Nov. 26, 1935. T. L. DIMOND 2,022,030

SIGNALING SYSTEM

Filed Feb. 16, 1935

FIG. 1

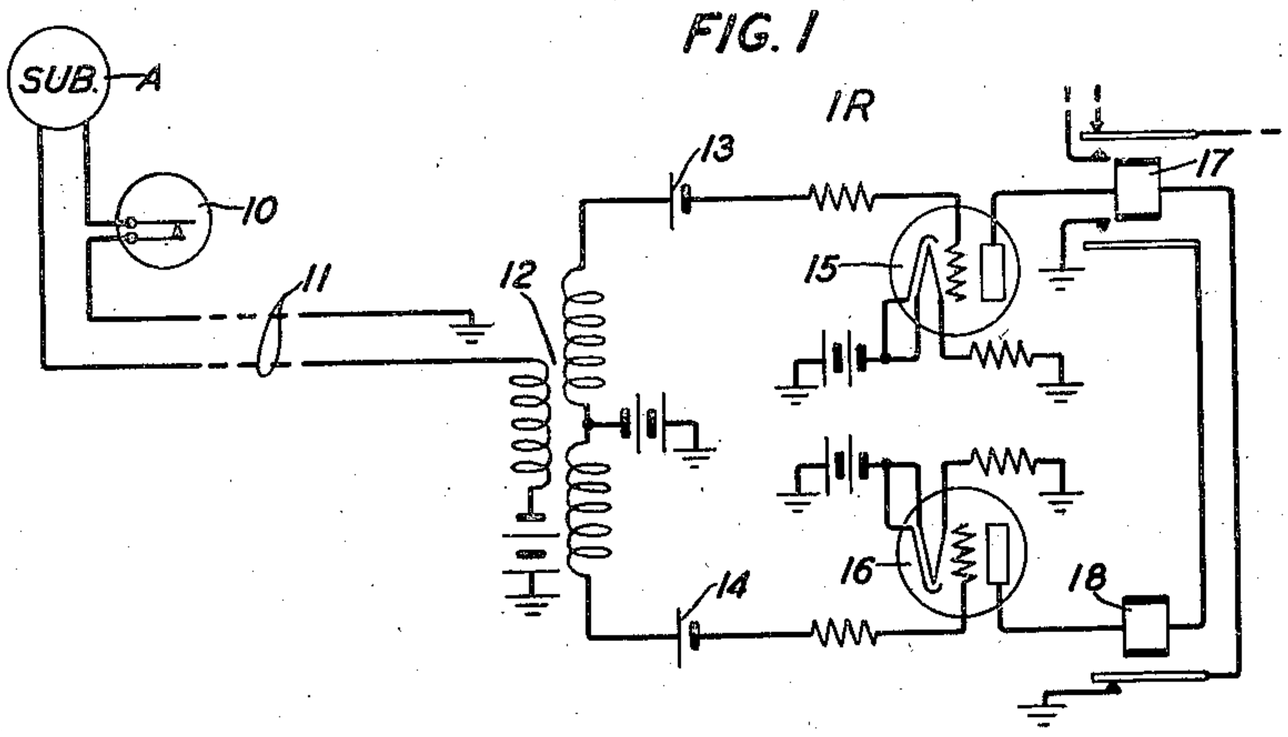


FIG. 2

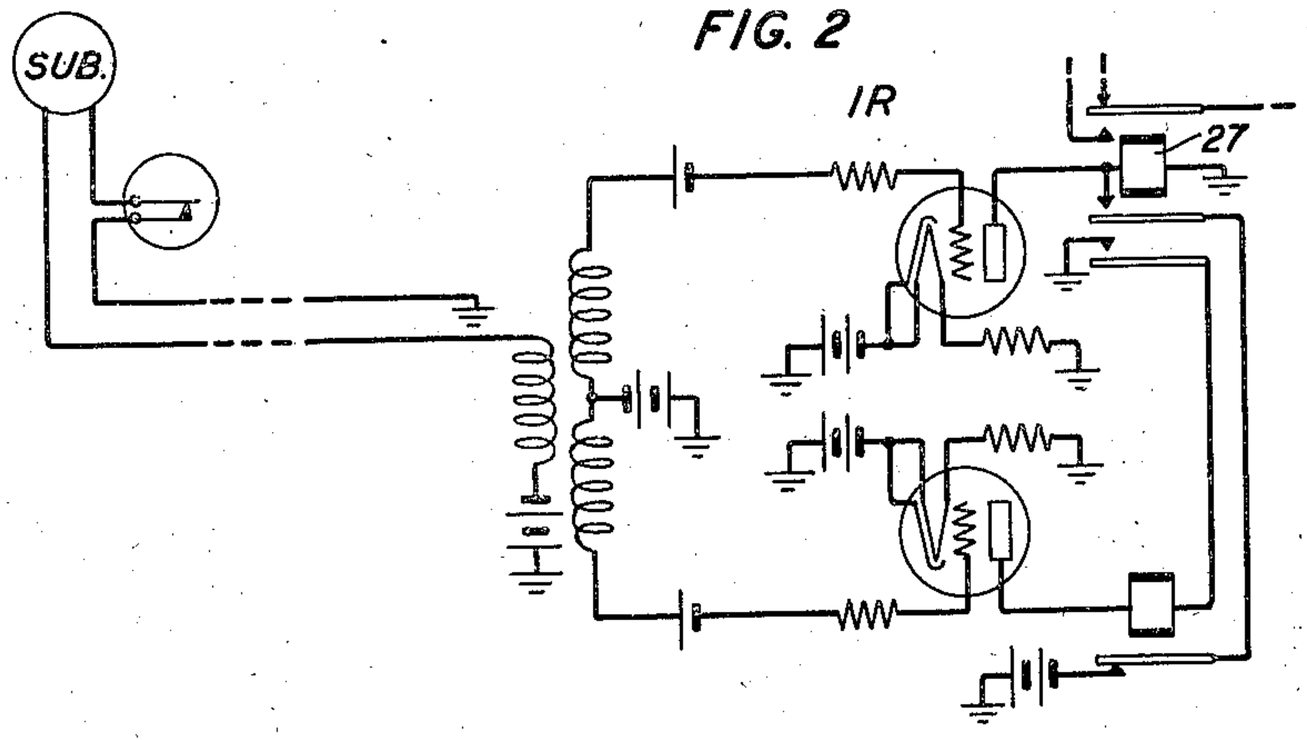
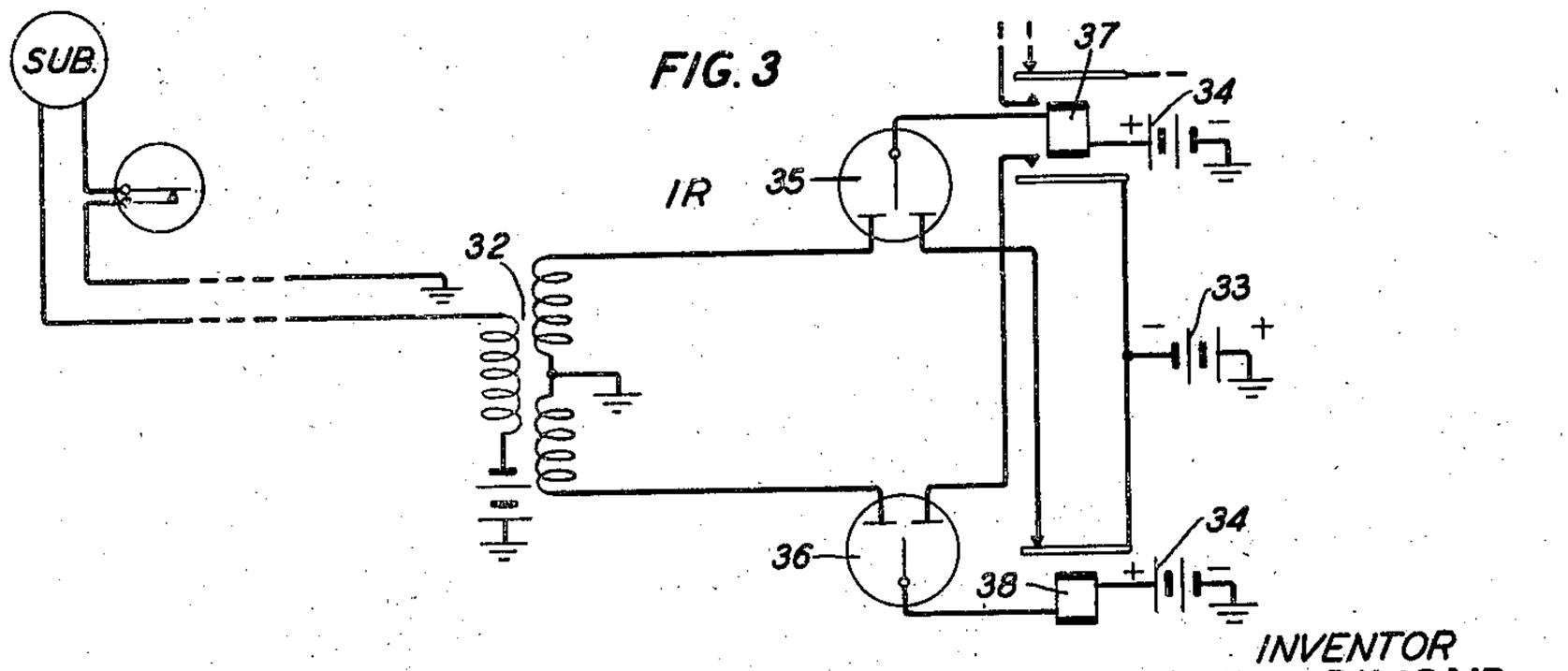


FIG. 3



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SIGNALING SYSTEM

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9 Claims. (Cl. 179—16)

This invention relates to signaling systems and particularly to systems in which automatic switches are directively controlled by current impulses in a direct current signaling circuit.

The object of the invention is to provide an improved impulse circuit arrangement which is capable of responding to impulses incoming over lines of high resistance and over lines having a low insulation resistance.

In an impulse receiving device arranged in accordance with this invention, one three-element gas-filled tube is energized in response to the closing of a direct current signaling circuit to operate an impulse receiving relay and another three-element gas-filled tube is energized in response to the opening of the signaling circuit to operate a second impulse receiving relay, the operating circuits for each one of the impulse receiving relays being controlled by the other of these relays. The impulse receiving relays may be effective to control an impulse register or to control a circuit by directively operating an automatic switch.

A feature of the invention is an impulse receiving device comprising a transformer, two three-element gas-filled tubes, a relay operatively controlled by one of the tubes for responding to the closing of an incoming impulse circuit which includes a winding of the transformer, and a relay operatively controlled by the other of the tubes for responding to the opening of the impulse circuit. The control element of one of the tubes is connected to one secondary winding of the transformer and the control element of the other tube is connected to another secondary winding of the transformer. The anode of one of the tubes is connected to the winding of the relay which responds to the closing of the incoming impulse circuit and the anode of the other tube is connected to the winding of the relay which responds to the opening of the incoming impulse circuit; the operating circuit for each one of the relays is controlled by the other.

A more complete understanding of the invention may be obtained by considering the specific embodiments of the invention shown in the drawing which forms a part of this specification. The invention is not, however, limited in its application to these specific arrangements and is, in general, applicable to any signaling system in which selective signals are created by the opening and closing of a signaling circuit.

Referring to each of the three figures of the drawing, A represents a subscriber's station in an automatic telephone system and IR represents impulse receiving means.

The apparatus at station A includes a dial 10, or an equivalent impulse sender, and is connected by line 11 to a central office or exchange in which automatic switching equipment is provided for establishing a connection between the line 11 and an idle impulse receiving means IR in response to the removal of the receiver at station A to originate a call. The impulse receiving means IR may be used to directly control in succession each of a train of selective switches to complete a desired connection or may be used to operate a register which thereafter controls the various switches through which a desired connection is established. Reference may be had to chapter III of the second edition of Automatic Telephony by Smith and Campbell for a description of an automatic telephone system comprising switches of the well-known Strowger type controlled by the dial impulses when dialed. Reference may be had to Patent No. 1,395,977 granted to F. A. Stearn et al. on November 1, 1921 for a description of a system comprising switches of the power-driven type which are revertively controlled by a register-controller, set in accordance with trains of impulses created by the operation of the dial at any calling subscriber's station to which the register-controller is connected.

The impulse receiving means IR, in Fig. 1 comprises the transformer 12, the two three-element hot-cathode gas-filled tubes 15 and 16 and the two relays 17 and 18. The transformer has three windings, the primary winding being connected in series with the central office battery and the line 11. The inner ends of the secondary windings of the transformer are connected to the negative pole of the central office battery; the outer end of the upper winding is connected to the grid or control element of the tube 15; and the outer end of the lower winding is connected to the grid or control element of tube 16. The cathode of each tube is connected to the negative pole of central office battery so that there is normally an insufficient difference in potential between the grid and cathode to cause ionization of the gas. If necessary, batteries 13 and 14 may be connected in series with the secondary windings of the transformer to normally maintain the grid elements at a proper potential level. The anode of tube 15 is connected in series with the winding of relay 17 and through the back contact of relay 18 to ground, the positive pole of the central office battery also being connected to ground. The anode of tube 16 is connected in series with the winding of relay 18 to the lower armature of relay 17.

Each of tubes 15 and 16 are filled to a low pressure with a gas such as neon, argon or helium; and the electrodes of each tube are so designed that the gas becomes ionized upon impression of the required potential across the cathode and grid, whereupon the tube becomes a conductor between the cathode and anode. Although the potential normally impressed across the cathode and anode is insufficient to cause the breakdown of the tube, the tube remains energized even though the grid element is restored to its normal negative potential, until the cathode to anode circuit is opened or short-circuited.

Upon extension of line 11 to the impulse receiving means IR, a circuit is closed from battery, through the primary winding of transformer 12 over the lower conductor of line 11, through the telephone instrument and dial 10 at station A, back over the upper conductor of line 11 to ground. The closing of this circuit induces an electromative force in the upper and lower secondary windings of transformer 12, thereby temporarily rendering the grid element of tube 15 less negative and the grid element of tube 16 more negative. The tube 16 does not respond; but the temporary change in the potential of the grid of tube 15 causes the ionization of the gas and the tube becomes a conductor, so that relay 17 is operated by the current in the cathode-anode circuit. In operating, relay 17 closes at its upper contacts a circuit which controls an impulse register or a selector switch. Relay 17 also connects ground through its lower contacts to the winding of relay 18, but relay 18 cannot immediately operate since the tube 16 is not energized.

When the subscriber at station A operates the dial 10, the line 11 is interrupted by the dial contacts in usual manner. At the first opening of the line 11, an electromotive force is induced in the secondary windings of transformer 12, thereby temporarily rendering the grid of tube 15 more negative and the grid of tube 16 less negative. The temporary change in the potential of the grid of tube 16 causes the ionization of the gas and the tube becomes a conductor, so that relay 18 is operated by the current in the cathode-anode circuit of tube 16. The change in the potential in the grid of tube 15 does not cause its deenergization; but, when relay 16 operates, tube 15 is deenergized and relay 17 releases, thereby opening the outgoing impulse circuit in response to the opening of the line 11 at dial 10. The release of relay 17 causes the deenergization of tube 16 and the release of relay 18. As soon as the line 11 is again closed at dial 10, the electromotive force induced in the secondary winding of transformer 12 causes the reenergization of tube 15 and reoperation of relay 17, thereby again closing the outgoing impulse circuit at the upper contacts of relay 17. Thus, each opening and closing of the line 11 at the contacts of dial 10 causes a corresponding opening and closing of the outgoing impulse circuit at the impulse receiving means IR.

The impulse receiving means IR shown in Fig. 2 is the same as that shown in Fig. 1, except that relay 27 which is substituted for relay 17 of Fig. 1 has an additional set of contacts to provide a locking circuit for this relay. When relay 27 operates, the anode of the tube is short-circuited so that the tube is immediately deenergized.

The impulse receiving means IR shown in Fig. 3 comprises the transformer 32, the two three-element cold cathode type gas-filled tubes 35 and 36, and the relays 37 and 38. The primary winding of the transformer is connected in series with the central office battery and subscriber's line. One end of each of the secondary windings is connected to ground, the other ends being connected to the grid elements of tubes 35 and 36. The anode element of tube 35 is connected through the winding of relay 37 to the positive pole of battery 34, and the anode element of tube 36 is connected through the winding of relay 38 to the positive pole of battery 34, the negative pole of battery 34 being connected to ground. The cathode of tube 35 is normally connected through the back contact of relay 38 to the negative pole of battery 33, the positive pole of battery 33 being connected to ground. The cathode of tube 36 is connected to the lower front contact of relay 37. When the line is closed and connected to the primary winding of transformer 32, the electromotive force induced in the secondary windings causes the breakdown of tube 35 and the operation of relay 37. Relay 37 closes at its upper contacts the outgoing impulse circuit and at its lower contacts connects the cathode of tube 36 to the negative pole of battery 33. When the subscriber's line is opened by the dial, the electromotive force induced in the secondary windings of transformer 32 causes the breakdown of tube 36 and operation of relay 38. The operation of relay 38 causes the release of relay 37 thereby opening the outgoing impulse circuit. The release of relay 37 causes the release of relay 38. When the line is again closed, at the end of the dial impulse, the tube 35 and relay 37 are reenergized, thereby again closing the outgoing impulse circuit.

What is claimed is:

1. In combination, a first circuit, a second circuit, a first three-element gas-filled tube, a second three-element gas-filled tube, a first relay, means including said first tube for operating said first relay in response to the closing of said first circuit, a second relay, means including said second tube for operating said second relay in response to the opening of said first circuit, and means including said tubes and relays for closing said second circuit in response to the closing of said first circuit and for opening said second circuit in response to the opening of said first circuit.

2. In combination, a transformer, an impulse circuit including the primary winding of said transformer, two three-element gas-filled tubes, the control element of one of said tubes being connected to one secondary winding of said transformer, and the control element of the other of said tubes being connected to another secondary winding of said transformer, a relay for operation in response to the closing of said impulse circuit, another relay for operation in response to the opening of said impulse relay circuit, the operating circuit for each one of said relays being controlled by the other of said relays, and another circuit controlled by one of said relays.

3. In combination, a circuit, means for opening and closing said circuit, two three-element gas-filled tubes, two relays, the winding of one of said relays being connected to an element of one of the tubes and the winding of the other of said relays being connected to an element of the other of said tubes, and circuit means for operatively associating said signaling circuit with the control element of each of said tubes, the closing of said circuit being effective to cause the breakdown of one of the tubes and operation of one

of the relays, and the opening of said circuit being effective to cause the breakdown of the other of the tubes and the operation of the other of the relays.

4. In combination, a circuit, means for opening and closing said circuit, two three-element gas-filled tubes, two relays, the winding of one of said relays being connected to an element of one of the tubes and the winding of the other of said relays being connected to an element of the other of said tubes, and circuit means for inductively connecting said signaling circuit to the control element of each of said tubes, the closing of said circuit being effective to cause the breakdown of one of the tubes and operation of one of the relays, and the opening of said circuit being effective to cause the breakdown of the other of the tubes and the operation of the other of the relays.

5. In combination, a circuit, means for opening and closing said circuit, two three-element gas-filled tubes, two relays, the winding of one of said relays being permanently connected to an element of one of the tubes and the winding of the other of said relays being permanently connected to an element of the other of said tubes, and circuit means for operatively associating said signaling circuit with the control element of each of said tubes, the closing of said circuit being effective to cause the breakdown of one of the tubes and operation of one of the relays, and the opening of said circuit being effective to cause the breakdown of the other of the tubes and the operation of the other of the relays, contacts on each of said relays for controlling the other of the relays, and other circuit controlling contacts on one of said relays.

6. In combination, a circuit, means for opening and closing said circuit, two three-element gas-filled tubes, two relays, the winding of one of said relays being connected to an element of one of the tubes and the winding of the other of said relays being connected to an element of the other of said tubes, circuit means for operatively associating said signaling circuit with the control element of each of said tubes, the closing of said circuit being effective to cause the breakdown of one of the tubes and operation of one of the relays, and the opening of said circuit being effective to cause the breakdown of the other of the tubes and the operation of the other of the relays, and other circuit controlling contacts on one of said relays.

7. In combination, a circuit, means for opening and closing said circuit, two three-element gas-filled tubes, two relays, the winding of one of said relays being connected to an element of one of the tubes and the winding of the other of said relays being connected to an element of the other of said tubes, circuit means for operatively associating said signaling circuit with the control element of each of said tubes, the closing of said circuit being effective to cause the breakdown of one of the tubes and operation of one of the relays, and the opening of said circuit being effective to cause the breakdown of the other of the tubes and the operation of the other of the relays, and means for holding said one of the relays operated and for causing the deenergization of said one of the tubes.

8. In combination, an impulse circuit, two three-element gas-filled tubes, circuit means for operatively associating said tubes with said circuit, a relay for operation in response to the ionization of one of said tubes, a relay for operation in response to the ionization of the other of said tubes, and means for alternately connecting each of said relays to its associated tube for operation in response to impulses in said circuit.

9. In combination, an impulse circuit, two three-element gas-filled tubes, circuit means for operatively associating said tubes with said circuit, a relay for operation in response to the ionization of one of said tubes, a relay for operation in response to the ionization of the other of said tubes, and means for alternately connecting each of said relays to its associated tube for operation in response to impulses in said circuit, the cathode-anode circuit of each of the tubes being under the control of the relay associated with the other of the tubes.

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