

June 6, 1944.

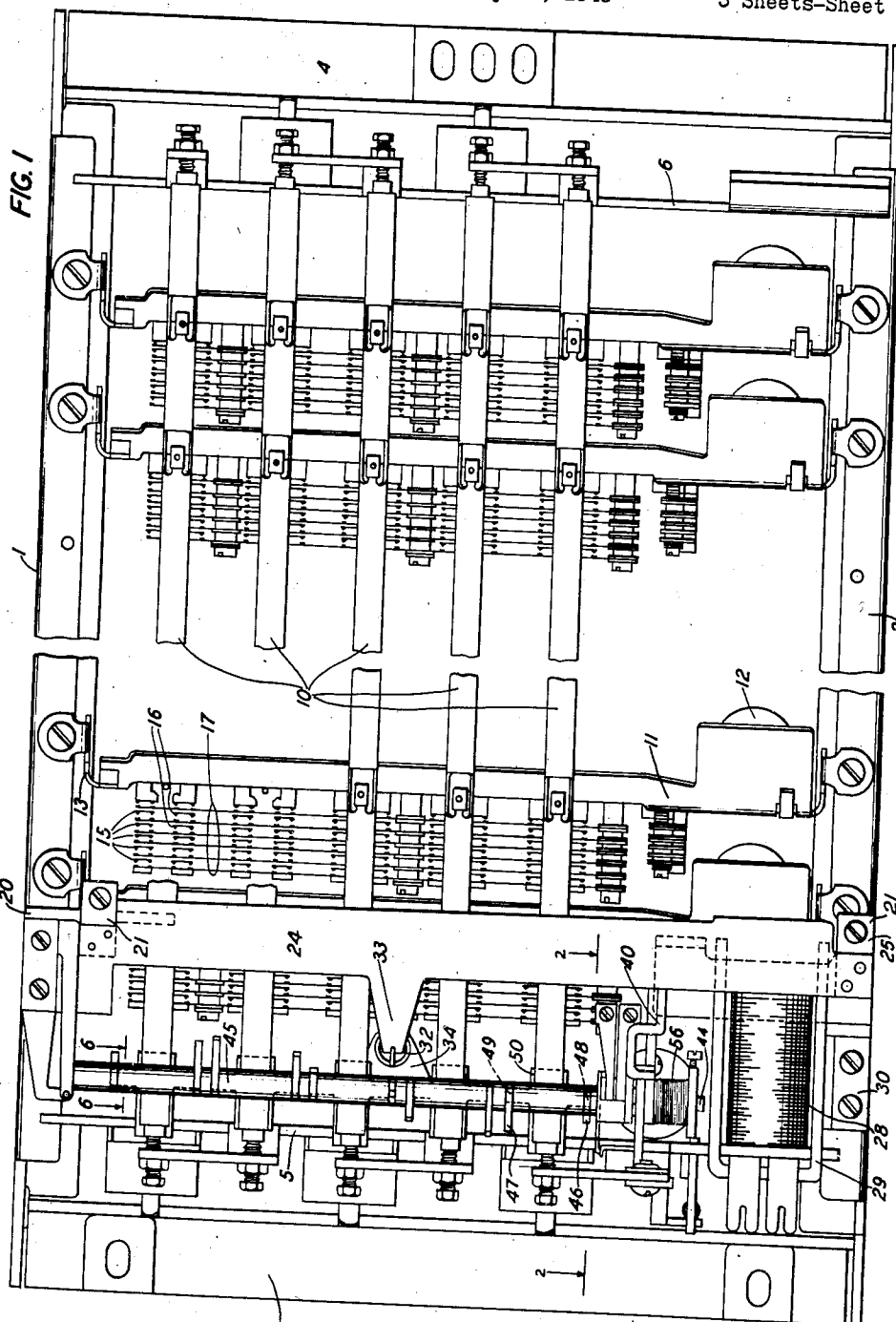
F. H. HIBBARD

2,350,458

SWITCHING MECHANISM

Filed May 18, 1943

3 Sheets-Sheet 1



INVENTOR
F. H. HIBBARD
BY *M. R. McKenney*
ATTORNEY

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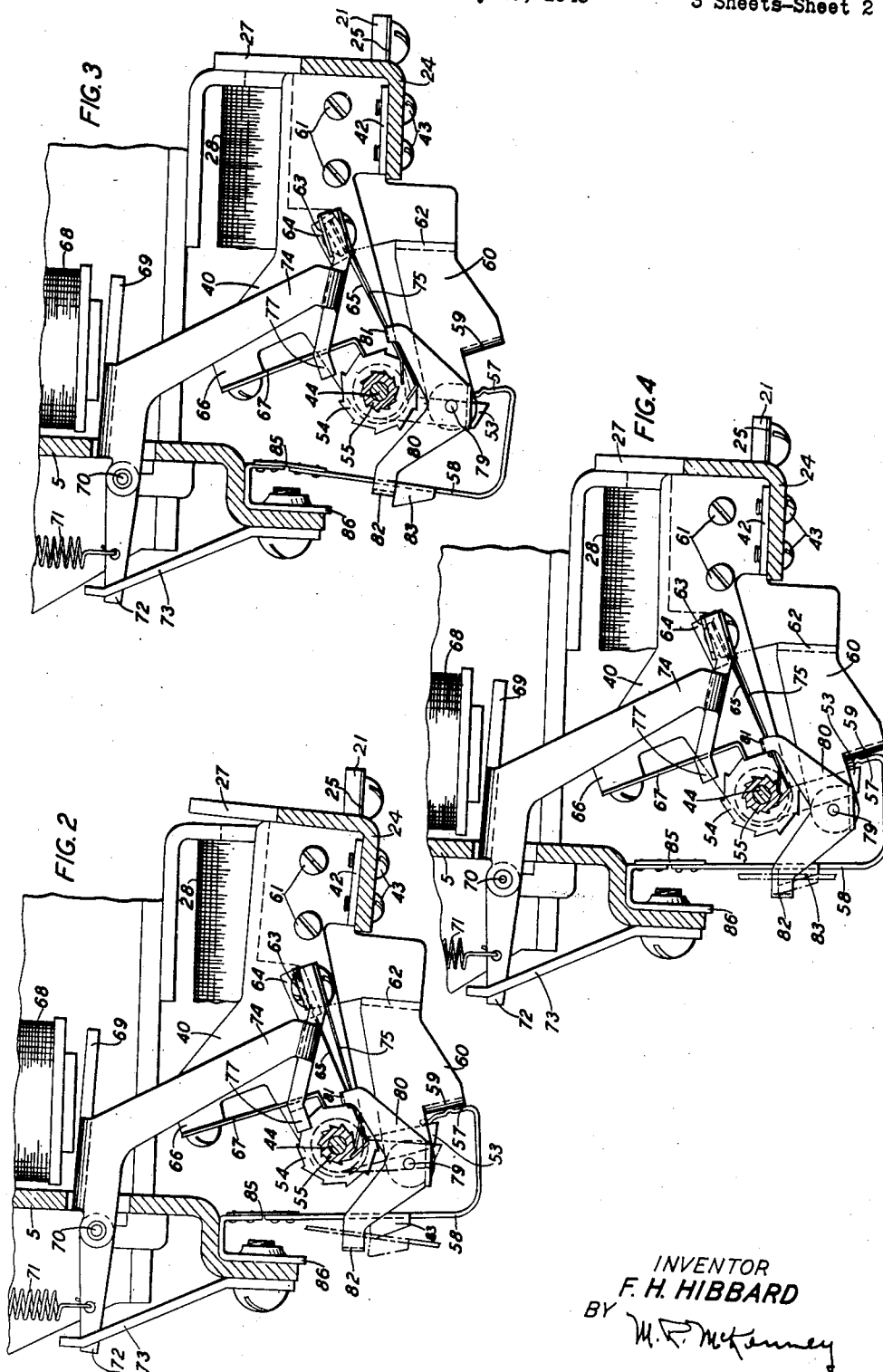
F. H. HIBBARD

2,350,458

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3 Sheets-Sheet 2



INVENTOR
F. H. HIBBARD
BY *M. R. McManey*
ATTORNEY

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FIG. 5

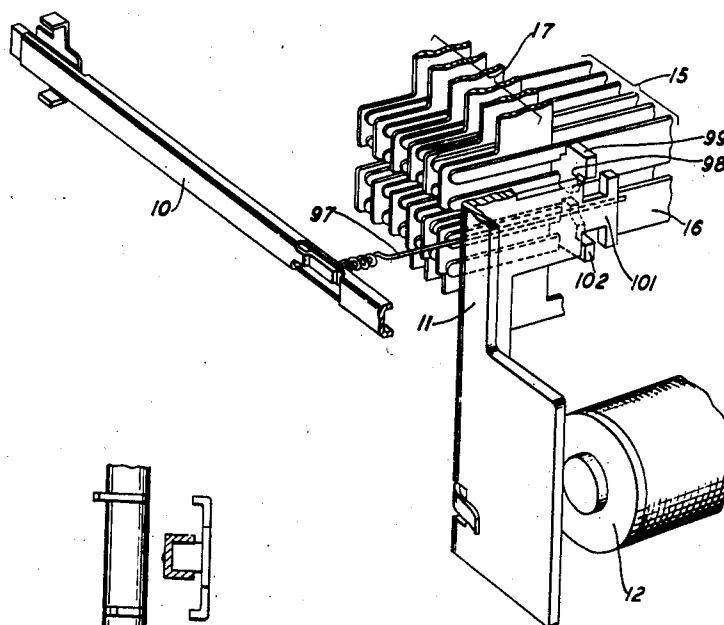


FIG. 6

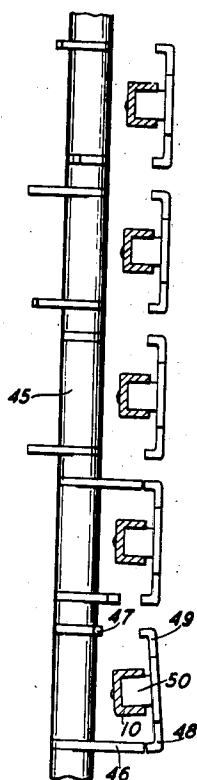
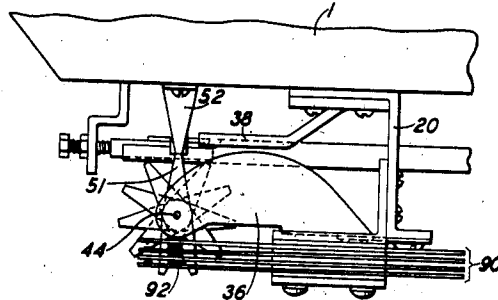


FIG. 7



INVENTOR
F. H. HIBBARD
BY *M. R. McKinney*
ATTORNEY

UNITED STATES PATENT OFFICE

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SWITCHING MECHANISM

Frank H. Hibbard, Mountain Lakes, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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7 Claims. (Cl. 179—27.54)

This invention relates to switching mechanisms and particularly to such mechanisms as are employed in automatic telephone systems for the establishing of connections.

An object is to simplify and reduce the cost of such mechanisms and to make them more readily controllable by outside electrical circuits.

Heretofore, crossbar switches have been used in which bars and rows of contacts are coordinately arranged so that the operation of a select bar in one coordinate direction by a corresponding select magnet followed by the operation of a hold bar in the other coordinate direction by a corresponding hold magnet causes connections to be closed between contacts at the intersecting points of said two bars. In certain arrangements of this type of switch, each select bar is arranged to serve two rows of contacts by being rotated in one direction or the other by a corresponding select magnet.

The present invention relates to improvements in a switch of this latter type whereby in place of the individual magnets for a plurality of select bars, the operations of these bars are controlled by two magnets only in response to dial pulses incoming to said switch. That is, a plurality of such select bars are controlled in their selective movements by two common magnets and a common associated control mechanism. If a switch is considered in which, for example, five select bars are located horizontally and ten hold bars vertically, the present invention would provide a vertical shaft at one end of the select bars having ten projections thereon arranged in a helical formation, while each select bar is provided with a crosspiece or oppositely extending arms with the outer end of each arm in a position in line with a corresponding projection on the vertical shaft. This vertical shaft is rotatable in steps by a pawl and ratchet mechanism controlled by a single magnet responsive to dial pulses incoming to the switch. This magnet, pawl and ratchet mechanism and shaft are mounted on a frame which may be shifted by another single magnet to swing away from the arms on the select bars and to be returned to normal by a spring. The functioning of this mechanism is such that the frame containing the shaft, the pawl and ratchet mechanism and the magnet operating it is shifted in a position where the projections on the shaft will not interfere with the arms on the select bars. The shaft is then rotated in steps until a certain projection on the shaft is placed opposite a particular arm. The frame is then released to normal condition so that the selected projec-

tion will engage the corresponding arm on a select bar to rotate it in the proper direction.

Another feature is an arrangement whereby the shaft remains in rotated position after each operation of a select bar and is restored to normal when a succeeding selection is initiated, that is on a succeeding operation of the magnet for shifting the frame, mechanism is provided which releases the shaft to its normal position in readiness for a succeeding rotation thereof by the pawl and ratchet mechanism and its magnet to select a select bar for rotation on the subsequent release of the frame to normal.

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

Fig. 1 shows a front view of a typical crossbar switch in which the applicant's invention has been incorporated;

Figs. 2, 3 and 4 show various control positions of certain of the mechanisms of applicant's invention;

Fig. 5 is a fragmentary perspective view of a portion of a horizontal and a vertical bar and the contact sets at the cross-point of these bars;

Fig. 6 is a detailed view of the operating shaft and the horizontal bars of the switch looking at one end of these bars; and

Fig. 7 is a top view of the switch particularly relating to off-normal contacts of the applicant's invention as controlled by the operating shaft. Referring now to the drawings, the switch consists of an upper frame member 1, a lower frame member 2, a left-hand member 3 and a right-hand member 4 with intermediate left-hand supporting member 5 and right-hand supporting member 6 connected between the members 1 and 2. Between these members 5 and 6 are pivoted five horizontal bars marked generally with the numeral 10 and between the upper and lower members 1 and 2 are mounted what are generally referred to as vertical units, each comprising contacts and a vertical bar such as bar 11 with its associated magnet 12 for rotating it. This vertical bar is mounted on a frame 13 attached to the upper and lower frame members 1 and 2 with screws as shown. On this frame member 13 are also mounted individual contact springs. At each cross-point of a vertical and a horizontal bar there are located an upper group of contacts 15 and a lower group of contacts 16 of two horizontal rows of contact springs and associated with these sets of horizontal contact springs are vertical contact strips 17 with which the horizontal contact springs may establish connections respectively on the operation of the mechanism

as will be described more fully in connection with Fig. 5. It is sufficient to say at this time that the horizontal bars 10 may be rotated in a clockwise direction looking at Fig. 1 from the left to cause the actuation of the upper contacts 15 and rotated in a counter-clockwise direction to cause the actuation of the lower contacts 16 to connect with the strips 17 on the operation of the associated vertical bar 11 by a magnet 12.

The applicant's invention has been applied to this mechanism to eliminate the usual operating magnets for rotating the horizontal bars in these two directions and consists of the following parts. Between the members 1 and 2 are secured by brackets, such as 20 on frame member 1 and 21 on frame member 2, a vertical frame member 24 by means of a leaf hinge 25 secured to members 21 and 24, and a leaf hinge 26 secured to members 23 and 24 so that the member 24 will be hinged at each end for rotation under control of an armature extension on the member 24, marked 27, controlled by a magnet 28 mounted on a yoke piece 29 secured by a bracket 30 to the lower frame member 2. The member 24 is held in normal position by means of a spring 32 secured to a projection 33 on member 24 and at the opposite end to a projection 34 on the frame member 5. The normal position occupied by the member 24 is determined by an angular extension at the top marked 36 shown particularly in Fig. 7, which engages a stop member 38 secured with the bracket 20 on the frame member 1. Between this angular extension 36 at the top of member 24 and a bracket 40, secured to the bottom of member 24 by means of an angular extension 42 and screws 43, is journaled a shaft 44. Surrounding this shaft is a sleeve 45 having helically arranged extensions such as 46 and 47, each of which is located opposite a corresponding arm such as 48 and 49, for example, extending from the bracket 50 connected to the lower horizontal bar 10. That is, each horizontal bar 10 is provided with such a bracket 50 with a lower arm 48 and an upper arm 49. Each one of these arms on the different bars is as stated opposite a corresponding projection on the sleeve 45, but normally out of engagement with these projections when the shaft is in normal position. The shaft also has an upper projection 51 which normally engages a spring stop 52 connected to the frame member 1. At the bottom of sleeve 45 and between this sleeve and the bracket 40 is located and secured a normal stop member 53 to maintain the shaft in normal position and two ratchet wheels 54 and 55 in the order named with the member 53 nearest bracket 40. Ratchet wheel 55 is used for rotating the shaft in operative positions in steps and ratchet wheel 54 is used as a stop ratchet. The shaft 44, sleeve 45, ratchet wheel and the stop 53 are returned to normal by means of a spiral spring 56 secured at the lower end to the shaft 44 and at the upper end to bracket 40. The stop member 53 engages normally the hooked end 57 of the spring member 58 which end in turn engages the downwardly extending projection 59 on a bracket 60 secured to bracket 40 by means of screws 61. This bracket 60 has an upwardly extending projection 63 which extends through an opening 64 in bracket 40 and to which is connected a holding pawl 65 engaging the ratchet wheel 55. This holding pawl 65 prevents the ratchet wheels from rotating in a counter-clockwise direction after having been advanced in a clockwise direction as will be described hereinafter. This bracket 40 is provided with

an extension 66 to which a holding pawl 67 is connected. This pawl 67 engages a tooth in ratchet wheel 54 and prevents the wheels from rotating in a clockwise direction under circumstances as will be described hereinafter.

On the frame member 5 is mounted an operating magnet 68 having an armature 69 pivoted at 70 and held in normal position by spring 71 secured at one end to the projection 72 of the armature 69 and at the other end secured to the frame member 5 in any suitable manner not shown. The back stop member 73 secured to the frame member 5 engages the projection 72 of the armature 69 is provided with an extension arm 74 at the end of which is secured a stepping pawl 75 engaging the ratchet wheel 55. At the end of extension 74 is also a downwardly bent member 77 which engages the pawl 67 when the armature 69 is attracted by the magnet 68 to pull this pawl away from the ratchet wheel 54. On the pivot 79 secured to bracket 60 is mounted a lever 80, one end of which, marked 81, is bent down to engage the pawls 65 and 75 to remove them from engagement with the ratchet wheel 55 when this lever is rotated in a clockwise direction. The opposite end of this lever is also bent downwardly as shown at 82 to be engaged by a tooth 83 on the spring 58, the purpose of which will be described hereinafter. The spring 58 is flexibly connected by means of a leaf spring 85 to a bracket 86 secured to frame 5. On the bracket 20 is also secured a pile of off-normal springs 89 which are controlled through the medium of stud 92 engaged by the extension 36 when the member 24 is rotated.

A description will now be made of the operation of this mechanism to select and establish connections at a cross-point between a horizontal bar and a vertical bar. Fig. 2 illustrates the normal position of the armatures 27 and 69 with the shaft 44 and all the other parts in normal position. The first thing that occurs is that the magnet 28 is energized to attract the armature 27 and rotate the member 24 and bracket 40 to shift the position of shaft 44 and its associated parts away from the arms on the brackets 50 so that the shaft 44 may be free to rotate in steps to select a particular horizontal bar for rotation in one direction or the other. The magnet 68 is then operated in steps to alternately attract and release armature 69 and thus cause the pawl 75 to engage the ratchet wheel 55 and rotate it each time the armature and pawl are returned to normal, under tension of the spring 71. When the armature 69 is attracted, extension 77 engages pawl 67 and removes it from the ratchet wheel 54 and this pawl remains out of engagement with the teeth of wheel 54 until the stepping pawl 75 has started to advance the wheels at which time it is released beyond the tooth it formerly engaged and when the step is completed, the pawl 67 will engage the next tooth to prevent further forward movement of the ratchet wheels at this time. Pawl 65 will also engage the next tooth in wheel 55 to prevent the ratchet wheels from restoring under tension of the return spring 56. Thus for each operation and release of armature 69, the ratchet wheels 54 and 55 and the sleeve 45 are rotated one step to bring a succeeding extension such as 46 in front of an associated arm such as 48 on a bracket 50. That is, the first projection 46 will be placed opposite the arm 48 on the first rotary step of sleeve 45 and the next projection 47 will be placed opposite the arm 49 on the

second step and so on, so that when the armature 59 ceases to operate only one of the projections on the sleeve 45 will be opposite a corresponding arm on a corresponding horizontal bar. It should now be observed that as the shaft 44 is rotated, the step 53 will be rotated with the shaft and thus cause the release of the spring 58 permitting this spring to move towards the left, but at this time the pawl 83 on this spring 58 will not hook under the extension 82 on lever 80 due to the operated position of armature 27, but will merely engage the inner right-hand surface of extension 82 at this time and as shown in dotted lines in Fig. 4.

The next step will be to have the armature 27 released by the magnet 28, thus shifting the shaft 44 and all the associated parts towards the horizontal bars and in so doing one of the projections on the sleeve 45 will engage the associated arm on the associated horizontal bar and rotate it in a corresponding direction. For example, if only a single step has been taken, the first or the lower projection 46 will engage the arm 48 and rotate the lower horizontal bar in a counter-clockwise direction. On the other hand, if two steps had been taken, the projection 47 would engage the arm 49 of the same horizontal bar to rotate it in a clockwise direction.

If, for example, the upper bar 13 had been rotated in a clockwise direction, it would have shifted its fingers 97, referring especially to Fig. 5, so that this finger will be in position opposite a slot 98 in an operating card 99 for the horizontal springs 15. Then when a vertical bar, for example, bar 11, is rotated by its magnet 12, the extension 101 engages the finger 97 and presses it against the card 99 which now shifts the springs 15 to engage with the contact strips 17 in the usual manner in switches of this type. If this horizontal bar had been operated in the opposite direction, finger 97 would have engaged a slot in card 102 and on the operation of the vertical bar 11 the projection 101 would have caused the finger to shift the card 102 to cause the springs 16 to engage with the contact strips 17. Thus the operation of any horizontal bar and any vertical bar will establish electrical connections between contacts at the intersecting point of these two bars. It will therefore be seen that the operation of magnet 28 followed by the operation of the magnet 68 in steps and the release of magnet 28 causes the selection and rotation of a horizontal bar in the proper direction to prepare for the establishing of a connection in the particular horizontal row of contact springs and thus this mechanism will replace the usual ten operating magnets for controlling the five bars in well-known crossbar structures.

As both magnets 28 and 68 are released after a selection, the horizontal bar selected will remain in the actuated position until another connection at another cross-point is desired. When this is about to take place, the operations will be the same as before except that in this case the shaft 44 and its associated parts will have to be restored to normal before the selection for a new connection is begun. It should be observed, therefore, that when armature 27 has released and the lever 80 shifted to normal, the projection 82 releases the pawl 83 and spring 58 which then caused the pawl 83 to be hooked under the projection 82. Thus when magnet 28 again attracts the armature 27, the pawl 83 will rotate lever 80 in a clockwise direction and thereby cause the extension 81 to engage the pawls 65 and 75 and remove them from engagement with teeth on

ratchet wheel 55 and thus permit the shaft 45 to rotate back to normal under tension of the spring 56. In Fig. 3, the shaft 44 and associated parts have been shown in a position where the lever 80 has thus released the shaft 44 and where the shaft has rotated back towards normal so that the normal stop 53 is about to engage the spring 58, and pull this spring towards the right until the stop and spring engage the projection 59 on the bracket 16. When spring 58 is being thus restored, it will withdraw the pawl 83 from the extension 82 on the lever 80 and thereby permit the lever 80 to return to normal under tension of the pawls 65 and 75 which again engage teeth in ratchet wheel 55. With the armature 27 actuated and the shaft 45 shifted away from the arms on the horizontal bars, the mechanism is again positioned for control by magnet 68 to select another horizontal bar for rotation as hereinbefore described.

What is claimed is:

1. In a crossbar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a select bar selecting and operating means including a select rod having helically arranged projections thereon, a ratchet mechanism for said rod, a magnet for actuating said ratchet mechanism, a mounting for said rod and ratchet mechanism, an operating magnet for controlling said mounting to move said select rod so that the selected projection engages the corresponding select bar to move it and means responsive to the movement of said select bar followed by the movement of a hold bar for actuating the contacts at the corresponding cross-point.

2. In a crossbar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, selecting and operating means for said select bars including a rod having helically arranged projections, one for each select bar, a pawl, a ratchet mechanism for said rod, a magnet for actuating the pawl to rotate the rod in steps and a mounting for said rod and ratchet mechanism, an operating magnet for moving said mounting by an operative stroke so that during the rotation of said rod in steps the projections will not interfere with said select bars and for releasing said mounting on a release stroke so that the selected projection on said rod will actuate the corresponding select bar, means responsive to a subsequent operative stroke of said operating magnet for actuating said pawl and ratchet mechanism to release said rod from the position to which it has been rotated and permit its return to normal position and means responsive to the actuation of said select bar followed by the actuation of a hold bar for operating the contacts at the cross-points of said bars.

3. In a crossbar switch, select bars and hold bars coordinately arranged, contacts at each cross-point of said bars, a rod having helically arranged projections, one for each select bar, a magnet, a pawl and ratchet mechanism associated with said rod for control by said magnet to rotate the rod in steps, means for maintaining said rod in a position during the rotation of said rod in steps so that the projections thereon do not interfere with the respective select rods and for actuating a select bar by a projection on said rod depending on the extent of the rotary movement and means operative on the actuation of a select rod followed by the actuation of a hold bar for establishing a connection at the cross-point of said bars between the contacts thereat.

4. In a crossbar switch, select bars and hold bars arranged coordinately, contacts at each cross-point of said bars, a select rod having helically arranged projections, one for each select bar, means for rotating said select rod to place any projection opposite a corresponding select bar, means for preventing the projections from touching the select bars during the rotary movement of said select rod and for shifting said select rod after it has been rotated to cause the projection placed opposite a select bar to rotate said select bar and means responsive to the rotation of said select bar and the actuation of a hold bar for operating the corresponding contacts at the cross-point of said bars.

5. In a crossbar switch, select bars and hold bars arranged coordinately, contacts at each cross-point of said bars, a select rod having helically arranged projections, two projections for each select bar, means for rotating said select rod in steps to place one or the other of any pair of projections in position to act on a corresponding select bar, means for preventing the projections from touching the select bars during the rotary movement of said select rod and for causing the projection placed in position to act to rotate the associated bar in a certain direction, and means responsive to the rotation of said select bar in said certain direction followed by the actuation of a hold bar for operating a corresponding set of contacts at the cross-point of said bars.

6. In a crossbar switch, horizontal and vertical bars coordinately arranged, contacts at each cross-point of said bars, a select rod having helically arranged projections, means for rotating said rod in steps, means operative to move said select rod laterally to cause a particular projection, depending on the extent of the rotary movement of said select rod to actuate a corresponding horizontal bar, means responsive to the actuation of said horizontal bar followed by the actuation of a vertical bar for actuating the contacts at the cross-points of said bars.

7. In a crossbar switch, horizontal and vertical bars coordinately arranged, contacts at each cross-point of said bars, a select rod having helically arranged projections, means for rotating said rod in steps, means operative to move said select rod laterally in one direction prior to the rotation thereof to prevent projections on the rod from interfering with the vertical bars during its rotation and for returning said select rod laterally to its normal position to cause a particular projection depending on the extent of the rotary movement of said select rod to actuate a corresponding horizontal bar, means responsive to the actuation of said horizontal bar followed by the actuation of a vertical bar for operating the contacts at the cross-point of said bars.

FRANK H. HIBBARD.