June 16, 1942. K. L. FREDERICK 2,286,799

SWITCHING MECHANISM

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FIG. 1

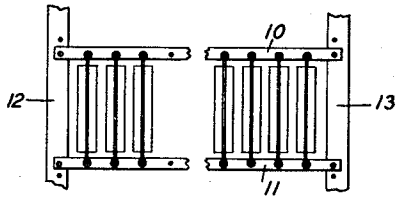

FIG. 2

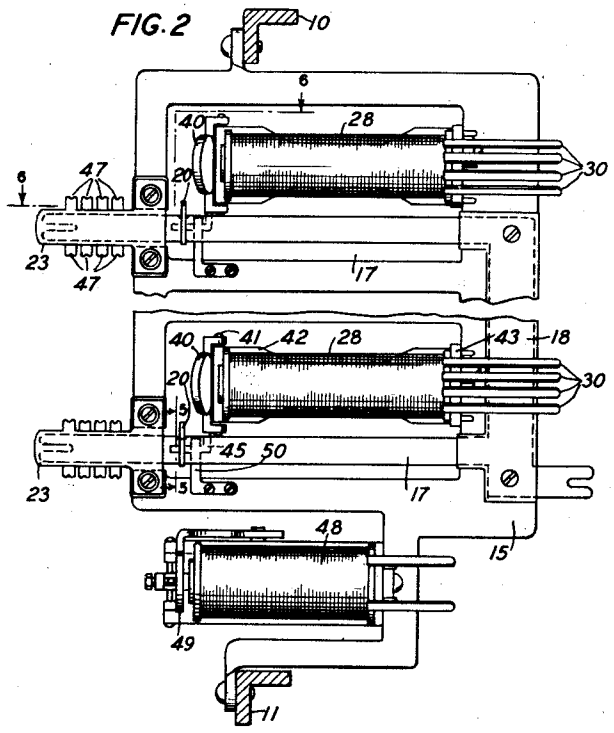

FIG. 3

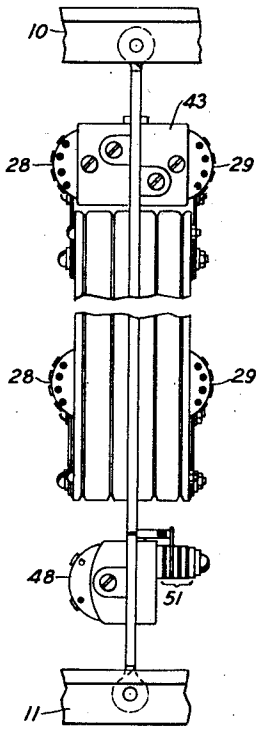

FIG. 5

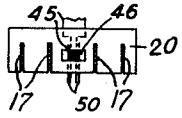

FIG. 4

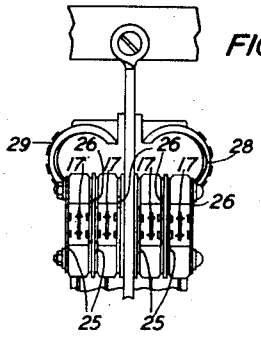

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FIG. 6

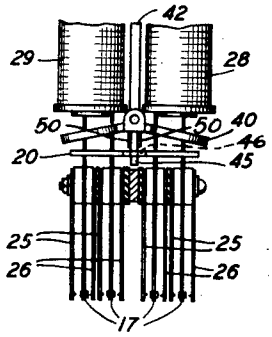


FIG. 7

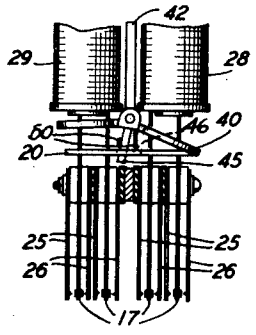


FIG. 8

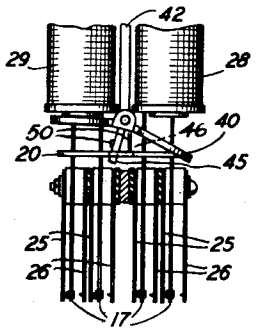
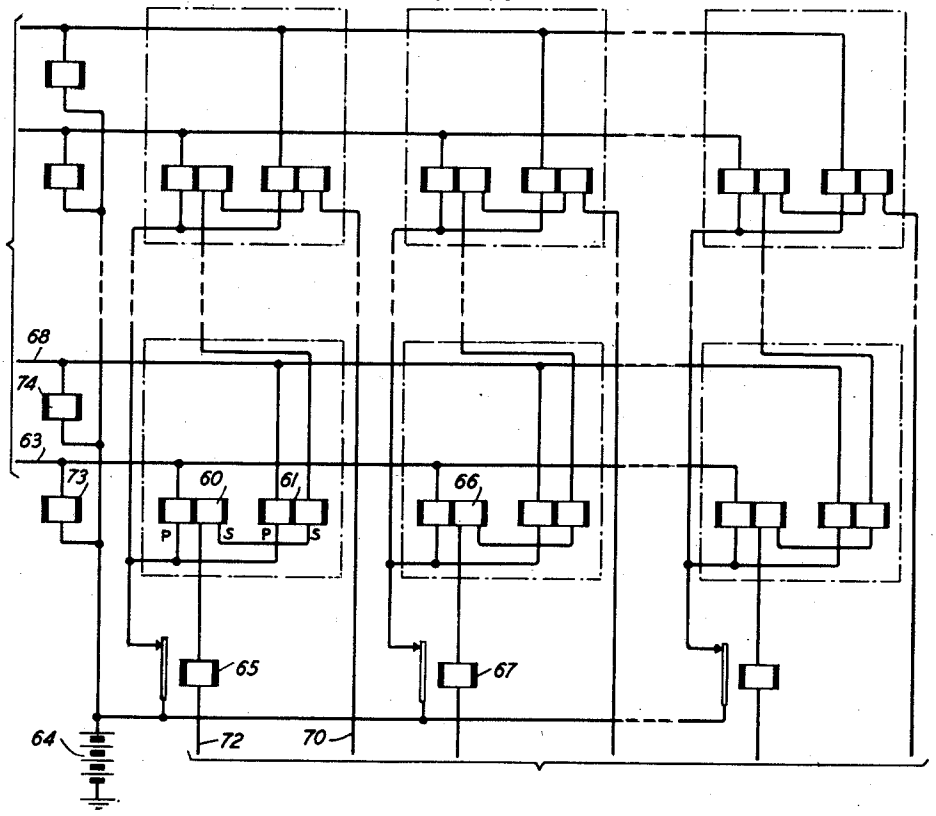


FIG. 9



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UNITED STATES PATENT OFFICE

2,286,799

SWITCHING MECHANISM

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Application August 2, 1940, Serial No. 349,672

8 Claims. (Cl. 179—27.54)

This invention relates to switching mechanisms and particularly to automatic switching devices of the type used in telephone systems.

An object is to simplify and reduce the number of construction details of such switches and to reduce the operating and maintenance cost thereof.

The invention has been applied to a switch structure that partakes to some extent of the principles of the cross-bar type of switch as well as of the so-called all-relay types of switches.

It is a feature of the applicant's invention to arrange operating magnets in pairs at cross-points of vertical and horizontal rows and to have horizontal and vertical rows of contacts controlled by said magnets so that the operation of one or the other magnet at a cross-point causes connections to be established between a set of vertical contacts and one or the other of two sets of horizontal contacts at said cross-point.

Another feature is an arrangement whereby each magnet is provided with a primary and a secondary winding and whereby the operation of a primary winding followed by the operation of the secondary winding causes the full energization of the magnet to establish a connection, and whereby when the circuit for the secondary winding is closed a relay operates to open the circuit for the primary winding so that the magnet is held operated over the secondary winding only.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows in general the arrangement of the applicant's switch structure in a frame;

Fig. 2 is a fragmentary side view of a vertical unit;

Fig. 3 is a rear view;

Fig. 4 is a front view;

Fig. 5 is a view taken on line 5—5 of Fig. 2;

Figs. 6, 7 and 8 are views taken approximately on the line 6—6 of Fig. 2 and show the different positions of the armatures on the magnets in a pair; and

Fig. 9 shows the pairs of magnets at different cross-points in applicant's switching systems and the wiring for these magnets.

Referring now to the drawings, a switching unit may be arranged with, for example, from 1 to 20 vertical units such as have been illustrated diagrammatically in Fig. 1. These units are mounted between the horizontal bars 10 and 11 and these bars in turn are mounted on upright rack members 12 and 13. Each one of the vertical units may consist of the frame member 15 having lugs at its upper and lower ends by means of which it is mounted to the horizontal bars 10 and 11 through screws. On this frame member series of vertical springs, such as shown in the spring pile-ups 17, may be mounted for each horizontal row. These spring pile-ups may be connected at the back of the frame electrically by being cut, for example, from single sheets connected and insulated from each other at 18. These vertical springs extend forward to the front of the switch where the individual piles 17 are connected together by a card 20 as shown in Fig. 5. Associated with the vertical springs 17 at the front of the switch are horizontal contacts 23 which are divided in two groups so that when the springs 17 are moved laterally to one side they may be connected individually to one subgroup of horizontal contacts such as the group 25 and when moved laterally in the opposite direction, they may be connected individually to a second subgroup of horizontal contacts, such as the group 26. Thus, if the switch is considered as a whole, connections may be made between vertical contacts and one or the other of two groups of horizontal contacts at each cross-point. There may be, for example, five horizontal rows of horizontal contacts, each row including two groups of horizontal contacts at each cross-point and ten to twenty vertical rows of such groups of contacts. Thus a switch may have a capacity of 200 different connections. At each cross-point of the contacts in the vertical frame member are mounted two magnets 28 and 29 connected to the back of the frame member and having two windings each, with the terminals from these windings extending toward the back of the switch, as shown for example at 30. These magnets may operate on the butterfly armature 40 mounted to rotate in one direction on the energization of one magnet and in the opposite direction by the energization of the other magnet. The armature is mounted on a pin 41 on a forward extending central pole-piece 42 extending from the back of the frame between the magnets and the pole-piece may be mounted to the frame 15 and to a yoke piece 43 connecting the cores of the two magnets. At the bottom of the armature 40 a bell-crank lever 45 is connected and extends forward with its free end through an elongated slot 46 in the associated bar or card 20 so that when the armature is moved in one direction or the other, the vertical springs connected to this bar will be moved towards the left or the right to make contact

with one group or the other of the horizontal contacts. These horizontal contacts may, of course, be wired in any suitable manner or strapped in horizontal rows by means of lugs, such as lugs 47 as required. The armature 40 is held normally in a neutral position by springs 50 engaging the lever 45 on opposite sides. At the bottom of the frame member 15 a relay 48 may be mounted having an armature 49 that controls contacts 51 for purposes as will hereinafter be described.

Referring now particularly to Figs. 6, 7 and 8, it will be noted that in Fig. 6, the armature 40 is occupying the normal neutral position with the armature wings at equal positions from the cores of the two magnets 28 and 29 on the opposite side of the central pole-piece 42. In this position the lever 45 has no effect on the associated bar 20 connecting the vertical springs 17. These springs are shown, therefore, not connected with either of the groups 25 or 26 of the horizontal contacts. It should be observed now, by referring to Fig. 7 in particular, that if the primary winding of the magnet 29 is energized through its primary winding, the left-hand wing will be attracted to slightly rotate the armature 40. This rotation will not be sufficient to move the bar 20 out of neutral position as the slot 46 therein permits this movement to take place before the lever 45 operates on the bar 20. If now the secondary winding of magnet 29 is energized, the armature will swing further in the same direction and the lever 45 will shift through the bar 20 the vertical contact springs 17 to engage respectively with the horizontal group of contacts 25. It will be observed, as will be described hereinafter, that in the wiring of these coils, the secondary windings of both the magnets 28 and 29 will be energized simultaneously but the armature will be moved by magnet 29 as it has been previously shifted by the energization of the primary winding to be nearer its core. This advanced position of the armature is shown in Fig. 8. If the primary winding of magnet 28 had been operated and then the secondary windings of both magnets 28 and 29, the armature would have swung in the opposite direction, first slightly due to the energization of the primary winding of magnet 28 and then fully by the energization of the secondary winding of this magnet and thus the vertical springs 17 would have made connection respectively with the horizontal contact group 26. It may be observed that when the armature has been once actuated in one direction or the other and has been attracted by the corresponding magnet, the circuit for energizing the primary winding may be opened and the armature held solely by the energization from the secondary winding.

Fig. 9 shows wiring for the windings of the magnets in a switch of this type. The two magnets at each cross-point are shown enclosed by a dash-dotted line box and the magnets of the lower left-hand cross-point are marked 60 and 61, respectively. The switch may have a capacity of, for example, twenty vertical units and five horizontal rows with two magnets at each cross-point. It will be noted that the primary windings of one coil at each cross-point of the first horizontal row are wired from a common lead 63 to battery 64 through the armature and front contacts of the associated relay in each vertical unit such as, for example, the lead 63 is connected through the primary winding of magnet 60 to battery 64 over contacts of relays 65. Similarly, the primary winding of magnet 66 is wired from the common lead 63 through this winding, over contacts of the relays 67 for the vertical unit in which magnet 66 is located to battery 64 and corresponding primary windings of the succeeding magnets in this horizontal row are similarly connected. The primary windings for the other magnet of each vertical unit in the same horizontal row are similarly connected, for example, the primary winding of magnet 61 is connected from a common lead 68 through this winding to the battery 64 through contacts of relay 65, and corresponding primary windings of the corresponding magnets in the same horizontal row are also connected through contacts of the associated relays, such as 67. Thus there will be two common leads for each horizontal row containing two magnets at each cross-point, thus if five of such rows are provided there will be ten leads such as 63 and 68. On the other hand the secondary windings of the magnets in each vertical unit are connected in series as, for example, in the first vertical row from a lead 70 through these secondary windings through the winding of relay 65 to a lead 72.

If it is now assumed that a magnet 60 shall be operated to attract the armature to cause the vertical contact springs 17 of this row to connect with the corresponding horizontal contacts, ground is connected to lead 63. Thus current will pass from battery 64, contacts of relays 65 and 67 and other succeeding relays over the primary windings of magnets 60 and 66 and succeeding magnets to ground on lead 63. Thus the armatures of this group of magnets will be partially rotated as shown, for example, in Fig. 7, to cause the left-hand wing of this armature to move closer to the core of the associated magnet 29, but this will not cause any connections to be made between the vertical and horizontal contacts involved. Then current is passed over the circuit from lead 70 to lead 72 through the secondary windings in series with all the magnets in this vertical row, and through the winding of the relay 65. Therefore, the magnet 60 will now be fully operated and cause the armature to be fully attracted to act through the bar 20 on the vertical springs 17 to move them into connection with the group of horizontal contacts 25. Relay 65 will also operate in this circuit and open the connection to battery 64 for the primary winding of the magnet 60 and this magnet will, therefore, now be held operated by the current through the secondary winding only. The ground supplied at lead 63 may, of course, be disconnected in any suitable manner. In a similar manner other connection may be made in the switch by supplying ground on the horizontal leads such as 63, etc., followed by the application of current on vertical leads corresponding to leads 70 and 72 in other vertical units. Relays such as 73 and 74 may be provided in the circuits for the primary windings for each horizontal row to control off-normal contacts, for example, if required in systems to which this switching mechanism may be applied.

What is claimed is:

1. In a switching device, horizontal and vertical rows of contacts, with one set of vertical contacts and two sets of horizontal contacts at each cross-point, two magnets for each cross-point, each having two windings, means for first energizing the primary windings of one each of the two mag-

nets of a horizontal row of magnets, then energizing the secondary windings of a vertical row of magnets comprising the two magnets at each cross-point, for fully energizing the magnet having its primary winding energized at the cross-point at which said magnet is located in the horizontal row and in the corresponding vertical row and then deenergizing the said primary windings, and means responsive to said full energization of said magnet for closing a connection between the corresponding horizontal and vertical sets of contacts, said energization of the secondary winding of said magnet at said cross-point being sufficient to maintain said magnet fully operated.

2. In a switching device, horizontal and vertical rows of contacts with one set of vertical contacts, and two sets of horizontal contacts at each cross-point, a common relay for each of said vertical rows of contacts, two magnets at each cross-point each having a primary and a secondary winding, means responsive to the operation of one or the other of the magnets at a cross-point for actuating the vertical contacts at said cross-point to cause them to connect respectively with the contacts of one or the other of the sets of horizontal contacts at said cross-point, a horizontal circuit for the primary winding of one each of the magnets at each of the cross-points in each horizontal row, a horizontal circuit for the primary windings of the other magnets at each of the cross-points in each horizontal row, said circuits extending at each cross-point to a common lead through the associated primary windings to battery through contacts of the common relay in the corresponding vertical row so that when ground is connected to one of said circuits the associated primary windings in the corresponding horizontal row will be energized, a vertical circuit connecting the secondary windings in each vertical row in series through the winding of the associated common relay, so that when a horizontal circuit is energized, a corresponding primary winding is energized and when current is applied to a vertical circuit the corresponding secondary winding is energized to actuate the corresponding magnet to establish a connection between the corresponding vertical and horizontal contacts and to operate said relay to open the horizontal circuit while the vertical circuit through the secondary winding holds the magnet energized to maintain the established connection.

3. In a switching device, a plurality of vertical frames, means for mounting said frames side by side, mechanism mounted on each vertical frame comprising groups of two magnets each mounted one group above the other, a group of vertical contact strips mounted at the rear of said frame and having forwardly extending contact springs located below each group of two magnets, two groups of horizontal contact springs mounted on said frame adjacent each group of two magnets so that when the forwardly extending vertical contact springs at a point are moved in one direction, they will make contact respectively with one group of horizontal contacts and when moved in the opposite direction will make contact with the other group of horizontal contacts at said point, an armature for each group of two magnets so located and constructed as to move in one direction on the energization of one magnet in the group and in the opposite direction on the energization of the other magnet in said group, a bar connected to the vertical contact springs associated with each group of magnets, a projection from the associated armature so associated with said bar that when the armature is moved in one direction it will shift the bar to shift the associated vertical springs in one direction to make contact with the associated horizontal group of contacts and when the armature is moved in the opposite direction the associated bar will move in the opposite direction to connect the vertical contact springs with the other group of associated horizontal contacts.

4. In a switching device, horizontal and vertical rows of contacts with one set of vertical contacts and two sets of horizontal contacts at each cross-point, a pair of magnets for each cross-point, each having two windings, means for first energizing the primary winding of one each of the pair of magnets of a horizontal row of magnets, then energizing the secondary windings of a vertical row of magnets comprising a pair of magnets at each cross-point for fully energizing the magnet having its primary winding energized at the cross-point at which said magnet is located in a horizontal row and in the corresponding vertical row, and then deenergizing the said primary winding, an armature associated with each pair of magnets and controlled by either of said magnets when fully energized to rotate in one direction or the other a bar associated with each armature and the associated vertical contacts for actuating said vertical contacts to connect with one of the associated set of horizontal contacts in response to the rotation of the armature in one direction and for actuating said vertical contacts to connect with the other of said two sets of horizontal contacts in response to the rotation of said armature in the opposite direction, said energization of the secondary windings of the magnet at said cross-point being sufficient to maintain said associated armature fully rotated.

5. In a switching device, horizontal and vertical rows of contact sets with one set of vertical contacts and two sets of horizontal contacts at each cross-point, two magnets located at each cross-point, means for partially energizing either one of the magnets at a cross-point and then partially energizing both magnets at said cross-point to fully energize the magnet first partially energized, and means responsive to said full energization of said magnet for closing a connection between the associated vertical set of contacts and a corresponding set of horizontal contacts at said cross-point.

6. In a switching device, horizontal and vertical rows of contact sets, with one set of vertical contacts and two sets of horizontal contacts at each cross-point, two magnets located at each cross-point, means for partially energizing either one of the magnets at a cross-point and then partially energizing both magnets at said cross-point to fully energize the magnet first partially energized, an armature controlled by the magnets of said cross-point, and means responsive to the full energization of said magnet for operating said armature to actuate the associated set of vertical contacts to connect respectively with a corresponding set of horizontal contacts at said cross-point.

7. In a switching device, horizontal and vertical rows of contact sets with one set of vertical contacts and two sets of horizontal contacts at each cross-point, two magnets located at each cross-point, means for partially energizing either one of said magnets at a cross-point and then partially energizing the magnets at said cross-

point to fully energize the magnet first partially energized, a bar at each cross-point for controlling the associated vertical set of contacts and means responsive to the full energization of said magnet for shifting the associated bar to move the vertical contact set to connect with a corresponding set of horizontal contacts at said cross-point.

8. In a switching device, horizontal and vertical rows of contact sets with one set of vertical contacts and two sets of horizontal contacts at each cross-point, two magnets located at each cross-point, a circuit for partially energizing either one of the magnets at a cross-point, a circuit for partially energizing both magnets at said cross-point to fully energize the magnet first partially energized, means operative in response to the establishing of said second circuit for opening said first circuit, means responsive to the full energization of said magnet for closing a connection betwen the associated vertical set of contacts and the corresponding set of horizontal contacts at said cross-point, said energization by said second circuit being sufficient to maintain the connection between said contacts closed.

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