March 24, 1936. F. K. LOW 2,034,874

SIGNALING SYSTEM

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FIG. 1

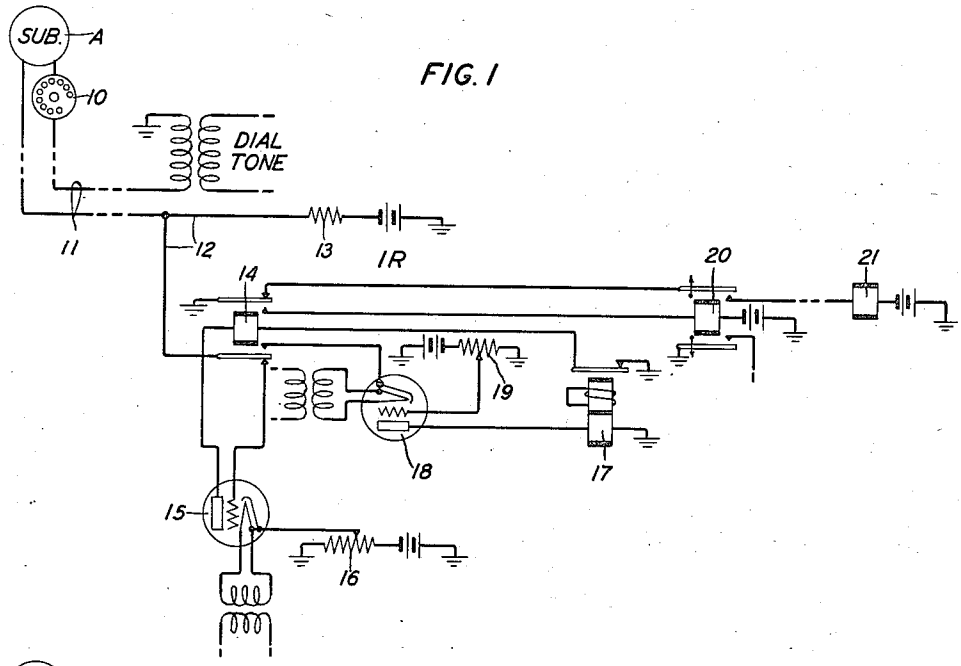
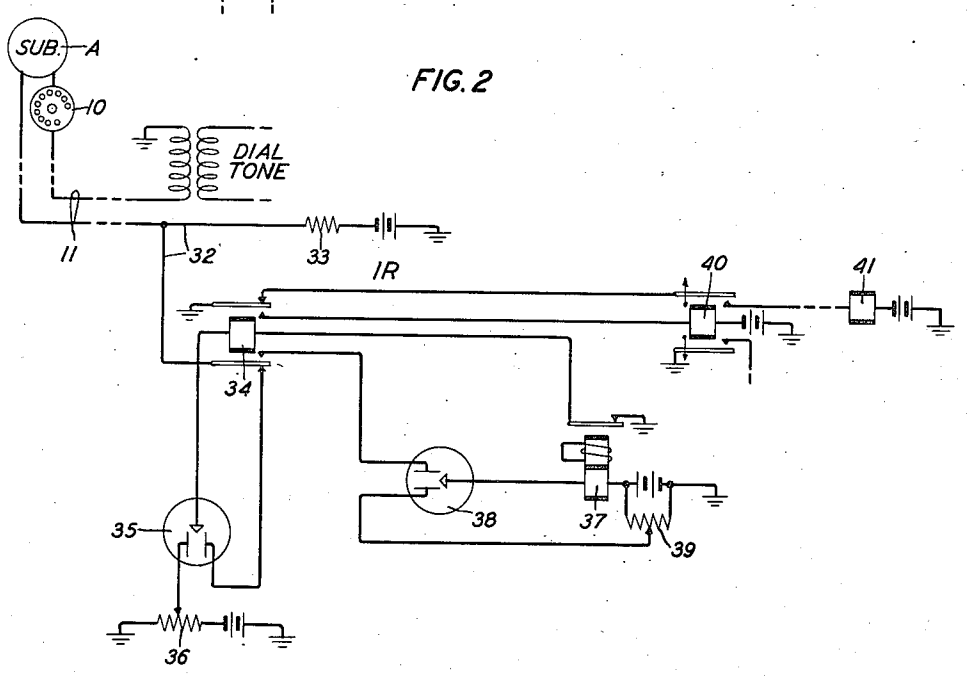


FIG. 2



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SIGNALING SYSTEM

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6 Claims. (Cl. 179—16)

This invention relates to signaling systems and particularly to signaling systems comprising an electrical signaling circuit.

The object of the invention is is to provide a more sensitive electrical signal receiving means and to insure the accurate response of such a means to incoming signals.

The invention is an impulse signal responsive device comprising a signal receiving relay under the control of two three-element ionic tubes, one of the tubes being normally connected by the signal receiving relay for response to the closing of a signaling circuit and the other tube being connected by the operation of the signal receiving relay for response to the opening of the signaling circuit.

A better and 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 two 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 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 1,395,977 granted to F. A. Stearn et al, November 1, 1921, for a description of a system comprising switches of the power-driven panel 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, shown in Fig. 1 of the drawing, comprises a three-element gas-filled ionic tube 15 and relay 14 for operation in response to the closing of the signal impulse circuit through resistor 13, a similar ionic tube 18 and relay 17 for operation in response to the opening of the aforementioned impulse circuit, and a slow-to-release relay 20 for operatively connecting the contacts of impulse relay 14 to an associated register or selector 21. Each of the ionic tubes 15 and 18 is a hot-cathode type tube filled to a low pressure with a gas such as neon, argon or helium. The cathodes may be either directly or indirectly heated, although the tubes 15 and 18 are shown in the drawing as having a cathode indirectly heated by connection with an alternating current source. For a more complete description of an ionic tube of this nature reference may be had to an article entitled "Hot-Cathode Thratrons" by A. W. Hull published in General Electric Review, volume 33, pages 213 to 223 inclusive and to Patent 1,921,004, granted to A. L. Samuel August 8, 1933.

Upon extension of the line 11 to the impulse receiving means IR, in response to the removal of the receiver at station A to originate a call, an impulse circuit is closed from the negative pole of the central office battery, (the positive pole of which is connected to ground) through resistor 13, over conductor 12 and line 11, through the telephone instrument and dial 10 at station A, and through one winding of the dial tone transformer to ground. The difference in potential normally existing between the anode and cathode of tube 15, due to the connection of the anode through the winding of relay 14 to ground at the back contact of relay 17 and the connection of the cathode to a point of the potentiometer 16, while sufficient to maintain the energization of the tube, is insufficient to alone cause ionization of the gas; and with the grid or control element normally at a negative potential with respect to the cathode, due to its connection through the lower back contact of relay 14 and resistor 13 to the negative pole of battery, ionization of the gas is normally prevented. When, however, the above mentioned impulse circuit is closed, the drop in potential through resistor 13, raises the potential of the grid to allow ionization so that the gas becomes a conductor between the anode and cathode. The cathode to anode current energizes the winding of relay 14 to cause the operation of this relay. In operating, relay 14

closes a circuit for operating the slow-to-release relay 20 and tranfers conductor 12 from the grid of tube 15 to the cathode of tube 18. The disconnection of conductor 12 from the grid of tube 15 has no effect, the cathode to anode current, once started, continuing unaffected by any change in the grid potential. As long as the impulse circuit remains closed, the potential of conductor 12 impressed, through the lower front contact of relay 14, on the cathode of tube 18 is not enough lower than the potential impressed, through the lower winding of relay 17, on the anode of tube 18 to cause energization of the tube; and the potential impressed on the grid or control element of tube 18, due to the connection of this element to a point of the potentiometer 19, being negative with respect to the cathode, ionization of the gas is prevented. Relays 14 and 20 remain operated and no further action occurs until the subscriber at station A dials the number of another station with which a talking connection is desired.

Upon the opening of the impulse circuit at the contacts of dial 10 to transmit the first dial impulse, the potential of conductor 12 and cathode of tube 18 is decreased (made more negative) so that the grid of the tube becomes positive with respect to the cathode, and the resulting ionization of the gas causes a cathode-anode current which is effective to energize the lower winding of relay 17 and thus cause its operation. In operating, relay 17 opens the cathode-anode circuit of tube 15 thereby causing the deionization of this tube and the release of relay 14. With relay 14 released the cathode-anode circuit of tube 18 is opened and the potential of conductor 12 is again impressed on the grid of tube 15; but, this potential being negative with respect to the cathode of tube 15 as long as the impulse circuit is held open at the contacts of dial 10, the tube 15 is not immediately reenergized. The release of relay 14 closes a circuit through its upper back contact and the upper front contact of relay 20 for operating the register or selector 21 in response to the first impulse created by the dial. Relay 20, being slow in releasing remains operated during the response of relay 14 to dial impulses. The aforementioned opening of the cathode-anode circuit of tube 18 causes the deionization of tube 18 and the release of relay 17. Due to the short-circuited upper winding of relay 17, this relay is somewhat slow in releasing so that the grid of tube 15 is sure to have been reconnected through the back contact of relay 14 to conductor 12 before ground potential is reconnected through the upper back contact of relay 17 to the anode of tube 15. As soon as the impulse circuit is again closed by the dial contacts, at the end of the first impulse of the series, the potential of conductor 12 and grid of tube 15 is again increased so as to become less negative with respect to the cathode; and the resulting ionization of tube 15 causes its reenergization and the reoperation of relay 14. The above-described cycle of operations is repeated in response to each succeeding impulse created by the opening and closing of the impulse circuit, the register or selector 21 being operated in response to each of the impulses in the series. Upon disconnection of the calling line from the impulse receiving means IR, the energization of tube 18 and operation of relay 17 causes the deenergization of tube 15 and release of relay 14. The release of relay 14 then causes the deenergization of tube 18 and release of relay 17 and also causes the release of relay 20 thus completing the restoration of the impulse receiving means to normal.

The impulse receiving means IR, shown in Fig. 2 of the drawing differs from that shown in Fig. 1 only in that the tubes are of the cold-cathode type. For a description of one such tube, reference may be had to Patent 1,784,869, granted to F. Gray, December 16, 1930. The tube 35 is energized and relay 34 operated upon closing of the impulse circuit through resistor 33, conductor 32, and the line 11. Relay 34 closes the circuit for operating the slow-to-release relay 40. The operation of relay 34 also transfers conductor 32 from the grid or control element of tube 35 to the cathode of tube 38, the control element of tube 38 being biased to prevent breakdown until the impulse circuit is opened. The tube 35 and relay 34 remain energized until the impulse circuit is opened at the contacts of the dial to transmit the first impulse of a series, whereupon the potential of conductor 32 and cathode of tube 38 is decreased to cause breakdown of the tube and operation of relay 37. The operation of relay 37 causes the deenergization of tube 35 and release of relay 34. The release of relay 34 closes the circuit for operating the register or selector 41. The release of relay 34 also causes the deenergization of tube 38 and release of relay 37. Relay 37 has a short-circuited winding as does relay 17 of Fig. 1. When the impulse circuit is again closed at the end of the dial impulse, tube 35 is reenergized and relay 34 reoperated. The response of tubes 35 and 38 and relays 34 and 37 to each dial impulse of the series effects the operation of the register or selector 41. When the calling line is disconnected from the impulse responsive means IR, tube 38 is reenergized and relay 37 operated, tube 35 deenergized and relay 34 released, and tube 38 deenergized and relay 37 released in the order named. The continued release of relay 34 causes the release of relay 40.

What is claimed is:

1. In a signaling system, a line, a signal sender, signal receiving means comprising two ionic tubes, means for operatively connecting said line to one of said tubes, and means responsive to the operation of said one tube for transferring said line from said one tube to the other of said tubes.

2. In a signaling system, a line, a signal sender, signal receiving means comprising two ionic tubes, a circuit including said line and sender, and means for connecting said line to said tubes so that one of said tubes is operatively responsive to the closing of said circuit and the other tube is responsive to the opening of said circuit.

3. In a signaling system, a line, a signal sender, signal receiving means comprising two ionic tubes, a circuit including said line and sender, and a relay for connecting said line to the one or the other of said tubes, the connection of said line to one tube being adapted to cause the tube to respond to the closing of said circuit and the connection of said line to the other tube being adapted to cause the tube to respond to the opening of said circuit.

4. In a signaling system, a line, a signal sender, signal receiving means comprising two ionic tubes, a circuit including said line and sender, and a relay for connecting said line to the one or the other of said tubes, the connection of said line to one tube being adapted to cause the tube to respond to the closing of said circuit and the connection of said line to the other tube being adapted to cause the tube to respond to the

opening of said circuit, said relay being operatively responsive to the operation of said one tube.

5. In a signaling system, a line, a signal sender, signal receiving means comprising two ionic tubes, a circuit including said line and sender, and a relay for connecting said line to the one or the other of said tubes, the connection of said line to one tube being adapted to cause the tube to respond to the closing of said circuit and the connection of said line to the other tube being adapted to cause the tube to respond to the opening of said circuit, said relay being operatively responsive to the operation of said one tube, and another relay operatively responsive to the operation of said other tube.

6. In a signaling system, a line, a signal sender, signal receiving means comprising a first relay, a second relay and two three-element ionic tubes, a battery, a resistance, a first circuit including said battery, resistance, line and sender in series, normally closed contacts of said first relay for operatively connecting one of said tubes to the junction point between said resistance and line, normally open contacts of said first relay for operatively connecting the other of said tubes to said junction point, a second circuit including the anode of said one of the tubes and the winding of said first relay and normally closed contacts of said second relay, and a third circuit including the anode of said other tube and the winding of said second relay.

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