

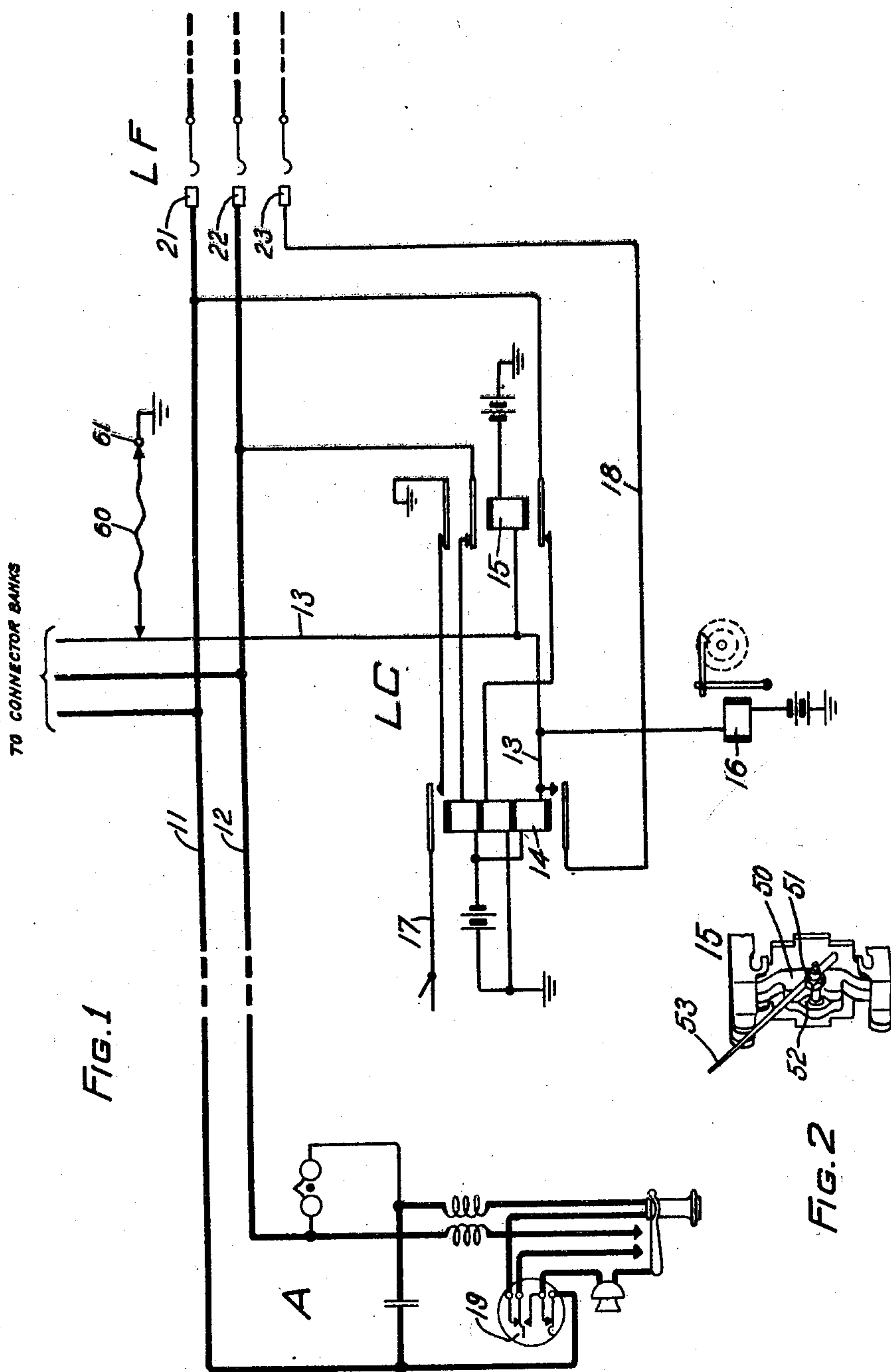
Nov. 17, 1931.

M. B. McDAVITT ET AL

1,831,922

TELEPHONE EXCHANGE SYSTEM

Filed Feb. 10, 1930



INVENTORS M. B. McDAVITT, JR.
P. C. SCHWANTES, JR.
BY *ge 704c*
ATTORNEY

UNITED STATES PATENT OFFICE

MARCELLUS B. McDAVITT AND PAUL C. SCHWANTES, JR., OF NEW YORK, N. Y., ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

TELEPHONE EXCHANGE SYSTEM

Application filed February 10, 1930. Serial No. 427,379.

This invention relates to telephone systems and particularly to line circuits in automatic and semi-automatic telephone systems.

The object of this invention is to facilitate maintenance service in an exchange employing line-finder switches.

When it is found necessary for maintenance reasons to block the cut-off relay of a line circuit in an automatic office employing line-finder switches, means should be provided to prevent hunting line-finder switches from seizing the terminals of the associated line as if it were a calling line. Otherwise it is necessary to insulate the contacts of the cut-off relay to prevent such seizures.

According to this invention the line relay is provided with the usual operating windings and with a holding winding which is connected in parallel with the winding of a cut-off relay. Upon the origination of a call the line relay, which is energized by its operating windings, connects its holding winding and the winding of the cut-off relay to the associated sleeve terminals in the banks of the line-finder switches. Upon seizure of the line by one of the line-finder switches the cut-off relay is operated, both the line relay and the cut-off relay being held operated until the calling subscriber replaces the receiver upon the switchhook. When so arranged the blocking of the cut-off relay in its operated position does not connect the winding of the cut-off relay to the sleeve terminal, and it is therefore not necessary to insulate contacts.

Figure 1 of the drawing shows a subscriber's line circuit, arranged according to this invention, for use in a system in which automatic switches are employed in extending connections between calling and called subscribers. Fig. 2 shows the front end of the cut-off relay of the line circuit together with a toothpick or other insulating wedge for holding the armature of the relay in its operated position. A relay of this type is shown in detail in the patent to E. B. Craft, 1,156,671, October 12, 1915.

Referring to Figure 1, the subscriber's station shown schematically at A is connected by the line conductors 11 and 12 to the line circuit LC, to terminals 21 and 22 in the bank

of the line-finder switch LF, and to terminals (not shown) in the banks of connector switches. The line circuit includes the line relay 14, the cut-off relay 15, and, if the subscriber at station A is a message-rate subscriber, the message register 16. On calls originated by the subscriber at A a line-finder such as LF is used to extend the line to a first selector (not shown) in the train of switches used in completing the desired connection. When station A is the called station the connection is completed by a connector switch (not shown) having access to terminals to which the conductors 11, 12 and 13 connect. The line-finder, which is represented schematically by the brushes 21, 22, and 23 is similar to that disclosed and described in the patent to H. Hovland No. 1,711,682.

The line relay 14 has three windings all wound on the same core. The upper and middle windings are normally connected through back contacts of the cut-off relay 15 to the line conductors 11 and 12, and these windings will hereafter be referred to as the line windings of relay 14. The lower winding, which is permanently connected in parallel with the winding of the cut-off relay 15, is sufficiently inductive to hold relay 14 after it has been operated by the energization of its line windings. But it is not necessary that the holding winding be effective, in the circuit over conductor 13, to operate relay 14 when the line is seized by a connector switch.

When the subscriber at station A removes the receiver to originate a call the line relay 14 operates in an obvious circuit through its line windings. With the relay 14 operated, ground is connected through the upper outer armature and back contact of the cut-off relay 15, and through a front contact of line relay 14 to the group conductor 17. With ground connected to conductor 17 an idle line finder, having access to lines in the group associated with conductor 17, is rendered effective to advance its brushes in a vertical and a rotary movement in search for the terminals to which the conductors of the calling line are connected. The operation of the line relay also connects the winding of the

cut-off relay 15, in parallel with the holding winding of the line relay, to the sleeve terminal 23 in the bank of line-finder LF and to the corresponding terminal in the banks of each line-finder in the same group. These terminals are companion to the terminals to which conductors 11 and 12 are connected. When the brushes of the line-finder LF, which we will assume to be the line-finder used on this particular call, make contact with terminals 21, 22 and 23, a circuit is closed from battery through the holding winding of line relay 14 in parallel with the winding of cut-off relay 15, through conductor 18, terminal 23 and the sleeve brush of the line-finder switch, and through the winding of a control relay (not shown) in the line-finder circuit to ground. The control relay of the line-finder operates to stop the line-finder brushes on terminals 21, 22 and 23. The cut-off relay operates to disconnect the line windings of relay 14 from line conductors 11 and 12: but line relay 14 does not release since its holding winding is energized in parallel with the winding of the cut-off relay 15 in the circuit over conductors 13 and 18. The operation of relay 15 is also effective to disconnect ground from the group conductor 17.

When the calling line is extended through the line-finder LF to an associated selector, a busy (ground) potential is connected from the selector circuit through the sleeve brush of the line-finder to sleeve terminal 23, so that other line-finders thereafter searching for the contacts of a calling line will not stop on the terminals of the line to which line-finder LF is connected. This busy potential is also extended through the lower contacts of relay 14 over conductor 13 to the corresponding sleeve terminal in the banks of the connector switches which have access to the line of station A, so as to prevent seizure of the line by one of these switches on an incoming call.

The desired connection is thereafter established, under the control of dial 19 at station A, and the line conductors 11 and 12 are extended to talking battery through the windings of a supervisory or line relay associated with one of the switches used in completing the connection. When the subscriber at station A replaces the receiver upon the switchhook, the supervisory relay (through which talking current is supplied) releases thereby causing the busy potential (ground) to be disconnected from sleeve terminal 23 and from the sleeve terminals of the connector switches to which conductor 13 connects. The line relay 14 and the cut-off relay 15 release thus rendering the line circuit LC effective for use on the next call originated at station A.

When a connector circuit seizes the terminals to which conductors 11, 12 and 13 are connected, on an incoming call, the cut-off

relay 15 is energized in the circuit over conductor 13 so as to disconnect the line windings of relay 14 from conductors 11 and 12. The holding winding of line relay 14 is also energized over conductor 13 and relay 14 may or may not operate. If relay 14 operates no line-finder is started since ground cannot be connected to the group conductor 17 as long as the cut-off relay is operated.

Should it become necessary to disable the line of station A for maintenance reasons, the cut-off relay 15 may be blocked in its operated position by inserting the toothpick 53 (Figure 2) between the armature 50 and the back stop 51 so as to force the armature 50, toward the pole piece 52, into its operated position. The blocking of the cut-off relay in this manner does not interfere with calls originated on other lines in the same subgroup since line relay 14 is not operated and the winding of relay 15 is not connected to sleeve terminal 23.

It may be desirable to disable the line both for originating and for receiving calls in which case ground may be connected to conductor 13 by means of the cord 60 and the ground 61. The cut-off relay 15 is thus operated electrically, instead of being blocked manually, to disconnect the line windings of relay 14 from conductors 11 and 12, and to prevent ground from being connected to group conductor 17. A connector switch is prevented from seizing the terminals of this line because the ground on conductor 13 is effective as a busy or guarding potential. Line relay 14 may or may not operate because of the ground on conductor 13. If relay 14 does not operate, the calling-line potential is not connected to conductor 18 to cause hunting line-finders to stop on the terminals of this line. And if relay 14 does operate, the ground on conductor 13 is extended over conductor 18 to constitute a busy or guarding potential to prevent hunting line-finders from stopping on the terminals of this line.

It may be found preferable to have the lower winding of line relay 14 ineffective to operate this relay. When so arranged the busy ground, connected to conductor 13 by a connector switch on an incoming call or connected to conductor 13 for maintenance purpose as described in the preceding paragraph, is not extended to conductor 18. One advantage of this arrangement is to prevent any retardation of the hunting movement of a line-finder whenever the terminals of such a line are encountered.

It should also be noted that, since the line relay is held operated after the cut-off relay operates, it is no longer necessary that the line relay be slow in releasing.

What is claimed is:

1. In a telephone system, a line-finder switch, a connector switch, a terminal bank

for each of said switches, a line connected to terminals in the banks of said switches, a line relay for operating when a call is originated over said line, a cut-off relay for operating when the terminals of said line are seized at either of said switches to disconnect the operating winding of said line relay from said line, a holding winding for said line relay connected in parallel with the winding of said cut-off relay, a sleeve terminal for said line in the bank of said line-finder switch, said sleeve terminal normally having no connection to battery or ground, and contacts of said line relay for connecting said sleeve terminal to battery through the winding of said cut-off relay.

2. In a telephone system, a subscriber's station, a line-finder switch, a connector switch, line conductors for connecting said station to line terminals in the banks of said switches, a sleeve terminal associated with each set of said line terminals and normally having no connection to battery or ground, a line relay for operating when a call is originated at said station, a cut-off relay for disconnecting the operating winding of said line relay from said line conductors, a holding winding for said line relay permanently connected in parallel with the winding of said cut-off relay to the sleeve terminal in the bank of said connector switch, and contacts on said line relay for connecting the winding of said cut-off relay to the sleeve terminal in the bank of said line-finder switch.

3. In telephone system, a line-finder switch, a line connected to terminals in the bank of said switch, a marking terminal for said line in said bank, said marking terminal normally having no connection with battery or ground, a line relay, a cut-off relay, operating windings for said line relay connected to said line under control of said cut-off relay, a holding winding for said line relay in parallel with the winding of said cut-off relay, contacts of said line relay for connecting the winding of said cut-off relay to said marking terminal to mark said line as a calling line, and means for blocking the armature of said cut-off relay in its operated position without marking said line as a calling line.

4. In a telephone system, a line, a line relay for operating upon the origination of a call over said line, a line-finder switch for extending said line, line and test terminals in the bank of said switch associated with said line, said test terminal normally having no connection with battery or ground, a cut-off relay for disconnecting the operating windings of said line relay from said line, a holding winding of said line relay in parallel with the winding of said cut-off relay for holding said line relay operated, contacts of said line relay for connecting the winding of said cut-off relay to the test terminal of said line to mark said line as a calling

line, and means for holding the cut-off relay operated without a call having been originated or received over said line and without marking said line as a calling line.

5. In a telephone system, a line-finder switch, a connector switch, a terminal bank for each of said switches, a line connected to terminals in the banks of said switches, a line relay for operating when a call is originated over said line, a cut-off relay for operating when the terminals of said line are seized at either of said switches to disconnect the operating winding of said line relay from said line, a holding winding for said line relay connected in parallel with the winding of said cut-off relay, a sleeve terminal for said line in the bank of said line-finder switch normally having no connection to battery or ground, contacts of said line relay for connecting said cut-off relay to said sleeve terminal, and means for holding the armature of said cut-off relay in its operated position.

6. In a telephone system, a subscriber's station, a line-finder switch, a connector switch, line conductors for connecting said station to line terminals in the banks of said switches, a sleeve terminal associated with each set of said line terminals, said sleeve terminal normally having no connection with battery or ground, a line relay for operating when a call is originated at said station, a cut-off relay for disconnecting the operating winding of said line relay from said line conductors, a holding winding for said line relay permanently connected in parallel with the winding of said cut-off relay to the sleeve terminal in the bank of said connector switch, contacts on said line relay for connecting the winding of said cut-off relay to the sleeve terminal in the bank of said line-finder switch to mark said line as a calling line, and means for holding the cut-off relay operated without a call having been originated or received at said subscriber's station and without marking said line as a calling line.

7. In a telephone system, a line-finder switch, a connector switch, a terminal bank for each of said switches, a line connected to terminals in the banks of said switches, a line relay for operating when a call is originated over said line, a cut-off relay for operating when the terminals of said line are seized at either of said switches to disconnect the operating winding of said line relay from said line, a holding winding for said line relay connected with the winding of said cut-off relay, a sleeve terminal for said line in the bank of said line-finder switch, said sleeve terminal normally having no connection to battery or ground, and contacts of said line relay for connecting said sleeve terminal to battery through the winding of said cut-off relay.

8. In a telephone system, a subscriber's station, a line-finder switch, a connector

switch, line conductors for connecting said station to line terminals in the banks of said switches, a sleeve terminal associated with each set of said line terminals and normally having no connection to battery or ground, a line relay for operating when a call is originated at said station, a cut-off relay for disconnecting the operating winding of said line relay from said line conductors, a holding winding for said line relay permanently connected with the winding of said cut-off relay to the sleeve terminal in the bank of said connector switch, and contacts on said line relay for connecting the winding of said cut-off relay to the sleeve terminal in the bank of said line-finder switch.

9. In a telephone system, a line-finder switch, a line connected to terminals in the bank of said switch, a marking terminal for said line in said bank, said marking terminal normally having no connection with battery or ground, a line relay, a cut-off relay, operating windings for said line relay connected to said line under control of said cut-off relay, a holding winding for said line relay connected with the winding of said cut-off relay, contacts of said line relay for connecting the winding of said cut-off relay to said marking terminal to mark said line as a calling line, and means for blocking the armature of said cut-off relay in its operated position without marking said line as a calling line.

10. In a telephone system, a line, a line relay for operating upon the origination of a call over said line, a line-finder switch for extending said line, line and test terminals in the bank of said switch associated with said line, said test terminal normally having no connection with battery or ground, a cut-off relay for disconnecting the operating windings of said line relay from said line, a holding winding of said line relay connected with the winding of said cut-off relay for holding said line relay operated, contacts of said line relay for connecting the winding of said cut-off relay to the test terminal of said line to mark said line as a calling line, and means for holding the cut-off relay operated without a call having been originated or received over said line and without marking said line as a calling line.

11. In a telephone system, a line-finder switch, a connector switch, a terminal bank for each of said switches, a line connected to terminals in the banks of said switches, a line relay for operating when a call is originated over said line, a cut-off relay for operating when the terminals of said line are seized at either of said switches to disconnect the operating winding of said line relay from said line, a holding winding for said line relay connected with the winding of said cut-off relay, a sleeve terminal for said line in the bank of said line-finder switch normally

having no connection to battery or ground, contacts of said line relay for connecting said cut-off relay to said sleeve terminal, and means for holding the armature of said cut-off relay in its operated position.

12. In a telephone system, a subscriber's station, a line-finder switch, a connector switch, line conductors for connecting said station to line terminals in the banks of said switches, a sleeve terminal associated with each set of said line terminals, said sleeve terminal normally having no connection with battery or ground, a line relay for operating when a call is originated at said station, a cut-off relay for disconnecting the operating winding of said line relay from said line conductors, a holding winding for said line relay permanently connected with the winding of said cut-off relay to the sleeve terminal in the bank of said connector switch, contacts on said line relay for connecting the winding of said cut-off relay to the sleeve terminal in the bank of said line-finder switch to mark said line as a calling line, and means for holding the cut-off relay operated without a call having been originated or received at said subscriber's station and without marking said line as a calling line.

In testimony whereof, we have signed our names to this specification this 8th day of February, 1930.

MARCELLUS B. McDAVITT.
PAUL C. SCHWANTES, JR.