Jan. 4, 1944. W. H. T. HOLDEN 2,338,181

SWITCHING MECHANISM

Filed June 20, 1942

FIG. 1

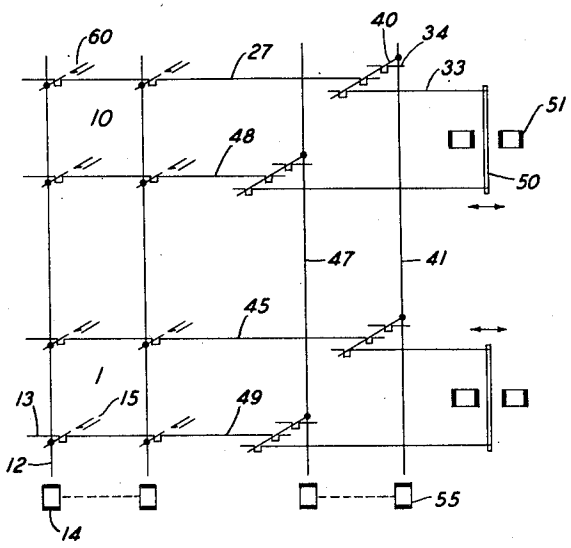
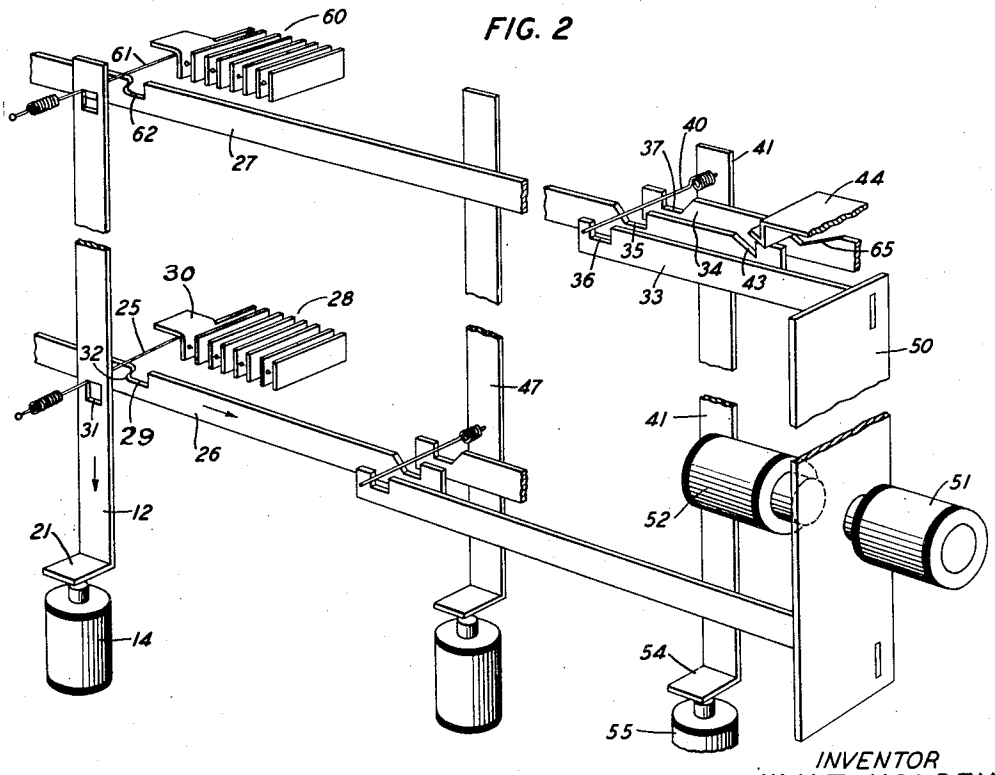


FIG. 2



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SWITCHING MECHANISM

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7 Claims. (Cl. 179—27.54)

This invention relates to switching mechanisms and particularly to mechanisms of the crossbar type as employed in automatic telephone systems to establish connections.

An object is to simplify and reduce the operating elements required in such switching mechanism.

Another object is to reduce the operating cost of such mechanisms by eliminating the use of electrical energy to maintain the mechanism in operative condition.

Heretofore so-called three-dimensional crossbar switching arrangements have been provided, that is, crossbar switches in which connections are established by three stages of operations to select a major group of connections, then a minor group of the selected major group and finally an individual connection in this minor group. Such switching systems may comprise a number of crossbar switches of the type in which the operation of a select bar in one coordinate direction followed by the operation of a hold bar in the other coordinate direction causes connections to be established between contacts at the crosspoint of said two bars. Such switches may be arranged for three-dimensional operation by an arrangement of four groups of bars and three groups of magnets so that the operation of one magnet of a first group acts on a preliminary bar to select one bar out of each of a plurality of groups of secondary bars for actuation then one magnet of a second group may be actuated to control all of the bars in a corresponding group of secondary bars to select all of said bars, one of which only will act on a tertiary bar for rotation thereof due to the operation of the preliminary bar. The actuated tertiary bar moves fingers so that when a hold bar of the fourth group is operated by its magnet in the third group this bar may act on this finger at the crosspoint of this tertiary bar to establish a connection thereat. A three-dimensional crossbar switching mechanism operating along these lines is disclosed in the Patent 1,528,763 to C. L. Goodrum et al. of March 10, 1925, and it will be observed that in systems of this kind the hold bar operating magnet must be maintained energized as long as the connection is to remain.

The applicant's invention relates to this general type of three-dimensional crossbar switch mechanisms and a feature thereof is an arrangement in which after a hold bar has been actuated to establish a connection, it is automatically locked in actuated position so that no magnet needs to be held energized during the period a connection is held, and another feature is an arrangement whereby a connection is released by the operation of magnets and bars in two stages.

The invention has been illustrated in the accompanying drawing in which

Fig. 1 shows in diagrammatic form a three-dimensional switch in accordance with the applicant's invention.

Fig. 2 is a perspective representation of a portion of the mechanisms in this switch to illustrate the functions of the various parts in accordance with the applicant's invention.

Referring now to the drawing and particularly to Fig. 1, if it is considered that individual crossbar units of any well-known type in which the operation of a bar in one coordinate direction followed by the operation of a bar in the other coordinate direction causes connections between contacts to be established at the crosspoint of these two bars, this figure illustrates in diagrammatic form an arrangement of such switches one on top of the other of which the first switch 1 and the last switch 10 only have been shown in a group of ten. In this case the select bars for these switches are shown as verticals and are common to all ten switches such as for example the select bar 12 which extends through switch 1, the eight intermediate switches and through switch 10. There may be, for example, ten of such vertical bars for these ten switches. The hold bars are shown as horizontals and are represented by a bar such as 13 in switch 1 and there may be, for example, ten such holding bars in each of the ten switches. Each of the vertical select bars are provided with the magnets such as for example magnet 14 for bar 12. By this arrangement therefore of ten switches, each having ten common select bars and ten holding bars, there will be one hundred crosspoints in each switch at which connections may be established through contacts such as for example indicated in diagrammatic form at 15 for the crosspoint between the selector 12 and the hold bar 13. Connections may therefore be established in this case between ten incoming lines to any one of a hundred outgoing lines and ten simultaneous connections may be held.

In Fig. 2 one of the common vertical select bars has been shown as a ribbon or bar 12 terminating in an armature 21 which serves to attract the bar 12 to the magnet 14 when energized to move the bar 12 downwardly in a sliding motion. Each of the select bars such as 12 control fingers such as 25 at each cross-point where this bar crosses

the hold bars in all of the ten switches. Associated with this select bar 12 has been shown in Fig. 2, a first hold bar 26 and a last hold bar 27 in one switch and opposite each of the fingers as shown for example at 28 are a series of springs for the crosspoint of bars 12 and 26 for operation by these bars. If the select bar 12 is moved downwardly the finger 25 will enter a slot 29 in hold bar 26 and if then hold bar 26 is moved toward the right, this finger will be moved toward the right and operate on a movable spring 30 which may be connected in any suitable manner through a stud for example, passing through intermediate stationary springs and which is secured to interposed movable springs so that connections may be established between the movable and stationary springs, when the holding bar 26 is moved towards the right. As the bar 12 will be restored to normal for use in establishing other subsequent connections it is provided with large openings such as 31 to permit the engaged finger 25 to be held by the operated hold bar 26 without being disturbed by any subsequent movements of this select bar. To insure that the finger is held securely by hold bar 26 the slot 29 has a hook-shaped depression at its left-hand side as shown at 32 and the finger 25 will rest in this depression as long as hold bar 26 is in actuated position.

Associated with each hold bar as shown for example in connection with the hold bar 27 is an operate bar 33 and a release bar 34. These bars 27, 33 and 34 are provided with slots 35, 36 and 37, respectively and above these slots, which are aligned normally, is placed a flexible spring member or finger 40 connected to a secondary vertical bar or ribbon 41. The hold bar 27 is also provided with another slot 43 and a latch spring 44 is so located above slot 43 that it will enter into this slot when the hold bar 27 is moved towards the right to hold it in actuated position as will be described hereinafter. If reference is made to Fig. 1, it will be noted that this vertical bar 41 extends across all ten switches and if hold bar 27 is considered as the last hold bar in the last switch 10, the corresponding last hold bars of the succeeding nine switches are associated with this vertical bar 41 and equipped with corresponding operate bars, release bars and fingers such as 33, 34 and 40. Similarly the succeeding hold bars in the ten switches are associated in the same manner with a secondary vertical bar, fingers, operate bar and release bar. That is ten vertical bars like 41 and associated equipments are provided. As shown in Fig. 1 the secondary vertical bar 41 is associated with the last hold bar 27 of the last switch and the last hold bar 45 of the first switch while the tenth secondary vertical bar 47 is associated with the first hold bar 48 of the last switch and the first hold bar 49 of the first switch and with intermediate corresponding hold bars. It should further be noted that the operate bars such as 33 for each switch are connected together by a transverse bar 50 and this transverse bar may be operated by an operate magnet 51 to move the ten operate bars toward the right and by release magnets 52 for operating the ten operate bars towards the left. The bar 41 may be provided with an armature 54 which may be attracted by magnets like 55 to lower the bar and the corresponding other nine vertical bars are similarly equipped with armatures and magnets to lower them.

A description will now be made of the establishing of a connection at a crosspoint in one of the switches 1 to 10 and the release of this connection in accordance with the applicant's invention. If it is assumed that a connection is desired at the crosspoint 60 of the holding bar 27 and the select bar 12, the first operation would be to operate magnet 14 to attract armature 21 and bar 12 to be moved downwardly. This will place the fingers such as 61 and 25 and all other fingers on bar 12 into the slots of all the hold bars for example finger 61 will be lowered into slot 62 on the hold bar 27. As the hold bar 27 is in the tenth switch and the last bar in this switch, a vertical secondary bar which would preselect the last bars in all the switches must be operated. In this case, therefore, the bar 41 will be moved downwardly by the operation of magnet 55 and armature 54. This will place finger 40 in the slots 35, 36 and 37 of the hold bar 27, operate bar 33 and release bar 34 and the fingers corresponding to finger 40 for the other switches and the last hold bar in each switch would be similarly lowered in corresponding slots. Thus by the operation of bar 41, the selection of the last hold bar in any of the ten switches is accomplished. The next step will be to select the operate bar 33 to cause the hold bar 27 to operate. This is done by operating the operate magnet 51 which is common to all the operate bars and hold bars of the last switch in which the hold bar 27 is located. The operation of this magnet 51 will attract the plate 50 and move the operate bar 33 and all the other bars controlled thereby towards the right, but as only one finger, that is finger 40 is located in the slot 36 of the operate bar 33, this operate bar 33 is the only one that will move a finger. As this finger is also located in slot 35 of hold bar 27 this finger in moving toward the right will also move hold bar 27 towards the right. This movement will operate finger 61 towards the right which will then operate on the springs 60 at the crosspoint of this hold bar and the select bar 12 to establish connections between them. It will now be observed that in the movement of the hold bar 27 towards the right the latch spring 44 will drop into the slot 43 and lock the hold bar 27 in the operated position so that now the operate magnet 51 may be released to release bar 50 and the associated operate bars such as 33 which returns to normal and thereby releases finger 40 to normal. The magnet 55 for the secondary vertical bar 41 will also be released to release this bar to normal and return the fingers controlled thereby to a normal position. The select magnet 14 may also be released to release bar 14 and release all the fingers controlled thereby to normal. However, the finger 61 will remain controlled by hold bar 27 to maintain the contacts 60 in operated position. Therefore during the maintaining of this connection no hold magnet is maintained operated and therefore considerable saving in electrical power is accomplished by the applicant's invention by the arrangement of having the hold bar such as 27 locked in operated position. To reiterate, to establish a connection at any crosspoint in this switching arrangement, the first operation that takes place is to select a vertical row of contacts in any switch by the operation of a magnet such as 14, then to select a horizontal row in any of the switches by the operation of a magnet such as 55 and to select the desired horizontal connection in one of the switches, a magnet such as 51 of switch 10 may be operated and when these selections have been made all the operated magnets 14, 55 and 51 may

be released and the connection held until a release is desired.

To release this established connection at the cross-point 60, the magnet 55 will again be operated to lower the bar 41 to place finger 40 again in the slots of the operate bar 33, the hold bar 27 and the release bar 34. Then the release magnet 52 will be operated to move the operate bar 33 and the other nine bars associated with it towards the left. In this case therefore the slot 36 in bar 33 will move the finger 40 towards the left and thus move the release bar 34 through slot 37 towards the left. In moving the bar 34 in this direction it will engage through a slanting surface 65 the latch spring 44 and lift it out of the slot 43 in the hold bar 27 and permit this hold bar to be returned to normal and thereby release finger 61 and open the connection at the contacts 60. The magnets 55 and 52 may then be deenergized to return the associated bars to normal. It should be understood, of course, that while the connection at the crosspoint 60 is maintained, other connections may be established in any one of the ten switches by similar operations of vertical select bars, vertical secondary bars, operate bars and hold bars. That is ten simultaneous connections may be maintained in the switches located in any switch desired, or scattered over the switches in any desired manner.

What is claimed is:

1. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, four groups of magnets, means for establishing a connection between the contacts at any crosspoint in any switch in response to the operation of one magnet of each of three of said groups and to maintain said connections after all three of said magnets are released and means for releasing said connection in response to the reoperation of one of said three magnets and the operation of a magnet in the fourth group.

2. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, vertical bars common to all of said switches, each bar common to one vertical row of contacts in each switch, a magnet for each vertical bar, a horizontal bar individual to each row of horizontal contacts in each switch, secondary vertical bars common to all of said last-mentioned horizontal bars, each secondary bar common to one of said horizontal bars in each switch, a magnet for controlling each of said secondary bars, a bar mechanism for each switch associated with the group of horizontal bars thereof and with the secondary bars, two magnets for controlling each bar mechanism, said magnets, the two groups of vertical bars, the horizontal bars and bar mechanisms being so related and constructed as to cooperate with the contacts at the crosspoints of said switches that the operation of one each of the magnets for the two groups of vertical bars, causes the associated bars to preselect contacts at the crosspoints in a particular vertical row in all of said switches and to preselect a horizontal bar in each of said switches for subsequent operations to preselect the contacts at a crosspoint in each of said switches where a corresponding horizontal row of contacts crosses the preselected row of vertical contacts, and that the operation of one of the two magnets for controlling the bar mechanism for one switch causes said bar mechanism to actuate the preselected horizontal bar in said switch to close a connection between the contacts at the crosspoint of said actuated horizontal bar and the vertical bar common to all switches that was actuated, and that said horizontal bar when actuated holds the established connection after all three of the operated magnets are released, and that on the subsequent operation of the previously operated magnet for a secondary bar and the other magnet for the previously operated last-mentioned bar mechanism, causes the release of said horizontal bar to release the connection.

3. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, a first set of select bars common to all switches, a first magnet for actuating each select bar, a second set of select bars common to all switches, a second select magnet for actuating each of said second select bars, hold bars for each switch, operate bars for each switch, an operate magnet for the operate bars of each switch, a trip bar for each hold bar in each switch, a trip magnet for the operate bars of each switch, means responsive to the operation of a first select magnet, a second select magnet and an operate magnet for controlling the associated bars to actuate a corresponding hold bar to select and actuate the contacts at the corresponding crosspoint of the actuated first select bar and the actuated hold bar, means for maintaining the actuated hold bar in actuated position after the said magnets and their associated bars are released to maintain the connection and means responsive to the reactuation of the second select magnet and the trip magnet for the operate bars of the switch in which the connection is maintained for actuating the associated trip bar to release said hold bar to release said connection.

4. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, two groups of magnets, a pair of magnets associated with each switch, means including a system of operative bars for establishing a connection between the contacts at any crosspoint of any switch in which the energization of one magnet in each of said two groups and one magnet of a pair of magnets associated with the switch in which a connection is to be established, causes the actuation of corresponding bars to establish said connection and means for locking one of said operated bars to maintain the established connection after all of the energized magnets are released.

5. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, two groups of magnets, a pair of magnets associated with each switch, means including a system of operative bars for establishing a connection

between the contacts at any crosspoint at any switch in which the energization of one magnet in each of said two groups and one magnet of a pair of magnets associated with the switch in which a connection is to be established, causes the actuation of corresponding bars to establish said connection, means for locking one of said operated bars to maintain the established connection after all of the energized magnets are released, and means for releasing said established connection operative in response to the reenergization of one of the magnets in one of the two groups first energized and energizing of the other magnet of the pair associated with the switch in which the connection was made.

6. In a switching device, a plurality of crossbar switches each having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, three groups of magnets, bars controlled thereby, means for establishing connections between contacts at any crosspoint in any switch in response to the operation of magnets and bars in three successive stages from said three groups and for maintaining the established connection after all of the operated magnets are released and means for releasing the established connection in response to the operation of magnets and bars in two succeeding stages from two of said groups.

7. In a switching device, a plurality of crossbar switches, each switch having horizontal and vertical rows of contacts intersecting each other for the establishing of connections between the contacts of a horizontal row and the contacts of a vertical row at the crosspoint of said two rows, groups of magnets and bars controlled thereby, means for establishing a connection between contacts at any crosspoint in any switch in response to the operation of three magnets and a plurality of bars in succession and for maintaining the established connection by a single locked bar after all of said magnets are released and means for releasing said locked bar to release the established connection operative in response to the operation of two magnets and a plurality of bars in succession.

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