush 22 and its associated contact, loop of the called subscriber's line, connector brush 23 and its associated contact, lower armature and front contact of
120 relay 20, lower armature and back contact of relay 24, and the left-hand winding of relay 10 to ground.
125

The energization of relay 10 causes a reversal of the direction of current flow in the called subscriber's line to operate a polarized message register magnet (not shown), or similar device in the well-known manner.
130

This current reversal is accomplished through left-hand armatures and front contacts of relay 10, without allowing relay 9 to deenergize.

5 A circuit for ringing cut-off relay is also completed from grounded battery, winding of relay 25, outer right-hand armature and front contact of relay 10, off-normal contact 28 to ground. Off-normal contacts 28 and 29 were closed when the switch made its first primary step. Relay 25 energizes and locks itself to ground at contact 28, through its inner left-hand armature and front contact. At its right-hand armature it permanently opens the circuit of ringing relay 24, and prevents the reoperation of this relay. The connection is now complete and the subscribers may converse.

At the termination of the conversation both parties replace their receivers, the replacing of the calling subscriber's receiver resulting in the deenergization of relay 11. Relay 11 at its inner left-hand armature and front contact removes ground from the release trunk, which results in the release of the selector and finder in the well-known manner. The replacing of the called subscriber's receiver results in the deenergization of relay 10. A circuit is then completed from grounded battery, winding of release magnet 30, off-normal contact 29, outer right-hand armature and back contact of relay 11, inner right-hand armature and back contact of relay 10 to ground. The release magnet causes the restoration of the switch, and remains energized until this circuit is broken by the opening of the off-normal contact 29 when the brushes are fully restored. The return of the brush shaft at the same time restores the side-switch wipers to their normal position in the usual manner.

Referring now to the point in the operation just after the second series of impulses has been sent, it will be assumed that the desired line is busy. In that case direct ground will be connected to test terminal 32, through side-switch wiper 18 of some other connector in its third position. The marginal escape magnet 15 will now remain energized, and since relay 17 is included in its circuit, relay 17 will also be energized, causing the application of busy tone to the calling line. Alternating current is applied to relay 10 over a path from grounded battery, coil 34, outer right-hand armature and front contact of relay 17, left-hand winding of relay 10 to ground. The inductive action of this current on the windings of relay 10 causes a tone to be transmitted over the calling subscriber's line through condensers 35 and 36. The calling subscriber then replaces his receiver and causes the release of the connector by means of circuits previously described.

Should the calling subscriber accidentally disconnect himself by depressing his switch-

hook, the operation of the system is as follows. The opening of the calling line circuit results in the deenergization of relay 9, causing in turn the deenergization of relay 11. Relay 11 upon deenergization removes ground at its inner left-hand armature from the holding trunk and allows the finder and selector to release. The release circuit for the connector will not, however, be completed at this time, since relay 10 is still energized, it being assumed that the called subscriber does not replace his receiver. If the called subscriber should replace his receiver, the connector will be restored as previously described, but if he does not understand the cause of interruption and keeps his receiver from the hook the connector will not be restored. Upon the deenergization of relay 11 the shunt around relay 21 is removed, and this relay is energized in series with cut-off relay 37, which was energized upon seizure of the called line, to remove the control of the called subscriber's line relay in the well-known manner. Relay 21 upon energization completes a circuit from grounded battery, winding of relay 38, left-hand armature and front contact of relay 21 to ground. Relay 38, which is slow to act, replaces ground on the test terminal of the connector switch and thereby makes this switch test busy to other hunting selectors. If the connector were not made busy to other hunting connectors, any selector seizing it would immediately extend connection directly to substation 2.

The calling subscriber may now set up a connection as previously described by means of finder and selector switches and then operates any connector switch to set its brushes on multiple terminals of the calling line. In this case the escape magnet of such other connector will be allowed to deenergize, being marginal in character, and will, therefore, not energize through the resistance of relay 21, this circuit extending from grounded battery, winding of escape magnet 15 of such other connector, armature and back contact of relay 14, winding of busy relay 17, inner right-hand armature and back contact of relay 17, side-switch wiper 18 and its second contact, test brush 19 of such other connector, multiple test terminals 32, test brush 19 of the connector shown in the drawing, side-switch wiper 18 and its third contact, winding of relay 21 to ground.

The deenergization of the escape magnet at the other connector allows the side-switch wipers of such other connector to be released into the third position, whereupon relay 21 will be shunted by a path to ground at the inner left-hand armature and front contact of relay 11 at such other connector. A circuit is then completed from grounded battery, winding of relay 30, off-normal contact 29, outer right-hand armature and back contact

of relay 11, the inner right-hand armature and front contact of relay 10, right-hand armature and back contact of relay 9, inner right-hand armature and back contact of relay 11, right-hand armature and back contact of relay 21 to ground. The connector switch shown in the drawing is then released, as previously described.

The deenergization of relay 21 results in the deenergization of relay 38, which then removes ground from the test terminal of the connector shown in the drawing.

It is to be observed that the inner right-hand armature of relay 11 must require more time in falling off than the inner left-hand armature of relay 11, in order that the shunt around the windings of relay 21 may be removed for a sufficient length of time in advance of the closure of the inner right-hand armature of relay 11 on its back contact to give relay 21 sufficient time to energize and prevent the closure of the release circuit at its right-hand armature and back contact. The desired time of falling off of these armatures may be accomplished by suitable adjustment of the relay contacts.

What is claimed is:

1. In a telephone exchange system, calling and called subscribers' lines, automatic switches, means including a train of said automatic switches to establish a connection from a calling to a called subscriber's line, means controlled jointly by said calling and called subscribers to control the release of the final switch of said train, means controlled by said calling subscriber to control the release of the preceding switches of said train, and means including another final switch to reestablish connection between said subscribers should the preceding switches only be released by the calling subscriber.

2. In a telephone exchange system, calling and called subscribers' lines, automatic switches, means including a train of said automatic switches to establish connection from a calling to a called subscriber's line, means to control the release of the preceding switches of said train, means including another final switch to reestablish connection between said subscribers should the preceding switches be released by the calling subscriber, and means to render said first-mentioned final switch inaccessible to use by calling subscribers until reconnection has been established.

3. In a telephone exchange system, calling and called subscribers' lines, automatic switches, means including a train of said automatic switches to establish connection from a calling to a called subscriber's line, means controlled jointly by said calling and called subscribers to control the release of the final switch of said train, means controlled by said calling subscriber to control

the release of the preceding switches of said train, means including another final switch to reestablish connection between said subscribers should the preceding switches be released by the calling subscriber, and means operated simultaneously with said reconnection to release said first-mentioned final switch.

4. In a telephone exchange system, calling and called subscribers' lines, automatic switches, means including a train of said automatic switches to establish connection from a calling to a called subscriber's line, means controlled jointly by said calling and called subscribers to control the release of the final switch of said train, means controlled by said calling subscriber to control the release of the preceding switches of said train, means including another final switch to reestablish connection between said subscribers should the preceding switches be released by the calling subscriber, means to render said first-mentioned final switch inaccessible to use by calling subscribers until reconnection has been established, and means operated simultaneously with such reconnection to release said first-mentioned final switch.

5. In a telephone exchange system, calling and called subscribers' lines, connector switches, means including one of said connector switches to establish connection from a calling to a called subscriber's line, means to prevent the establishment of a talking connection if the called line is busy, means to establish a talking connection if the called line is idle, means controlled by said connector switch to make said called line test busy to other connectors, and means made operative under the control of the said calling subscriber to render said busy test ineffective.

6. In a telephone exchange system, calling and called subscribers' lines, connector switches, means including one of said connector switches to establish connection from a calling to a called subscriber's line, means to prevent the establishment of a talking connection if the called line is busy, means for establishing a talking connection if the called line is idle, means to render said busy test ineffective under certain conditions, a relay, a release circuit partially controlled at contacts of said relay, and means made operative under the control of the calling subscriber to affect the condition of said relay.

7. In a telephone exchange system, calling and called subscribers' lines, automatic switches, means including a train of said automatic switches to establish connection from a calling to a called subscriber's line, testing means at the final switch of said train to prevent the establishment of a talking connection if the called line is busy, means

to establish a talking connection if the called line is idle, means controlled by said final switch to make said called line test busy to other final switches, means controlled jointly
5 by said calling and said called subscribers to control the release of the final switch of said train, means controlled by said calling subscriber to control the release of the preceding switches of said train, a relay, means
10 including circuits controlled at contacts of said relay to render said first mentioned final switch inaccessible to use by calling subscribers until reconnection has been established and to operate simultaneously with
15 such reconnection to release said first mentioned final switch, and means made opera-

tive under the control of the calling subscriber to affect the condition of said relay.

8. In a telephone exchange, calling and called subscribers' lines, means for establishing connections between said lines, means
20 for excluding other connections from a connected pair of calling and called lines, and means under control of said calling line, party to said connected pair of lines, for
25 removing said excluding means from said called line.

In witness whereof, I hereunto subscribe my name this 28th day of December, A. D., 1916.

HENRY P. CLAUSEN.