

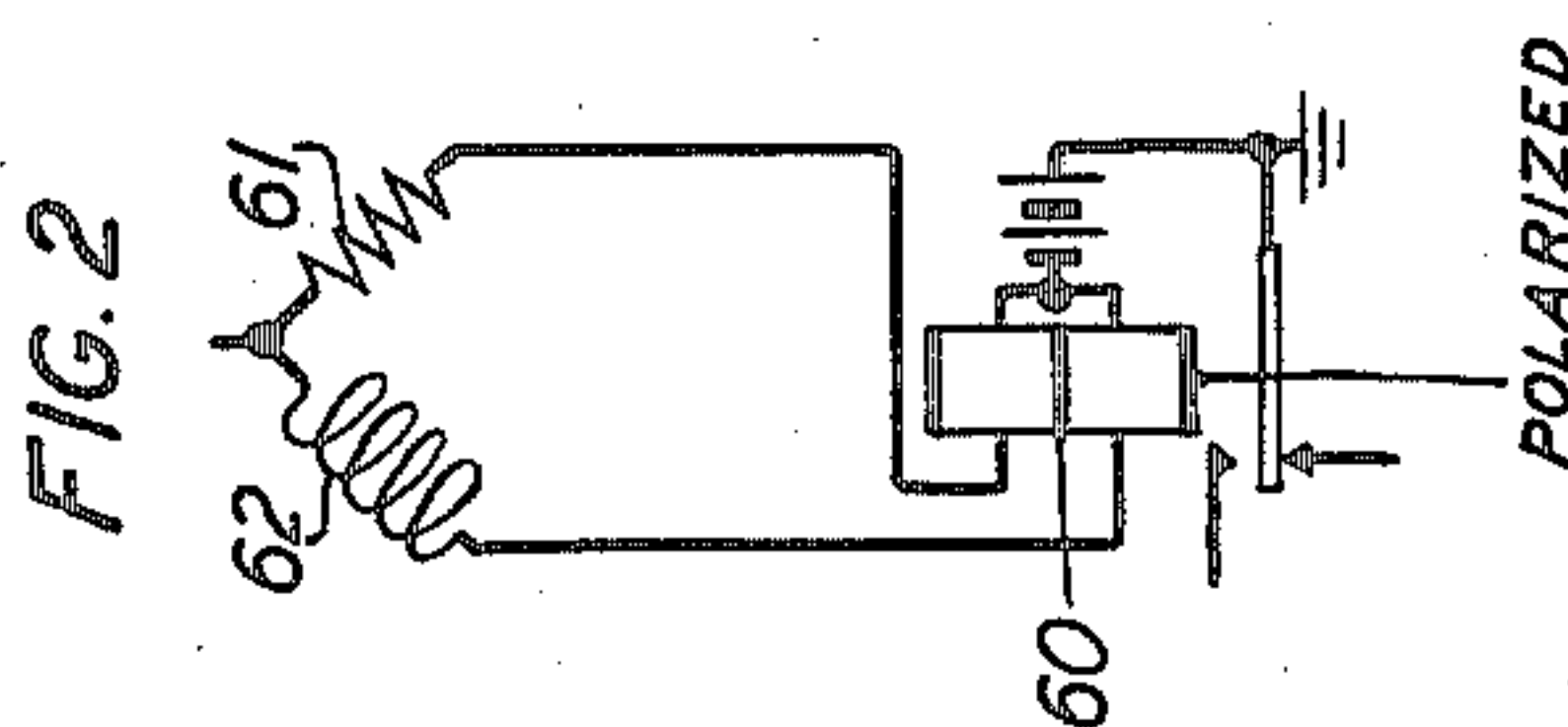
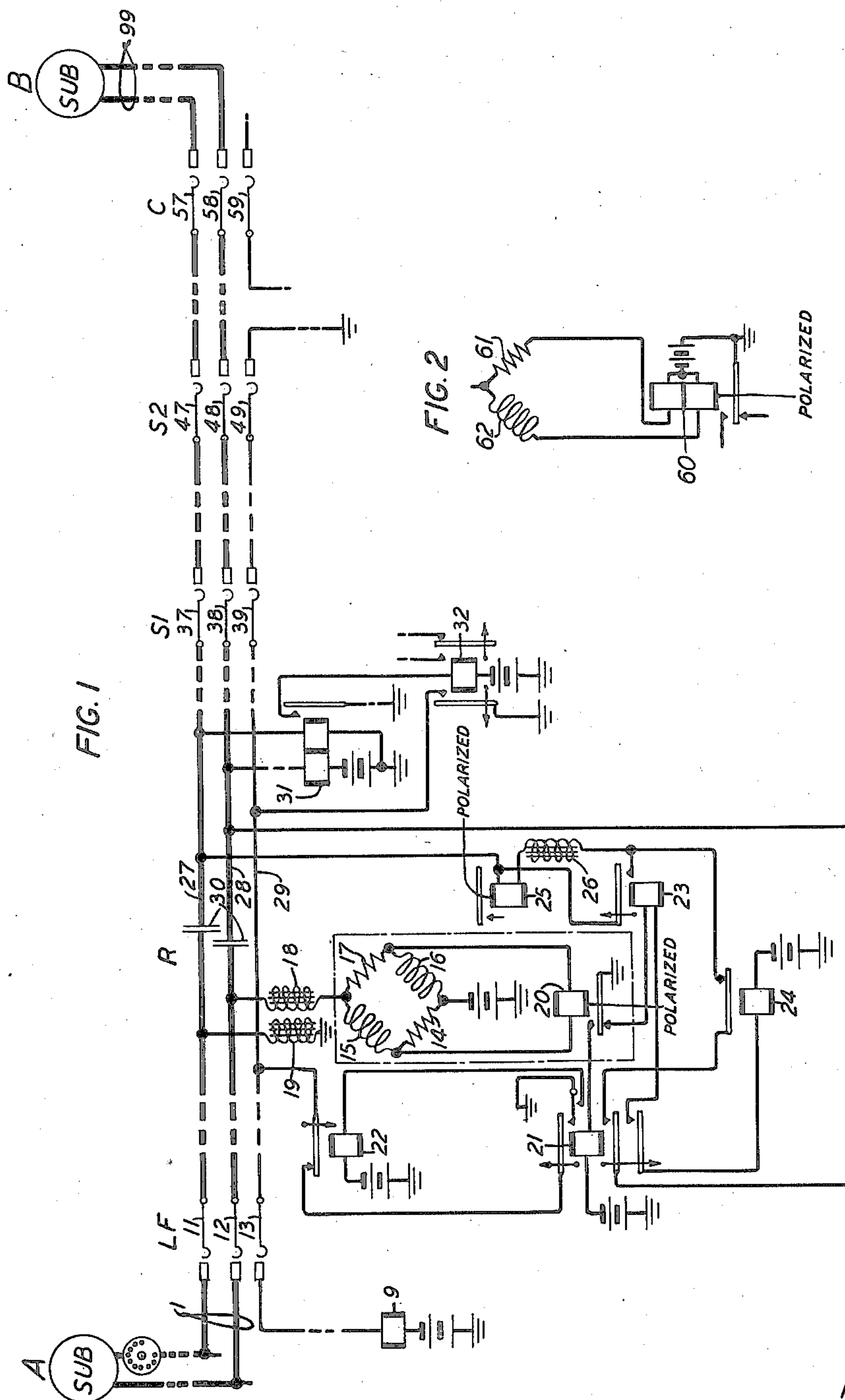
April 7, 1936.

H. M. BASCOM

2,036,316

TELEPHONE SYSTEM

Filed March 3, 1933



INVENTOR
H. M. BASCOM
BY
J. E. 40
ATTORNEY

UNITED STATES PATENT OFFICE

2,036,316

TELEPHONE SYSTEM

Henry Melvin Bascom, Brooklyn, N. Y., assignor
to American Telephone and Telegraph Com-
pany, a corporation of New York

Application March 3, 1933, Serial No. 659,557

13 Claims. (Cl. 179—16)

This invention relates to signaling systems and more particularly to directive impulse receiving means in electromagnetically operated signaling systems.

5 The object of the invention is to provide simple and reliable impulse receiving means applicable to signaling lines of widely varying resistance and insulation characteristics.

10 This invention is an arrangement, for receiving signaling impulses, comprising two inductive and two non-inductive resistances connected to form a Wheatstone bridge with similar elements in the opposite legs and with a polar relay bridged across the junction points between the dissimilar elements. The bridge is connected in series with
15 battery to a signaling conductor or line, the bridge being normally balanced. The change of current flowing in the line, due to the opening or closing of the line to transmit a signaling im-
20 pulse, causes the bridge to become temporarily unbalanced thus operating the polar relay in the one direction or the other. Such an impulse re-
25 ceiving circuit is not responsive to leakage currents due to low insulation resistance of the sig-
naling line and by a proper proportioning of the bridge elements is sufficiently sensitive to be ap-
plicable to long and high resistance lines.

30 Another feature of the invention is an arrange-
ment for receiving signaling impulses comprising
a non-inductive resistance, an induction coil and
a differentially wound polar relay; signaling bat-
tery is connected through one winding of the re-
lay and the induction coil, and also through the
35 other winding of the relay and the non-inductive
resistance, to the signaling line, the steady state
current through the windings being equal. Upon
the closing and opening of the signaling circuit,
an electromotive force is induced in the induction
coil which causes the flow of current through both
40 windings of the relay to cause the operation of its
armature in one direction or the other. This im-
pulse receiving arrangement is also non-respon-
sive to leakage currents.

45 The telephone system illustrated in the draw-
ing, which forms a part of this specification, is
one in which the subscriber's station equipments
include a dial or other impulse sending device
and in which selector and connector switches of
the well known two-motion step-by-step
50 (Strowger) type are employed in establishing
connections between calling and called lines. It
is, of course, understood that the invention may
be applied to any system involving the transmis-
sion of and response to selective current im-
55 pulses. Referring to the drawing;

Figure 1 represents schematically a calling
subscriber's station A and line 1, a line-finder LF,
an impulse receiving circuit unit R, a first selec-
tor S1, a second selector S2, a connector C, and a
called subscriber's line 99 and station B;

Fig. 2 shows an alternative arrangement of the
impulse receiving relay which may be substituted
in Fig. 1 for the portion within the broken line
enclosure.

10 The equipment at the calling station A and
called station B is of the usual type employed with
common battery central offices, the equipment at
station A being shown to include a dial for use by
the subscriber at this station in controlling the
establishment of a desired connection. The line-
finder switch LF may also be of the well known
15 Strowger type, reference may be had to the pat-
ent to H. Hovland, No. 1,711,682, granted May 7,
1929 for a detailed description of the operation of
such a line finder. For a description of the oper-
ation and construction of selector and connector
20 switches of the Strowger type reference may be
had to pages 53 to 65, inclusive, of the 2nd edition
of "Automatic Telephony" by Smith and Camp-
bell published in 1921.

25 The invention will be further described assum-
ing a call from station A to station B. The re-
ceiver having been removed at station A to orig-
inate a call and the line-finder LF having op-
erated to advance its brushes 11 and 12 into en-
30 gagement with the terminals to which the line
1 is connected, a dialing circuit is traced from
battery through the windings of non-inductive
resistance 14 and induction coil 15 in parallel
with the windings of induction coil 16 and non-
35 inductive resistance 17, through the induction
coil 18, through brush 12 of line-finder LF over
line 1 and through the station equipment at sta-
tion A, back through brush 11 of line-finder LF
and through induction coil 19 to ground. The
40 induction coils 15 and 16 are alike; and the re-
sistances 14 and 17 are alike and equal to the
steady state resistance of each of coils 15 and 16.
This bridge arrangement results in the ends of
the winding of relay 20 being at the same poten-
45 tial when the current, through the bridge com-
posed of resistances 14 and 17 and coils 15 and 16,
is not changing and results in a difference in po-
tential across the winding of relay 20 when the
current through the bridge is changing. The in-
50 duction coils 18 and 19 are adapted to balance
the two sides of the line, this being particularly
desirable after the talking connection is estab-
lished. Relay 20 is a polarized relay adapted to
hold its armature in either extreme position until
55

the relay becomes energized in the proper direction to move the armature to the other extreme position. Upon the closing of the dialing circuit, the electromotive forces induced in the coils 15 and 16 causes a difference in potential between the ends of the winding of polarized relay 20 until the current reaches a steady state. The current through the winding of relay 20 being in the operating direction, this relay operates to close a circuit at its inner contact for operating relay 21. Although the current which causes the initial operation of relay 20 is temporary, the armature does not again change its position until the relay is thereafter energized by current in the opposite direction. Relay 21, operated, connects a temporary holding ground through its uppermost front contact and the back contact of relay 22 to the sleeve conductor of line-finder LF and closes a circuit for operating relay 22. When relay 22 operates, it disconnects the temporary holding ground from the sleeve conductor but since relay 22 is slow in operating, this ground connection is effective to hold the line-finder LF in its operated position and to hold the cut-off relay 9 until a permanent holding ground is connected to conductor 29 of selector S1 by the operation of its release relay as hereinafter described. At its inner lower front contact, relay 21 closes a circuit for operating the line relay 31 of selector S1, this circuit being traced from battery through the left winding of relay 31, over conductor 28, through the back contact of relay 24, resistance 26 and winding of the polarized supervisory relay 25, over conductor 27 and through the right winding of relay 31 to ground. Relay 31, operated, closes a circuit for operating the release relay 32. Relay 32 connects a holding ground to the sleeve conductor 29 to hold the line-finder in its operated position and to hold the cut-off relay 9 of line 1 in the usual manner.

When the subscriber at station A dials the first digit of the number of a desired station, the dialing circuit is, in the usual manner, alternately opened and closed at the interrupter contacts of the dial to transmit a corresponding train of impulses over the line to the central office. The first opening of the interrupter contacts causes an electromotive force to be induced in the coils 15 and 16, resulting in current through these coils and through the winding of polarized relay 20. Since this current is in the opposite direction to that which resulted in the initial operation of relay 20, the armature of this relay is actuated to open its upper contact and close its lower contact. A circuit is thus closed from ground through the lower contact of relay 20, winding of relay 23, lowermost front contact of relay 21, and through the winding of relay 24 to battery. Relays 23 and 24 are both operated by the current in this circuit, the operation of relay 23 being effective to short circuit resistance 26 and the winding of supervisory relay 25 and the operation of relay 24 being effective to open the energizing circuit for the line relay 31 of selector S1. When the interrupter contacts of the dial close the dialing circuit after the first opening thereof, the current again builds up in the line circuit and the polarized relay 20 is again energized by current in the same direction as that which caused its initial operation. The armature is, therefore, actuated to open the circuit through the windings of relays 23 and 24 and to again close the circuit through the winding of relay 21. Thus each opening of the interrupter contacts of the dial resulting from the dialing of any digit of a called

number results in the alternate opening of the upper contact and closing of the lower contact of relay 20 and the opening of the lower contact and the closing of the upper contact of this relay. Relay 21 is slow in releasing and remains operated until the connection is released by the calling subscriber. Relay 23, which is also slow in releasing, remains operated during the receipt of each train of impulses and releases only after receiving the last impulse of each train. Relay 24 is fast acting, alternately opening and closing the circuit through the windings of line relay 31 of selector S1 in response to each impulse received over line 1.

The alternate operation and release of relay 31 of selector S1 causes the advance of the brushes 37, 38 and 39 to a group of terminals corresponding to the first digit of the called number in the usual and well known manner. An idle set of terminals in this group having been thereupon automatically selected and seized, the impulse receiving unit R responds to the dialing of the second digit of the called number to effect the selective operation of the second selector to which the seized terminals are connected. In the drawing, this second selector, designated S2, is represented by the brushes 47, 48 and 49 and the line relay (not shown) of this selector responds to the closing and opening of the lower contact of relay 20 in the same manner as did the line relay 31 of selector S1. Additional selectors required for the completion of a connection are selectively operated in like manner. When the last two digits of the called number are dialed, a connector switch is selectively operated to seize the called line and if found idle to signal the called station in the usual well known manner. In the drawing, this connector designated C is represented by the brushes 57, 58 and 59, the called line with which connection is established being designated 99 and the station thereon designated B. The ground for holding the cut-off relay 9 of line 1 and for holding each of the selector switches employed in establishing the connection is connected to the sleeve conductor of the connector C in the usual manner. The talking current is transmitted through condensers 30, battery being connected to the calling station from circuit unit R for talking the same as for dialing. Talking battery potential is supplied to the called station from the connector in the usual manner. The polarized supervisory relay 25 of the circuit unit R responds to the reversal of current through its winding due to the answer of the called station in the well known manner. Relay 25 may control the operations necessary to the charging of the calling subscriber for a completed call or for any other desired supervisory function.

When the calling subscriber replaces the receiver, the opening of the line circuit causes relay 20 to actuate its armature to permanently open the circuit through the winding of relay 21, thus causing the successive release of relays 21 and 22. The release of relay 21 opens the circuit for energizing the line relay (not shown) of the connector C thus causing the connector to remove the holding ground from the sleeve conductor and the resultant release of the cut-off relay 9 and the restoration to normal of each of the selectors employed in establishing the connection.

A modification of the impulse receiving unit R is obtained by substituting Fig. 2 for that portion of Fig. 1 which is within the broken line enclosure. Relay 60 of Fig. 2 is like relay 20, a polarized relay

adapted to maintain its armature in either extreme position until energized by current in the proper direction to move the armature to the other extreme position. A single non-inductive resistance 61 and a single induction coil 62 are each connected, in series with one of the two like windings of the relay 60, from battery to the ring conductor of line-finder LF. The resistance 61 is equal to the steady state resistance of coil 62.

When the unit R becomes connected to a calling line, the current builds up faster through the upper winding of relay 60 and resistance 61 than it does through the lower winding of relay 60 and coil 62 resulting in the energization of relay 60 in such a direction as to actuate the armature to close its upper front contact. Each time the line circuit is opened, the self induced electromotive force of coil 62 causes a temporary flow of current through both windings of relay 60 which actuates the armature to close the lower contact. Thus relay 60, resistance 61 and coil 62 perform similar functions to those performed by the relay 20, resistances 14 and 17 and coils 15 and 16 of Fig. 1.

What is claimed is:

1. In a signaling system, a line, means for opening and closing said line to create impulses of current, a battery, and impulse receiving means connected in series with said battery and line, said impulse receiving means being operatively unaffected by a substantially steady current of any value in said line.

2. A signaling circuit, including a bridge comprising two like resistances in opposite legs, two like inductances in opposite legs, and the winding of a polarized relay connected across the junction points of unlike elements, and contacts for interrupting said circuit.

3. In combination, two like induction coils and two like non-inductive resistances all connected in series, unlike elements being adjacent, a relay, the winding of which is connected across two opposite junction points of unlike elements, and a source of current and interrupter contacts connected in series across the other two opposite junction points of unlike elements, a potential difference being induced by said induction coils to cause the temporary energization of said relay in one direction when said contacts close and in the other direction when said contacts open.

4. In a signaling system, a line, means for opening and closing said line to create impulses of current, a battery, and impulse receiving means connected in series with said battery and line, said impulse receiving means comprising a double wound polar relay, a non-inductive resistance in series with one winding of said relay and an induction coil in series with the other winding of said relay, said windings being differential to render said relay operatively unaffected by a substantially steady current in said line.

5. In a signaling system, a line, means for opening and closing said line to create impulses of current, a battery, and impulse receiving means connected in series with said battery and line, said impulse receiving means comprising a polar relay, two non-inductive resistances and two induction coils arranged to form a balanced Wheatstone bridge with like elements in opposite legs and with the polar relay bridged across the junction points between the dissimilar elements.

6. A signaling circuit including a non-inductive resistance, an induction coil and a relay, one winding of said relay and non-inductive resistance in series being connected in parallel with the other

winding and said induction coil in series, said relay being de-energized while the current in said circuit is steady, and means for opening and closing said circuit to cause said relay to be energized first in one direction and then in the other.

7. In combination, signal transmitting contacts and signal receiving means, said receiving means comprising a double-wound polarized relay, an induction coil and a non-inductive resistance, the resistance of said induction coil being equal to said non-inductive resistance and said relay adapted to retain its armature in either of its extreme positions until its winding becomes energized in the direction required for moving the armature to the other of its extreme positions, said coil and non-inductive resistance being so connected with the windings of said relay as to result in the temporary energization of said relay in one direction when said contacts are opened and in the other direction when said contacts are closed.

8. In combination, signal transmitting contacts, a signal receiver and a source of signaling current, said receiver comprising two induction coils, two non-inductive resistances and a polarized relay, the resistance of each of said coils being equal to each of said non-inductive resistances, said relay adapted to retain its armature in either of its extreme positions until its winding becomes energized in the direction required for moving the armature to the other of its extreme positions, said coils, resistances and relay winding being connected to form a Wheatstone bridge with unlike elements in opposite legs.

9. In a telephone system, subscribers' stations and lines, one of said stations being a calling station, an impulse transmitter at said calling station, a selector switch for use in extending a connection from said calling station to a called line, a line relay for said switch, means including a trunk for extending said calling line to said switch, a source of signaling current for said trunk, impulse receiving means comprising inductive and non-inductive elements and a polarized relay, a signaling circuit comprising said source and said calling line and said impulse receiving means in series, the elements of said impulse receiving means being so connected that said relay is temporarily energized in one direction upon the closing of said circuit, is temporarily energized in the other direction upon the opening of said circuit, and is operatively unaffected by a substantially steady current in said line, means responsive to the temporary energization of said polarized relay when said line is connected to said trunk for closing a circuit through the winding of the line relay of said switch, and means responsive to the alternate temporary energization of said polarized relay first in one direction and then in the other when impulses are being transmitted over said line for repeating corresponding impulses to the line relay of said switch.

10. In a signaling system, a line, an impulse controlled selector switch, means for connecting said line to said switch, an impulse transmitter for said line, and impulse receiving means adapted to repeat current impulses in said line to said switch, said impulse receiving means being operatively non-responsive to a steady current of any value over said line.

11. In a signaling system, a line, means for interrupting said line to create impulses of current, a battery and impulse receiving means connected in series with said battery and line, said impulse receiving means comprising a polarized relay, two

like non-inductive resistance units and two like inductive coils connected to form a Wheatstone bridge with unlike elements in adjacent legs and with the winding of said relay bridged across the
5 junction points between unlike elements, the resistance of said coils to a steady direct current being equal to that of said non-inductive resistance elements.

12. In a signaling system, a line, means for
10 opening and closing said line to create impulses of current, a battery, an impulse relay, and conductive means connecting said line to said battery and to the winding of said relay, said means being

of such a character that there is no current through said winding when the current over said line is not changing in value.

13. In a signaling system, a line, means for opening and closing said line to create impulses of
5 current, a battery, an impulse relay, and conductive means connecting said line to said battery and to the winding of said relay, said means being of such a character that there is current through
10 said winding only when the current over said line is changing in value.

HENRY M. BASCOM.