Jan. 5, 1937. P. W. SHEATSLEY 2,066,491

SWITCH

Filed Nov. 8, 1935 4 Sheets-Sheet 1

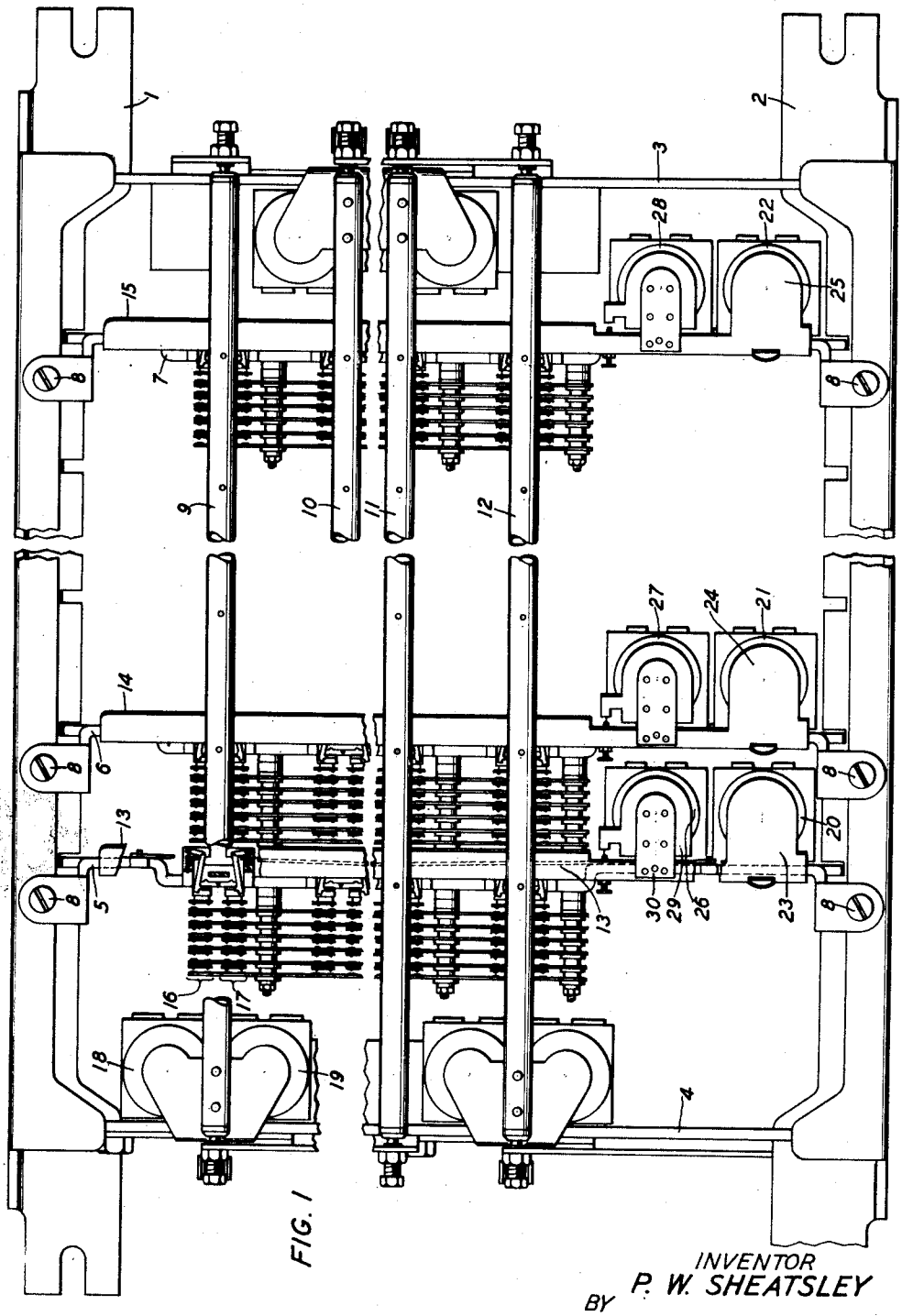


FIG. 1

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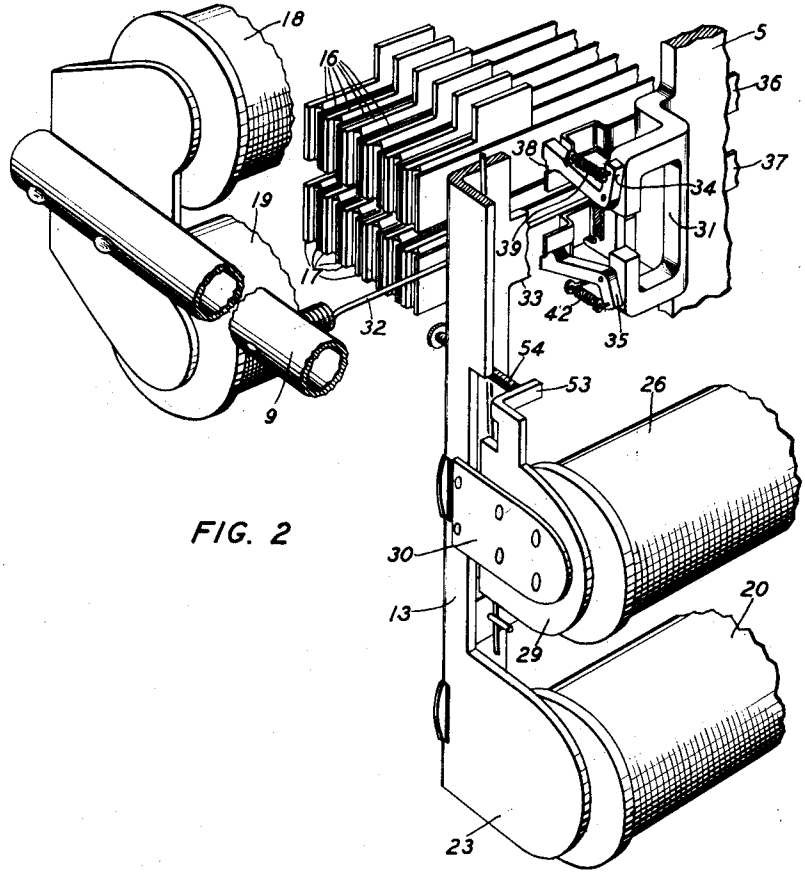


FIG. 2

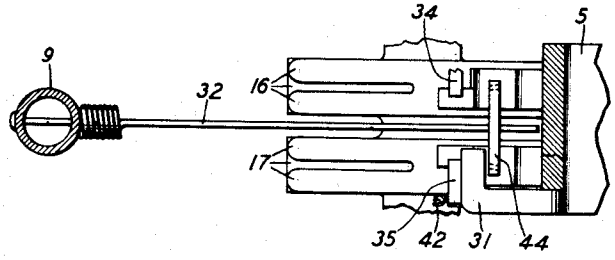


FIG. 3

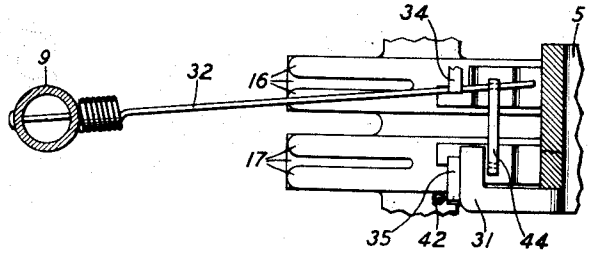


FIG. 4

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FIG. 5

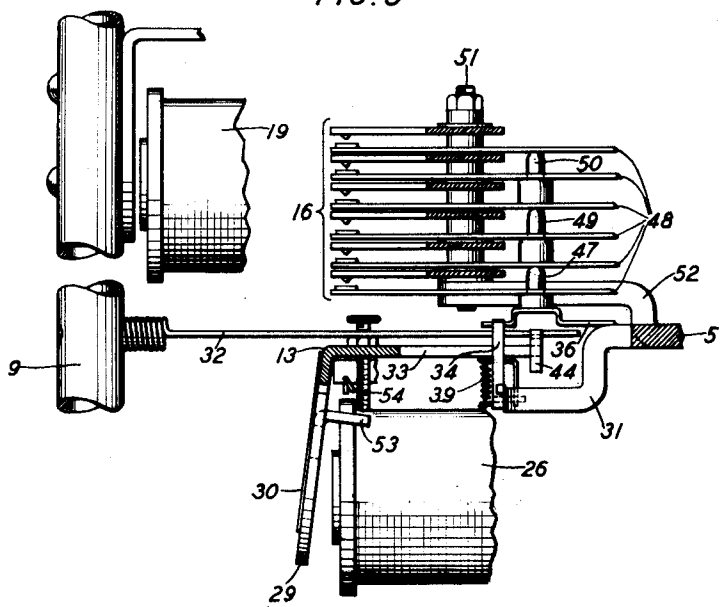
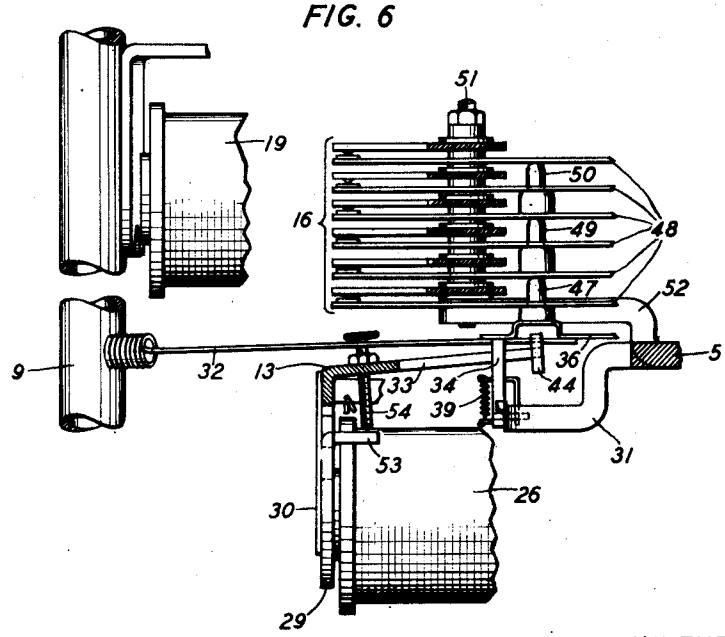


FIG. 6



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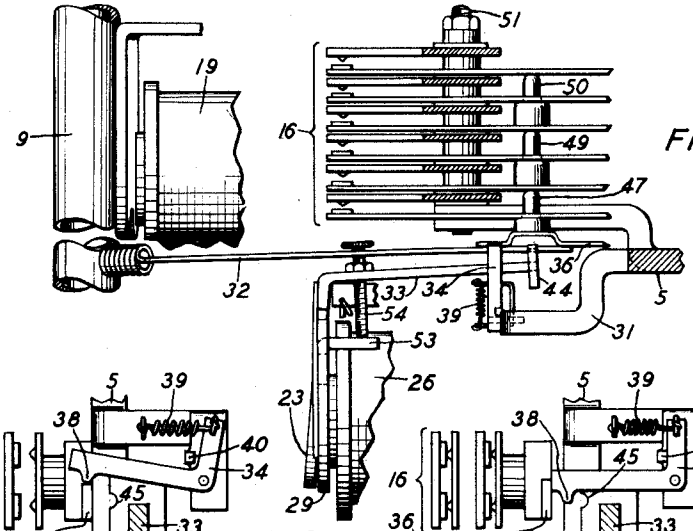


FIG. 7

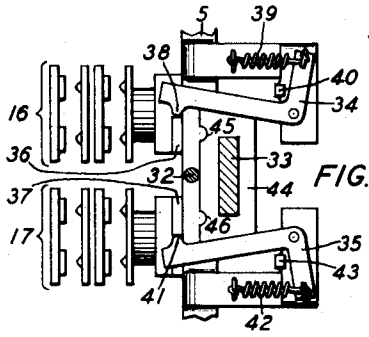


FIG. 8

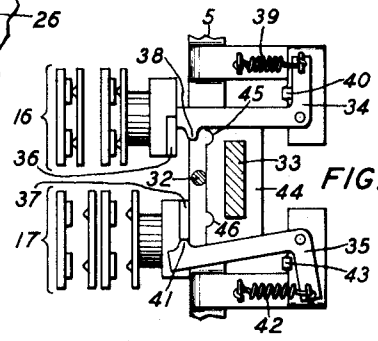


FIG. 11

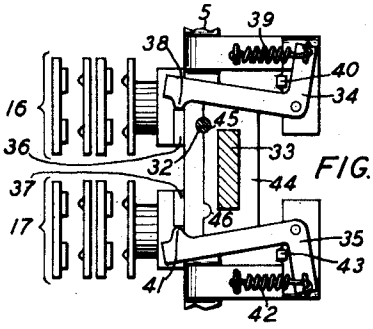


FIG. 9

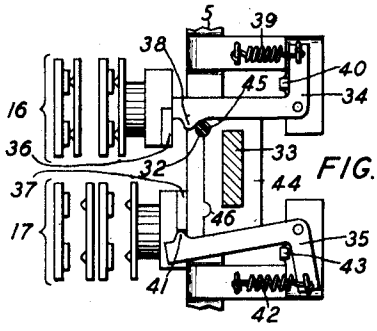


FIG. 12

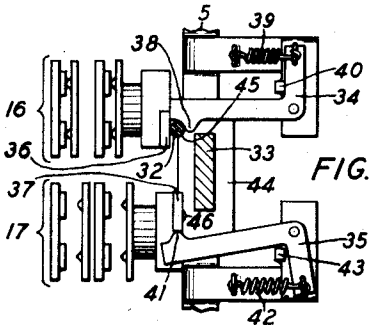


FIG. 10

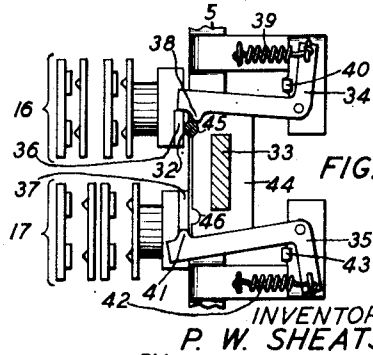


FIG. 13

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Patented Jan. 5, 1937 2,066,491

UNITED STATES PATENT OFFICE

2,066,491

SWITCH

Paul Weidner Sheatsley, Mountain Lakes, N. J., assignor to American Telephone and Telegraph Company, a corporation of New York

Application November 8, 1935, Serial No. 48,906

7 Claims. (Cl. 179—27.54)

This invention relates to automatic switches and particularly to those used in telephone systems.

The objects of the invention are to increase the capacity of automatic switches for making circuit connections without enlarging the size of the switch structure or unduly complicating the operating mechanism; to minimize the current consumption required for their operation; to improve the releasing operation of such switches; and otherwise to effect improvements therein.

In my copending application Serial No. 48,905, filed Nov. 8, 1935, there is disclosed and claimed an automatic switch of the cross-bar type in which the contacts at a cross-point, after being closed by the conjoint actuation of a pair of operating bars, are locked and maintained in their closed condition so as to permit the restoration of both operating bars and the associated magnets, and in which the cross-point contacts are restored to their normal open condition by the reoperation of one of said bars when the connection through said contacts is no longer required.

A feature of the present invention is a cross-bar switch in which the contacts at any desired cross-point are closed by the actuation of the two associated operating bars and are maintained closed by a locking or holding mechanism to permit the restoration to normal of both of said bars and also their associated magnets, and in which said closed cross-point contacts, when the connection therethrough is no longer needed, are unlocked and restored by the reoperation of the same two operating bars. This enables both operating bars to be used again in conjunction with other bars to close contacts at other cross-points without waiting for the first connection to be released. Also the fact that the operating magnets do not have to be energized throughout the entire duration of a connection means a considerable saving in current drain.

Another feature of the invention is a switch of this character in which one of the bars of any pair, which control a particular set of cross-point contacts, is arranged to move through a lesser distance in its contact releasing operation than it does in its contact closing operation. This not only insures a reliable release operation of the particular set of closed contacts involved, but it also is a safeguard against the inadvertent closure of other contact sets in the row controlled by the same bar.

These and other features of the invention will be discussed more in detail in the following specification and will also be set forth in the appended claims.

In the drawings, which also form a part of the specification:

Figure 1 is a front view showing as a whole a cross-bar switch incorporating the features of this invention. In this figure certain duplicate parts have been broken away and omitted to conserve space;

Fig. 2 is an enlarged partial perspective showing the essential operating elements of the switch;

Figs. 3 and 4 are side views of a portion of the contact operating mechanism, illustrating the horizontal operating bar in two different positions;

Fig. 5 is a fragmentary top view showing the horizontal and vertical operating bars and certain other parts in their normal positions;

Fig. 6 is a similar top view showing the contact set in its closed condition with the horizontal bar operated and the vertical bar in its fully operated position;

Fig. 7 is a similar top view showing the contact at the beginning of their releasing movement with the horizontal bar operated and the vertical bar in its partially operated condition; and

Figs. 8 to 13 are enlarged views illustrating the different relative positions of the parts involved in the closing and releasing operations of a contact set.

The invention is applicable in general to switches of the cross-bar type in which the bars of a plurality of sets cooperate with each other to bring about the selective operation of a desired set of circuit-making contacts. A switch of this kind is shown and described in an application of J. N. Reynolds, Serial No. 702,453, filed December 15, 1933, granted as Patent 2,021,329, Nov. 19, 1935. In the Reynolds patent and in the switch illustrated herein the cross-bars are rendered active by imparting a rotary movement thereto. Other switches of this general kind make use of sliding or longitudinally movable pairs instead of rotary pairs, and the present invention may also be applied to switches of this kind.

Referring now to the drawings, the switch illustrated therein includes a frame comprising two channel-shaped frame members 1 and 2 and two side members 3 and 4. The side members 3 and 4 fit into the channels of members 1 and 2 and are secured therein in any suitable manner, as by means of a welded joint.

The contact sets and the contact operating

mechanism are mounted in units on the vertical mounting plates 5, 6, 7, etc. These plates are secured by means of screws 8 to the upper and lower frame members 1 and 2. The number of these vertical units is variable and depends upon the desired capacity of the switch. One convenient capacity for switches of this kind is afforded by providing ten of these vertical units. For larger switches as many as twenty vertical units may be used. The contact bank which is formed by the contacts carried by the several mounting units may be considered as divided into two multiples, a horizontal multiple and a vertical multiple. The horizontal contact sets appearing at successive cross-points along a horizontal row may be multipled together by means of strap wires in a manner well known in the art. Likewise, the cooperating vertical contact sets appearing at successive cross-points in a vertical row may be multipled together. To effect a connection at any particular cross-point it is necessary to bring about a closure between the horizontal contact springs and the corresponding vertical contact springs. This is accomplished by means of the contact selecting and operating mechanisms which will be described hereinafter. Before taking up the operating mechanisms, however, a description will first be given of the cross-bars which control the selection and operation of these mechanisms.

The cross-bars of the switch comprise two sets, the horizontal or select bars 9, 10, 11 and 12, etc. and the vertical or actuating bars 13, 14, 15, etc. Each of the horizontal bars is common to two horizontal rows of contacts. For example, the horizontal bar 9 is common to the two uppermost horizontal rows of the contacts shown in Fig. 1. For each of these horizontal bars there are provided two operating magnets, such as the magnets 18 and 19 associated with the horizontal bar 9. One magnet rotates the bar in one direction, and the other rotates it in the opposite direction. As illustrated, the magnets for some of the horizontal bars are mounted on the frame member 3, and the magnets for the remaining horizontal bars are mounted on the opposite frame member 4. The number of horizontal bars may be varied and will be determined by the desired capacity of the switch. A convenient number of horizontal bars is five for switches of this kind.

The several vertical bars are attached for rotary movement to their respective mounting plates. The vertical bars 13, 14, 15, for example, are mounted on the plates 5, 6 and 7, respectively, and are operated in a rotary movement by the respective vertical magnets 20, 21 and 22. The magnets 20, 21 and 22 are provided, respectively, with armatures 23, 24, and 25 which are integrally formed with the corresponding vertical operating bars 13, 14 and 15. The energization of one of these magnets causes it to attract its armature and rotate the corresponding bar through a given distance for the purpose of operating and closing a selected set of contact springs. In addition to the operating magnets the vertical bars are also provided with release magnets 26, 27, 28, etc. Each of these release magnets is provided with armature. Magnet 26, for instance, has an armature 29 which is secured to the vertical bar 13 by means of a flexible hinge or spring 30. The purpose of this flexibly connected armature is, as will be described more fully in detail hereinafter, to produce a rotation of the vertical bar 13, when the release magnet 26 is energized, which is somewhat less in extent than the rotation of the bar caused by the energization of the operating magnet 20. This restricted movement of the vertical bar under the control of the magnet 26 and armature 29 is for the purpose of releasing an operated set of contacts. Each of the vertical bars just described is similarly equipped and is associated with a single one of the vertical rows of contacts above mentioned.

Coming now to the contact operating mechanisms, one of these is shown in detail in the upper left corner of the switch in Fig. 1 and is also shown more clearly in the views contained in the remaining figures of the drawings. These contact operating and releasing mechanisms are located at the respective cross-points. The particular mechanism located at the upper left corner of the switch as seen in Fig. 1 is disclosed more in detail in Fig. 2 and in the other figures. This mechanism, like the others in the switch, includes the flexible spring finger 32 on the horizontal bar 9, an operating arm 33 on the vertical bar 13, two latch levers 34 and 35, and two spring actuating elements 36 and 37. Latch levers 34 and 35 are pivoted on the upper and lower extensions of the bracket 31, which is integrally formed with the vertical mounting plate 5. The lever 34 has a cam 38 at one end thereof which normally bears on the upper surface of the contact actuating element 36, more clearly seen in Fig. 8. To the other end of the lever 34 there is attached a retractile spring 39, the force of which tends to rotate the lever toward its stop pin 40. The other latch lever 35 is similarly provided with a cam 41 which normally rests against the lower surface of the spring actuating element 37 and is urged by a retractile spring 42 toward the stop pin 43.

The free end of the operating arm 33 is provided with a plate 44. The free end of the flexible finger 32 normally rests against the plate 44 at a point midway between the ends thereof and opposite the gap between the two spring operating elements 36 and 37. These relative positions of the different parts are clearly seen in Fig. 8. The plate 44 is provided with notches 45 and 46 which lie respectively opposite the free ends of the spring operating elements 36 and 37.

The spring operating elements 36 and 37 are secured in some suitable manner to the frame of the switch and have their free ends shaped as seen in the different figures of the drawings. The free end of the spring 36 rests against the insulating stud 47 (Figs. 5, 6, and 7). The stud 47, together with the studs 49 and 50, mechanically interconnect the movable springs 48 of the set 16. Springs 48 extend to the rear of the switch where they are multipled to other similar sets of springs in the same horizontal row. The cooperating stationary springs, which are multipled in a vertical direction, are secured by means of a bolt 51 to a bracket 52 on the vertical mounting plate 5. In a similar manner the free end of the other spring operating element 37 lies in operative relation to the movable springs of the lower spring set 17. Each cross-point throughout the switch is equipped in the manner above described. This means, of course, that each horizontal bar has a plurality of fingers 32, one for each cross-point in the corresponding horizontal row and that each vertical bar has a plurality of arms 33, one for each cross-point in the corresponding vertical row.

A description will now be given of the manner in which the different parts of the switch function to selectively operate a desired set of cross-point contacts. Assume for this purpose that it is

desired to close the contact set 16. To operate contact set 16, it is first necessary to energize the magnet 19 to rotate the horizontal bar 9. This tilts the operating finger 32, associated with the cross-points comprising the contact sets 16 and 17, and all the other operating fingers attached to the bar 9 in an upward direction. As the flexible finger 32 reaches the limit of its upward movement, it slides into the notch 45 in the operating plate 44. Figs. 4 and 9 illustrate the mechanism at this stage of its operation. Following the positioning of the flexible finger 32 as just described, the vertical operating magnet 20 is energized to impart a full rotary movement to the vertical bar 13. As the bar 13 rotates, the operating plate 44 on the end of the arm 33 bends the flexible finger 32 and carries it into engagement with the free end of the operating element 36. With the continued movement of the plate 44 the finger 32 forces the element 36 against the stud 47, causing the movable springs 48 to be shifted against their tension into contact with their cooperating stationary springs. At the beginning of its movement the spring operating element 36 disengages the cam 38 on the end of lever 34, permitting the spring 39 to rotate the lever downwardly until its extreme end rests on the upper surface of the element 36. With the further movement of the element 36 to its extreme contact closing position it passes beyond the end of the lever 34 so that the spring 39 now draws the lever to its full downward position and against the stop pin 40. This stage of the operation is illustrated in Figs. 6 and 10. With the lever 34 in this position its free end latches the spring actuating element 36 and the movable contact springs in the operated position. Following this the horizontal and vertical magnets 19 and 20 are deenergized. The horizontal bar 9 restores to its normal position, and, as the vertical bar 13 begins its return movement, the flexible finger 32 escapes from the notch 45 and takes up its central position between the elements 36 and 37 and against the mid-point of the operating plate 44. This stage of the operation is illustrated in Fig. 11. The selected set of contacts 16 have thus been closed and latched by the conjoint movement of the horizontal and vertical bars, the horizontal bar has been released to restore all of its flexible fingers to their normal positions at the corresponding cross-points, and the vertical bar 13 has been restored to return all of its operating arms 33 to their normal positions. It should be noted that the vertical bar, when operated, rotated the operating arms 33 at each of the cross-points, and this in turn flexed the corresponding fingers 32 toward the left. Since, however, the flexible fingers 32 lie at a point between the upper and lower sets of operating springs, as seen in Fig. 8, no effect is produced at those cross-points which are not undergoing selection.

Assume next that it is desired to restore the operated set or contacts 16. To do this the horizontal bar 9 is again rotated by the magnet 19 to tilt the flexible finger 32 upwardly and into the notch 45. This position is shown in Fig. 12. Next the release magnet 26 is energized to attract the armature 29. During the initial travel of the armature 29 it has no effect on the vertical bar 13 because of its flexible attachment thereto. However, after the armature 29 has traveled through a portion of its stroke the finger 53 thereon engages the set screw 54, and during the remaining movement of the armature 29 the vertical bar 13 is rotated. The result of this is that the notched plate 44 carries the flexible finger 32 a limited distance in its horizontal movement. As the finger 32 moves toward the left, it engages the cam 38 and forces the lever 34 upwardly permitting the locked operating element 36 to escape the end of said lever. As the element 36 escapes the end of the latched lever 34, it moves in under the end of said lever and encounters the flexible finger 32. This stage of the operation is seen in Figs. 7 and 13. Following this the horizontal and vertical magnets are again released, and the bars and the flexible finger 32 restored to their normal position. As the finger 32 withdraws, the operating element 36, because of its own tension and because of the tension stored in the springs 48, forces the lever 34, by reason of the cam 38, upwardly until the cam 38 rests on the upper surface of the element 36 as seen in Fig. 8.

From the foregoing description it will be seen why the release magnet 26 is designed to operate the vertical bar through a distance somewhat less than the distance it is operated when the contacts are being closed and latched. Since the finger 32 is moved to a limited position by the release magnet 26, the operating element 36 is permitted to partially restore as soon as it is unlatched, and, by partially restoring, it moves in under the end of lever 34 so that the lever is prevented from again latching the contacts in their closed position as soon as the operating bars are restored. Moreover, the limited movement of the vertical bar, when in the act of releasing a particular set of contacts, is insufficient to cause the false closure of a set of contacts at some other cross-point in the same vertical row should the corresponding horizontal bar be operated at the time.

In a manner similar to that already described the other set of contacts 17 at the same cross-point may be selected, operated, and released by the operation of the horizontal bar in the opposite direction by means of magnet 18 in conjunction with the operation of the vertical magnet 20 and the release magnet 26. Likewise any other set of cross-points in the switch may be operated and released by the conjoint action of the proper horizontal and vertical bars.

One of the advantages of a switch of this kind is that all magnets are deenergized and all of the operating bars are retained in their normal positions except during the brief interval that the contacts are being closed and opened. This avoids undue consumption of current. Also it avoids the necessity of maintaining a plurality of the horizontal flexible fingers in their tensioned condition as is the case where it is necessary to hold the vertical bars energized to maintain the contacts closed.

What is claimed is:

1. In an automatic switch, operating bars, a set of normally open circuit-making contacts arranged to maintain their closed position independently of said bars, and contact controlling mechanism responsive to the movement of a plurality of said bars for closing said contacts and also responsive to the movement of said plurality of bars for opening said contacts.

2. In an automatic switch, operating bars, a set of circuit-making contacts, means for holding said contacts in their operated position independently of said bars, means for operating said bars, and means controlled by the action of two of said bars for operating said contacts

and for causing said holding means to restore said contacts.

3. The combination in an automatic switch of operating bars, a set of circuit-making contacts, means for holding said contacts in their operated position after said bars have restored, means for operating said bars, and means responsive to a first conjoint movement of a pair of said bars for closing said contacts and responsive to a subsequent conjoint movement of said pair of bars to cause the release of said contacts.

4. In a selective switch, a set of contacts, a pair of operating bars, means for operating said bars conjointly to effect the closure of said contacts, a device for holding said contacts closed to permit the restoration of said bars, and means including said holding device responsive to another conjoint operation of said bars for causing the opening of said contacts.

5. In a selective switch, a set of contacts, a first operating bar, a second operating bar, means for moving said first bar, means for moving said second bar a given amount in conjunction with the movement of said first bar to effect the closure of said contacts, and means for moving said second bar a different amount in conjunction with the movement of said first bar to effect the opening of said contacts.

6. In a selective switch, a set of contacts, a first operating bar, a second operating bar, means for moving said second bar a given amount in conjunction with the movement of said first bar to effect the closure of said contacts, means for latching said contacts in closed position, and means for moving said second bar a different amount in conjunction with the movement of said first bar to effect the opening of said contacts.

7. In a selective switch, a set of contacts, an operating bar, means for moving said bar a given distance to effect the closure of said contact set, and means for subsequently moving said bar a different distance to effect the opening of said contact set.

PAUL WEIDNER SHEATSLEY.