Aug. 1, 1944. G. DEAKIN ET AL 2,354,667

ELECTRIC SELECTION CONTROLLING CIRCUIT

Filed May 6, 1943 2 Sheets-Sheet 1

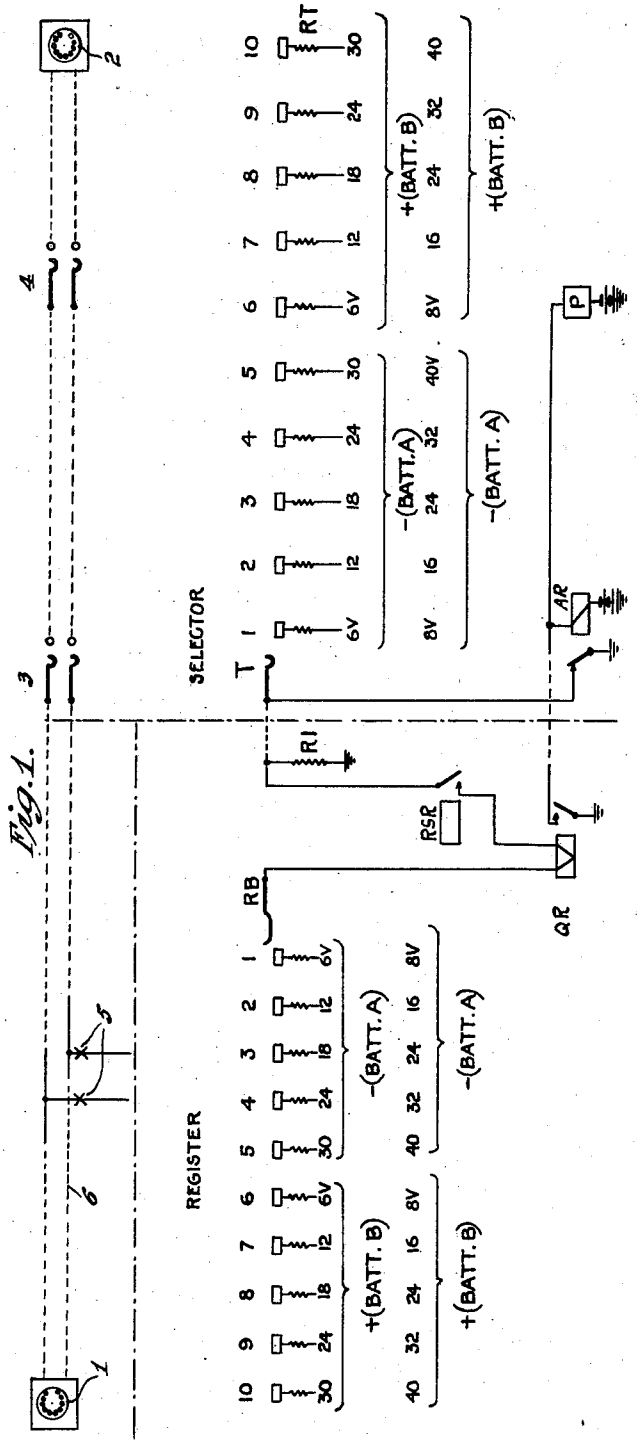


Fig. 1.

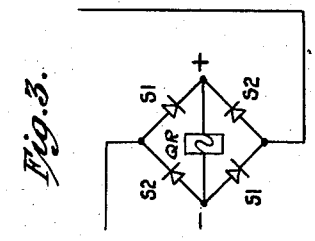


Fig. 3.

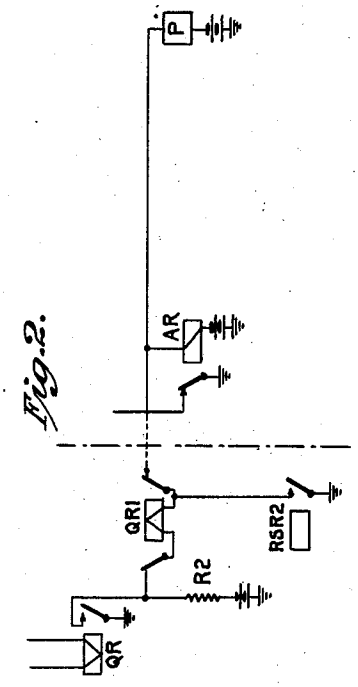


Fig. 2.

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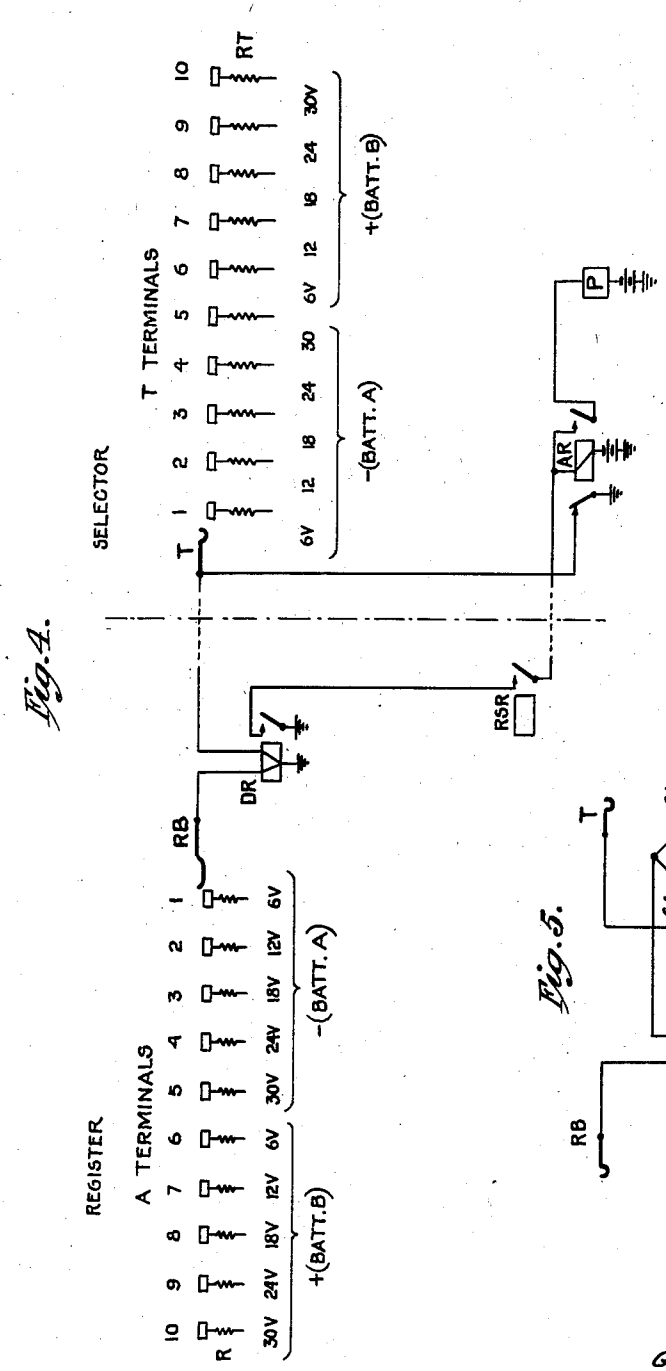


Fig. 4.

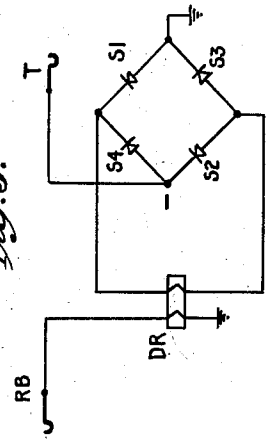


Fig. 5.

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ELECTRIC SELECTION CONTROLLING CIRCUIT

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Application May 6, 1943, Serial No. 485,828

13 Claims. (Cl. 179—18)

This invention relates to new and useful improvements in selection control circuits and more particularly to circuits for controlling the numerical selecting operation of selector switches employed in automatic telephone exchange systems.

The present is an improvement on the control circuits disclosed in the co-pending application of Gerald Deakin Serial No. 484,184, filed April 23, 1943, and in the various applications and patents referred to therein.

The invention will be explained with reference to Figs. 1 to 5 of the drawings which diagrammatically illustrate five modifications of as much of a control circuit, embodying the various features of the present invention, as is necessary for a clear understanding thereof.

In an automatic telephone system calling and called subscribers' stations 1 and 2 may be interconnected by means including a plurality of selector switches 3 and 4. The numerical operations of the selectors are controlled by the calling subscriber's customary impulse sender or other number indicating device through the agency of a register provided at the central exchange. The calling station 1 is connected to the brushes of selector 3 by non-numerical switches and a connecting circuit 6, and the register is attached to the connecting circuit 6 through switching means 5.

The selector switches are of the customary type having a bank of terminals with which a set of brushes cooperates. In the drawings three brushes are shown for selector 3 although the selector may have a larger number of brushes. The selector brushes are moved over the terminals while a magnet P is energized and are stopped on a set of terminals when this magnet becomes de-energized.

The register comprises a series of switches successively operable by the calling device in accordance with the successive digits of the called number. A brush and a set of terminals of one of these register switches is shown in Fig. 1. This is the register switch which responds to the digit destined for selector 3. When brush RB is advanced towards one of the terminals 1 to 10, in accordance with the operation of the calling device at the station 1, the register starting relay RSR, having been energized in the customary manner, a circuit is closed from ground over the armature and back contact of relay AR in the selector 3, the contacts of preceding selectors, the armature and front contact of relay RSR in the register, the winding of a relay QR, brush RB, the terminal engaged by the brush and positive or negative grounded battery of the voltage indicated below these terminals. QR operates and closes an energizing circuit for relay AR and the selector magnet P in parallel.

The magnet P starts the brushes of the selector to move over the terminals. Upon its energization relay AR removes the ground from the circuit of QR. However, once this relay pulls up it remains energized over resistance R_1 to ground, although it cannot become energized when RSR first closes its circuit to ground over R_1. Thus QR cannot release while the brush T travels from one terminal to the next.

Preferably, the relay QR has a core which is fully saturated when connected in a circuit having a minimum potential difference, e. g. between six volts and ground. When the relay core is not fully saturated in such circuit then its releasing time will vary after greater magnetization. The core may be of any suitable material requiring a minimum of magnetizing flux.

In this connection it should be noted that brush RB remains in contact with a terminal when it first touches the next terminal, but brush T cannot bridge adjacent terminals.

The first terminal engaged by the brush T of selector 3 is connected over a resistance to a six volt tap of negative battery. If the brush RB is resting on the first terminal which is also connected to six volt negative battery, or if brush RB rests on another terminal, then when the selector brush T reaches the terminal to which the same potential is connected as the potential connected to the register switch terminal, then no current or insufficient current will flow through the winding of relay QR to maintain it energized and this relay will become de-energized. It will open the circuits of relay AR and magnet P whereupon the selector is stopped and the relay AR makes the multiples of the terminal of which selector brush T rests busy by applying ground thereto over its armature and back contact in the usual way.

The D. C. voltage applied to adjacent terminals of the register and selector switches may differ by six or eight volts. The first five terminals are connected to negative and the second five to positive poles of the battery.

As shown in Fig. 1, the relay QR controls directly in its front contact the circuits of relay AR and magnet P and thus breaks considerable current upon its de-energization. In order to avoid this, the arrangement shown in Fig. 2 may be adopted. When the relay QR energizes, it closes a shunt circuit from ground over its armature and front contact, the back contact and left-hand armature

and the winding of a second relay QR_1 and the front contact and armature of a relay RSR_2 which at this time is energized in the register. While this condition prevails, the relay QR_1 cannot become energized and the selector relay AR and magnet P are maintained energized by ground over the front contact of RSR_2 and the right armature and back contact of QR_1. The relay QR is connected to the register and selector brushes in the same manner as shown in Fig. 1.

When the selector and register brushes engage terminals connected to the same potential, then the relay QR becomes energized, removes the shunt from the winding of QR_1 and permits this relay to energize over resistance R_2. QR_1 opens the circuit of AR and P whereupon the selector is stopped. QR_1 immediately becomes de-energized, but in the meantime RSR_2 became de-energized.

In the arrangements shown in Figs. 1 and 2, the polarity of the current flowing through relay QR reverses as the selector brush T and the register brush RB move from one terminal to the next. In order to guard against a tendency for relay QR to fall off during these reversals, it may be placed in a rectifier bridge as shown in Fig. 3. Rectifiers S_1 and S_2 which are provided in the arms of this bridge are so poled that the current flow through the winding of QR will always be in the same direction.

Although some cross-talk may exist on account of the appreciable current which flows over the wire connected to brush T when this brush passes over the terminals at high speeds, e. g., 100 terminals per second, the circuits shown in Figs. 1–3 have the merit of their simplicity and the absence of vacuum tubes or a high tension battery, and are thus particularly suited for P. B. X and similar installations.

In the arrangement shown in Fig. 4, when the register brush RB is set on a terminal then relay DR operates over one winding to ground. Upon the energization of RSR, the selector is operated in the usual way. When the selector brush T reaches the terminal to which battery of the same potential is connected as to the register terminal, then the relay DR falls away because its two windings are differentially disposed and so designed that under this condition, and only under this condition, equal and opposite magnetizing forces will be developed. The selector will thus be stopped.

As shown in Fig. 5, the right-hand winding of relay DR which is connected with the selector brush T is placed in a rectifier bridge so as to keep the flow of current through it always in the same direction for the reasons pointed out in connection with Fig. 3.

What is claimed is:

1. In combination, a selector switch having two sets of cooperating contacts, a magnet for operating said contacts, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage them, means for operating the brush to engage any terminal, a relay in said register, a control circuit extending from the brush of the register to the first set of contacts of the selector and including the relay, a source of potential, connections for applying the same potentials to the terminals and to the second sets of selector contacts, there being a predetermined difference between potentials applied to adjacent terminals and adjacent contacts, said relay being arranged to respond only when the first set of selector contacts and the register brushes engage contacts and terminals, respectively, to which the same potentials are applied, and an operating circuit for the magnet controlled by said relay.

2. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage them, means for variably operating the brush of the register switch, a relay in said register, a control circuit extending from the register switch brush to a brush of the selector and including said relay, a source of potential, connections for applying the same potentials to the register and selector terminals, there being a predetermined difference between potentials applied to adjacent terminals, said relay being arranged to respond only when the selector and register brushes engage terminals to which the same potentials are applied, and an operating circuit for the magnet controlled by said relay.

3. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a relay in said selector, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage them, means for variably operating the brush of the register switch, a relay in said register, a control circuit extending from the register switch brush to a brush of the selector and including the register relay, a source of potential, connections for applying the same potentials to the register and selector terminals, there being a predetermined difference between potentials applied to adjacent terminals, said register relay being arranged to respond only when the selector and register brushes engage terminals to which the same potentials are applied, operating circuits for the selector relay and magnet controlled by said register relay, and a path for applying a predetermined potential to the control circuit controlled by the selector relay.

4. The system according to claim 3, and in which a second relay is provided in said register, the circuit for the selector relay including a contact of the second relay, a third relay in the register for controlling the energizing circuit of said second relay, and a short circuit for the second relay controlled by the first register relay.

5. In combination, a plurality of numerically designated lines, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage them, means for variably operating the brush of the register switch in accordance with a digit of the called number, a relay in said register, a control circuit extending from the register switch brush to a brush of the selector and including rectifiers and said relay, a source of potential, connections for applying the same potentials to the register and selector terminals, there being a predetermined difference between potentials applied to adjacent terminals, said relay being arranged to respond only when the selector and register brushes engage terminals to which the same potentials are applied,

and an operating circuit for the magnet controlled by said relay.

6. The system according to claim 5, and in which said control circuit includes a rectifier bridge across the diagonals of which a winding of said relay is connected.

7. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage them, means for variably operating the brush of the register switch, a relay in said register having two differential windings, a control circuit extending from the register switch brush to a brush of the selector and including the relay, a source of potential, connections for applying the same potentials to the register and selector terminals, there being a predetermined difference between potentials applied to adjacent terminals, said relay windings being arranged to respond only when the selector and register brushes engage terminals to which the same potentials are applied, and an operating circuit for the selector relay and magnet controlled by said relay.

8. The system according to claim 7, and in which said control circuit includes a rectifier bridge across which one winding of said relay is connected.

9. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a relay in said selector, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage the terminals, means for variably operating the brush of the register switch, a first relay in said register having a core which is fully saturated when connected in a control circuit having a predetermined minimum potential difference, a second relay in said register having a contact connecting the winding of said first relay in a control circuit extending from the register switch brush to a brush of the selector, ground connected to said control circuit over a resistance of such value that the first relay, if energized, remains energized, sources of negative and positive D. C. potential, connections applying to a first group of terminals of the register and selector switches positive potentials differing one from the next by a predetermined voltage, and for applying to an adjacent second group of terminals negative potentials differing from one another by said predetermined voltage, parallel energizing circuits for the magnet and selector relay including a contact of the first register relay, and a path from the control circuit to ground over a contact of the selector relay.

10. The system according to claim 9, and in which said control circuit includes a rectifier bridge across which the winding of said first relay is connected.

11. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a relay in said selector, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage the terminals, means for variably operating the brush of the register switch in accordance with a numerical digit, a first relay in said register having a core which is fully saturated when connected in a control circuit having a predetermined minimum potential difference, a second relay in said register having a contact connecting the winding of said first relay in a control circuit extending from the register switch brush to a brush of the selector, ground connected to said control circuit over a resistance of such value that the first relay, if energized, remains energized, sources of negative and positive D. C. potential, connections applying to a first group of terminals of the register and selector switches, positive potentials differing one from the next by a predetermined voltage, and for applying to an adjacent second group of terminals negative potentials differing from one another by said predetermined voltage, a third and a fourth relay in said register, an energizing circuit for said third relay including a contact of the fourth relay, a short-circuit for said third relay including a contact of the first relay, parallel energizing circuits for the magnet and selector relay including contacts of the third and fourth register relays, and a path from the control circuit to ground over a contact of the selector relay.

12. In combination, a numerical selector switch having a terminal bank containing sets of terminals and a set of brushes adapted successively to engage said terminals, a magnet for operating said brushes, a relay in said selector, a register comprising a switch having a plurality of terminals and a brush adapted successively to engage the terminals, means for variably operating the brush of the register switch in accordance with a numerical digit, a first relay in said register having two differential windings connected to ground and one to the selector brush and the other to the register brush, a second relay in said register having a contact connecting a contact of said first relay to the circuits of the selector relay and magnet, sources of negative and positive D. C. potential, connections applying to a first group of terminals of the register and selector switches, positive potentials differing one from the next by a predetermined voltage, and for applying to an adjacent second group of terminals negative potentials differing from one another by said predetermined voltage, and a path from the selector brush to ground over a contact of the selector relay.

13. The system according to claim 12, and in which a rectifier bridge is inserted in the connection of the relay winding connected to the selector brush.

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