

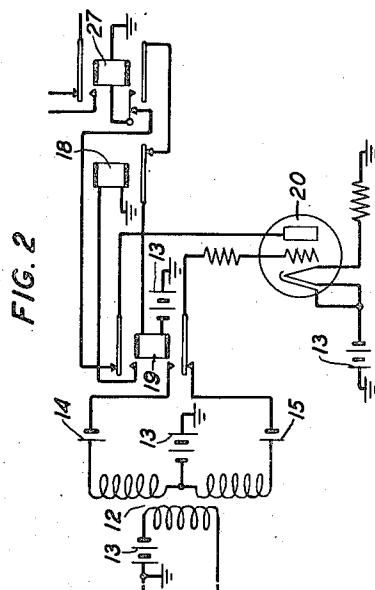
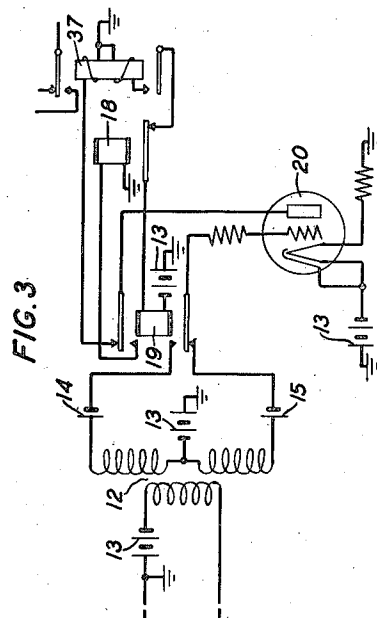
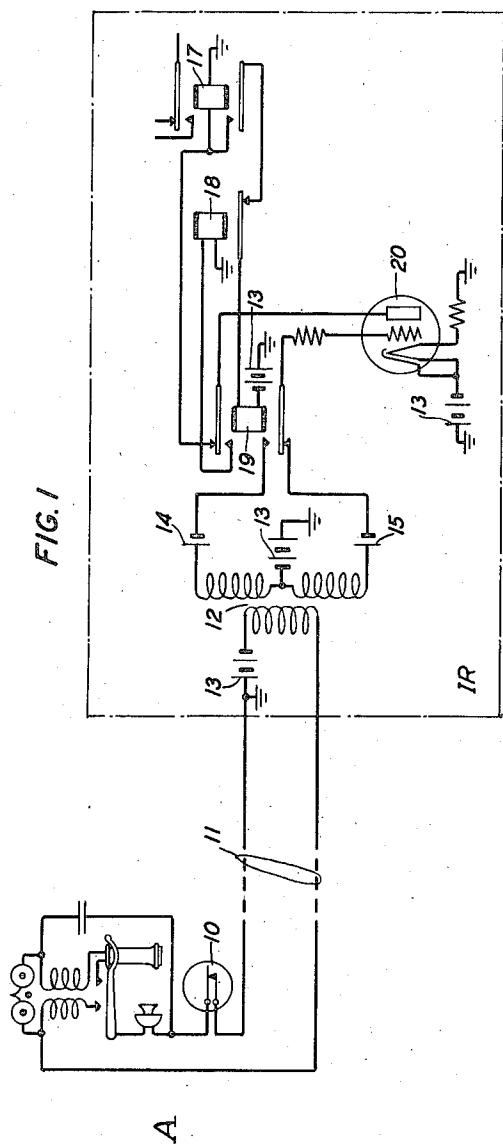
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## SIGNALING SYSTEM

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## SIGNALING SYSTEM

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This invention relates to signaling systems and particularly to systems in which automatic switches are directly 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, a 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 is energized in response to the opening of the signaling circuit to operate a second relay, means being provided for transferring the anode of the tube from one of these relays to the other in response to the operation of the one which is, at the time in question, connected to the anode. The impulse receiving relay may be effective to control a circuit for directly operating an automatic switch, may be effective to control impulse receiving means in another signaling circuit, or may be effective to operate an impulse register.

A feature of the invention is an impulse receiving device comprising a transformer, a three-element gas-filled tube, a relay controlled by the tube for operation in response to the closing of an incoming impulse circuit which includes a winding of the transformer, another relay controlled by the tube for operation in response to the opening of the incoming impulse circuit, and a switching relay for alternately rendering the tube effective to control the one and then the other of the two relays which respond to the closing and opening of the impulse circuit. The control element of the tube is connected through a back contact of the switching relay to one secondary winding of the transformer and through a front contact of the switching relay to another secondary winding of the transformer. The anode of the tube is connected through a back contact of the switching relay to the winding of the relay which responds to the closing of the incoming impulse circuit and through a front contact of the switching relay to the winding of the relay which responds to the opening of the impulse circuit.

A more complete understanding of the invention may be obtained by considering specific embodiments of the invention shown schematically 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 Fig. 1 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 or an equivalent impulse sender and is connected by a 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 comprises the transformer 12, the three-element ionic tube 20, the impulse relay 17 and auxiliary relays 18 and 19. The transformer has three windings, the primary winding being connected in series with the central office battery 13 and the line 11. The two secondary windings are alternately connected to the grid or control element of the tube by contacts of the auxiliary relay 19. The tube 20 is filled to a low pressure with a gas such as neon, argon or helium; and the electrodes 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. The potential required across the cathode and anode to maintain the energization of the tube is less than that which is required to cause the energization of the tube. The battery 13 applies the energy for heating the cathode of tube 20 and also maintains the cathode at a negative

potential with respect to the anode. The grid of the tube being connected to the battery 13 is also normally at a negative potential with respect to the anode; and, if necessary to further reduce the normal potential difference between the grid and cathode, batteries 14 and 15 are provided.

Upon extension of the line 11 to the impulse receiving means IR, a circuit is closed from the central office battery 13 through the primary winding of the transformer 12 over the lower conductor of line 11, through the instrument and dial 10 at station A, back over the upper conductor of line 11 to ground. The closing of this circuit induces an electromotive force in the upper and lower secondary windings of transformer 12. The electromotive force induced in the lower secondary winding is momentarily effective to render the grid element of tube 20 less negative, the difference in potential between the cathode and grid of the tube being increased sufficiently to cause ionization of the gas and the starting of a current between the cathode and anode and through the winding of impulse relay 17. In operating, relay 17 closes a circuit from battery 13 through the winding of relay 19, back contact of relay 18, and lower front contact of relay 17, to ground through the winding of relay 17. The current in this circuit is effective to operate relay 19, thereby transferring the anode of the tube from the winding of relay 17 to the winding of relay 18 and the grid of the tube from the lower to the upper secondary winding of transformer 12. The tube deenergizes when relay 17 operates due to being shunted by the winding of relay 19 or deenergizes when the anode is transferred by the operation of relay 19. The tube does not immediately reenergize since the electromotive force induced by the closing of the dialing circuit in the upper secondary winding of transformer 12 makes the grid more negative instead of less negative; furthermore, the induced electromotive force is of short duration. Relay 17 remains operated in series with relay 19, and at its upper contact closes a circuit for operating the line relay of a selector switch or for preparing an impulse register for operation.

When the dial 10 is operated, it interrupts the circuit over line 11 as many times as there are units in the digit dialed. The opening of the circuit induces an electromotive force in the secondary windings of transformer 12 in the opposite direction to that which is induced when this circuit is closed. The electromotive force thus induced in the upper winding renders the grid element of tube 20 less negative, the tube energizes, and relay 18 is operated. The operation of relay 18 causes the release of relays 17 and 19 thereby transferring the anode of tube 20 from the winding of relay 18 to the winding of relay 17, the tube being deenergized during the transfer. The release of relay 19 also transfers the grid of tube 20 from the upper to the lower secondary winding of transformer 12. When the circuit over line 11 is again closed by the contacts of dial 10 after creating the first dial impulse, the electromotive force induced in the lower secondary winding of transformer 12 again causes the energization of tube 20 and the reoperation of relays 17 and 19 as hereinbefore described; and the reoperation of relay 19 causes the release of relay 18. Thus it is apparent that each opening of the dial contacts causes the energization of tube 20, the operation of relay 18

and the release of relays 17 and 19; and that each closing of the dial contacts causes the energization of tube 20, the operation of relays 17 and 19 and the release of relay 18.

The release and reoperation of relay 17 in response to each impulse created by the operation of dial 10 causes the impulse to be repeated to operate a selector switch or to cause the impulse to be registered if the system is one employing a register controller.

The arrangement shown in Fig. 2 is exactly the same as that shown in Fig. 1 except that the impulse relay 17 of Fig. 1, which relay has a single lower front contact, is replaced by the impulse relay 27 which has a make-before-break combination. By the use of this spring combination the cathode to anode resistance is only momentarily shunted by the winding of relay 19 when relay 27 operates, and the possibility of the tube 20 being extinguished, before the operation of relay 19 is assured, is thereby reduced.

The arrangement in Fig. 3 is a further improvement over the arrangements shown in Figs. 1 and 2, the impulse relay 37 having a locking winding for connection in series with the winding of relay 19. The possibility of the tube 20 being extinguished, before the operation of relay 19 is assured, is thereby entirely eliminated.

What is claimed is:

1. In combination, an impulse circuit, a three-element gas-filled tube, a first relay controlled by said tube, a second relay controlled by said tube, an impulse circuit controlled by said first relay, means responsive to impulses in said first impulse circuit for changing the potential of the control element of said tube to energize said tube, and switching means controlled by said relays for transferring the anode of said tube from the winding of one of said relays to the winding of the other of said relays.

2. In combination, a circuit, means for opening and closing said circuit, a three-element gas-filled tube, a first relay, a second relay, circuit means including said tube for causing the operation of said first relay in response to the closing of said circuit, and circuit means including said tube for causing the operation of said second relay in response to the opening of said circuit, the operation of said second relay being effective to cause the release of said first relay and the release of said first relay being effective to cause the release of said second relay.

3. In combination, a circuit, means for opening and closing said circuit, a three-element gas-filled tube, a relay for operation in response to the closing of said circuit, a relay for operation in response to the opening of said circuit, and means comprising a third relay for operatively associating the first mentioned relays, one at a time, with said tube and said circuit.

4. In combination, a circuit, means for opening and closing said circuit, a three-element gas-filled tube, a relay for operation in response to the closing of said circuit, a relay for operation in response to the opening of said circuit, and means comprising a third relay for operatively associating the first mentioned relays, one at a time, with said tube and said circuit, said third relay being controlled by said first mentioned relays.

5. In combination, a circuit, signal means for opening and closing said circuit, a three-element gas-filled tube, two relays, means including said tube for operating one of said relays upon the closing of said circuit, means including said tube

for operating the other of said relays upon the opening of said circuit, and another circuit, said tube and relays being effective to close said other circuit in response to the closing of said first mentioned circuit and effective to open said other circuit in response to the opening of said first mentioned circuit.

6. In combination, a three-element gas-filled tube, a first circuit, means for closing and opening said first circuit, a second circuit, a relay for closing and opening said second circuit, the winding of said relay being normally connected to the anode of said tube, a relay for controlling said first relay, a third relay for operation in response to the operation of said first mentioned relay to transfer the anode of said tube from the winding of said first mentioned relay to the winding of said second mentioned relay, and means for changing the potential of the control element of said tube in response to the opening and closing of said first circuit.

7. In combination, a first circuit, means for opening and closing said first circuit, a first relay, a second relay, means including a three-element gas-filled tube for causing the operation of said first relay in response to the closing of said first circuit, means including said tube for causing the operation of said second relay in response to the opening of said first circuit, and a third relay for operatively associating the winding of said second relay with said tube in response to the operation of said first relay and for operatively associating the winding of said first relay with said tube in response to the operation of said second relay.

8. In combination, an incoming impulse circuit, an outgoing impulse circuit, a transformer having a primary winding and two secondary windings, the primary winding being included in said incoming impulse circuit, a three-element gas-filled tube, the control element of said tube being normally connected to one of said secondary windings, a first relay having contacts in said outgoing impulse circuit, the winding of said first relay be-

ing normally connected to the anode of said tube, a second relay for responding to the opening of said incoming impulse circuit and for thereupon causing the release of said first relay, and a third relay responsive to the operation of said first relay for transferring the grid of said tube from said one of the secondary windings of the transformer to the other of said secondary windings and for transferring the anode of said tube from the winding of said first relay to the winding of said second relay.

9. In combination, an incoming impulse circuit, an outgoing impulse circuit, a transformer having a primary winding and two secondary windings, the primary winding being included in said incoming impulse circuit, a three-element gas-filled tube, the control element of said tube being normally connected to one of said secondary windings, a first relay for controlling said outgoing impulse circuit, the winding of said first relay being normally connected to the anode of said tube, a second relay for responding to the opening of said incoming impulse circuit to cause the release of said first relay, and a third relay responsive to the operation of said first relay for transferring the control element of said tube from said one to the other of the secondary windings of the transformer and for transferring the anode of said tube from the winding of said first relay to the winding of said second relay and responsive to the operation of said second relay for transferring the control element of said tube from said other to said one of the secondary windings of the transformer and for transferring the anode of said tube from the winding of said second relay to the winding of said first relay.

10. In combination, an impulse circuit, a three-element gas-filled tube, said circuit being operatively connected to said tube, two relays, and means for alternately connecting said relays to said tube for operation in response to impulses in said circuit, and an impulse register controlled by said relays.

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