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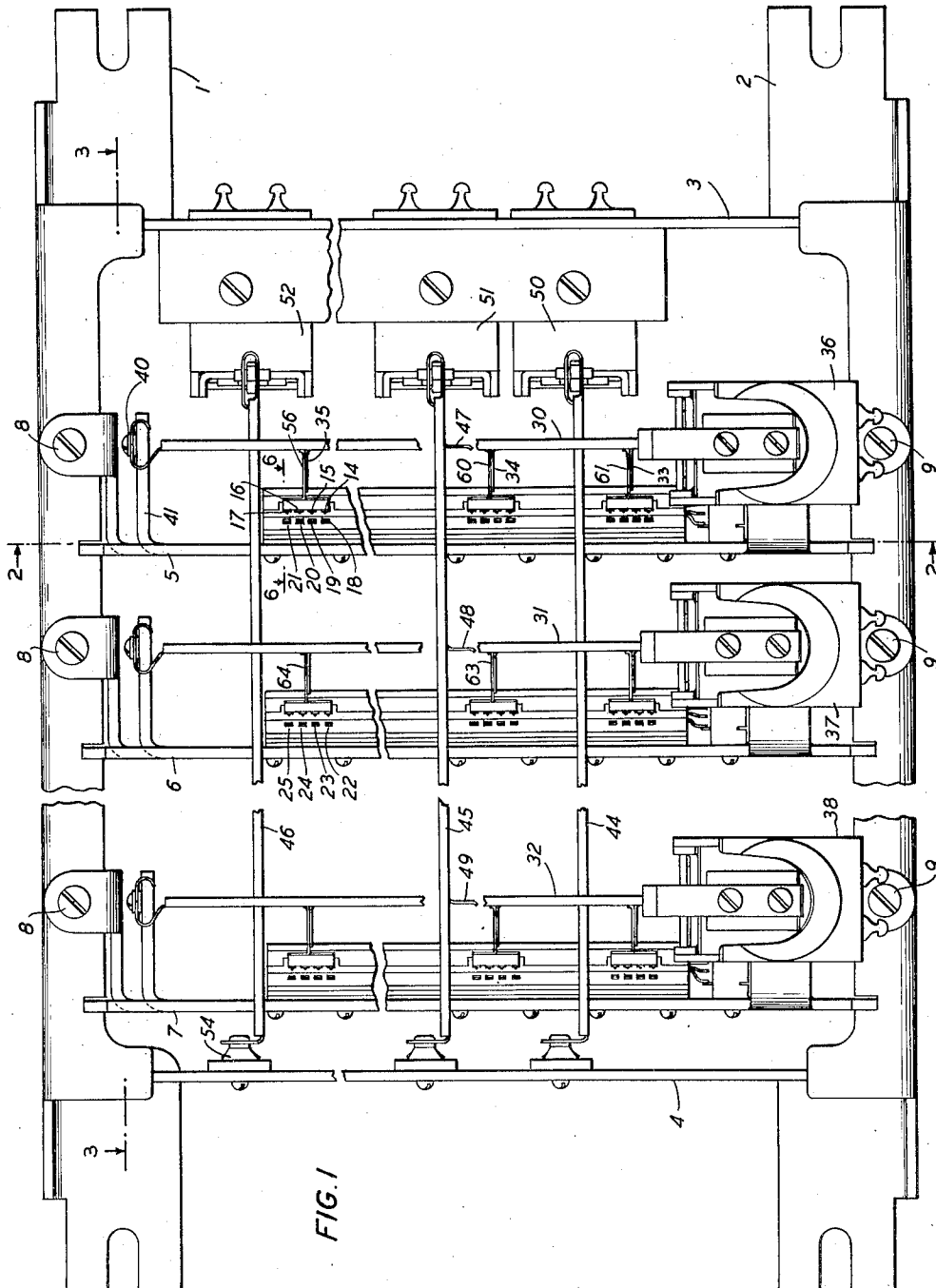
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2,060,176

SWITCH

Filed Oct. 22, 1935

5 Sheets-Sheet 1



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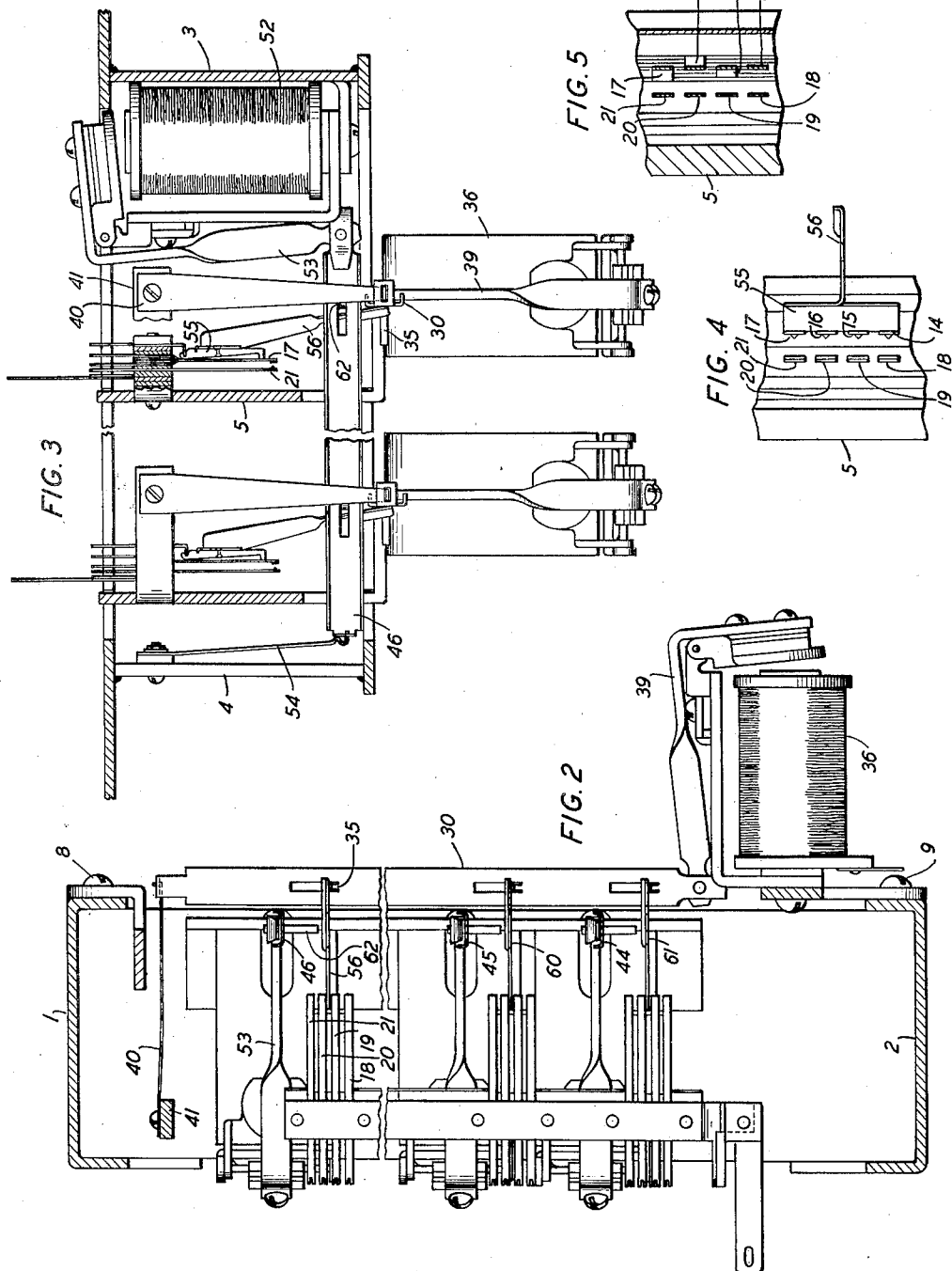
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SWITCH

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Sheets-Sheet 2



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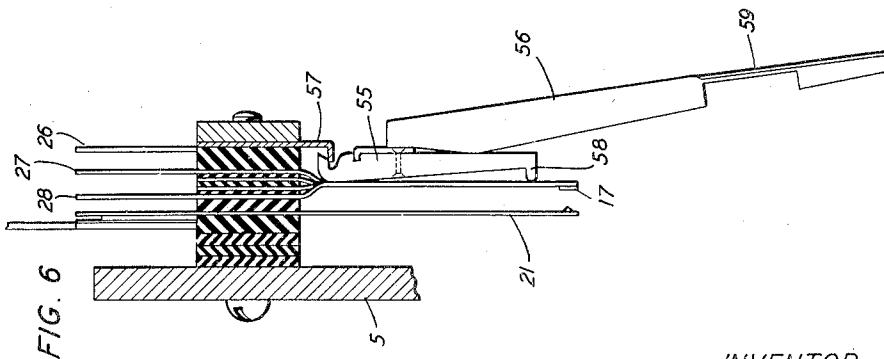
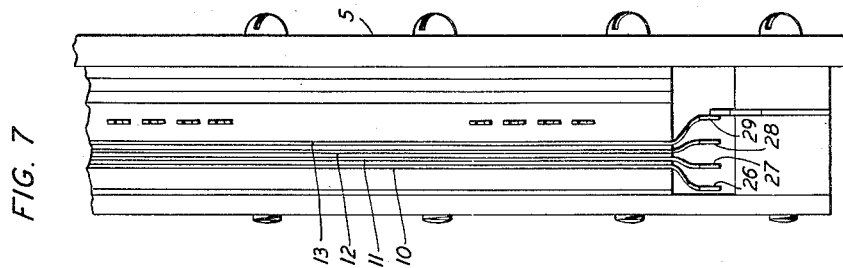
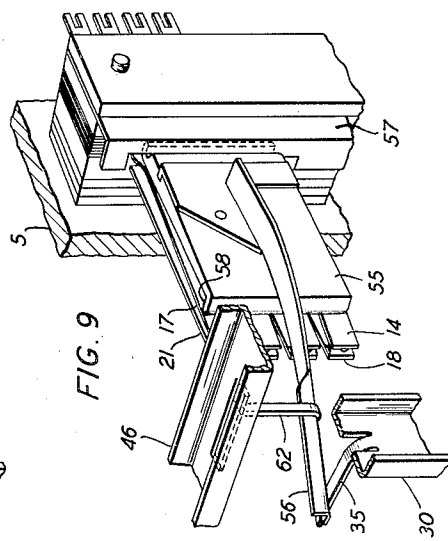
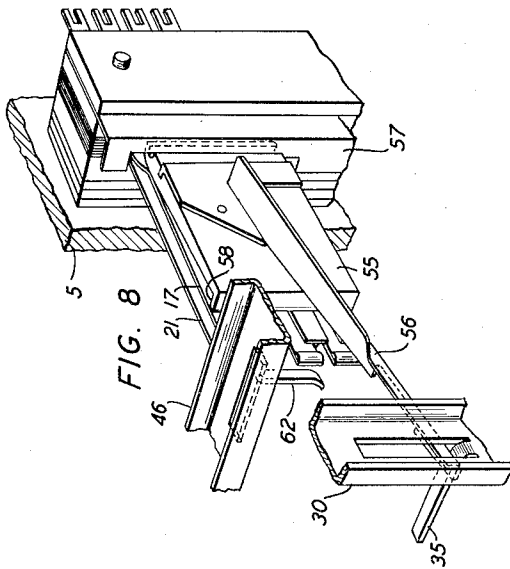
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SWITCH

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5 Sheets-Sheet 3



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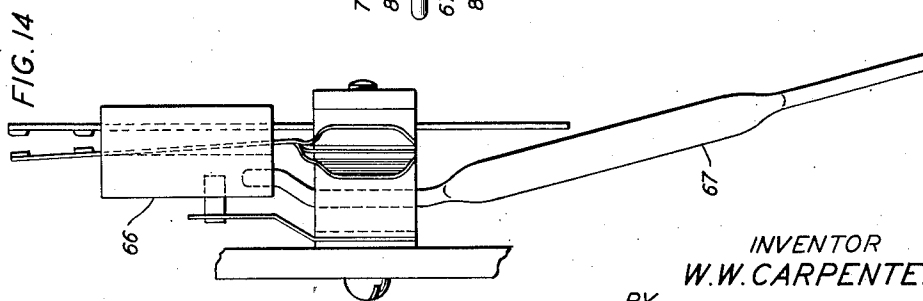
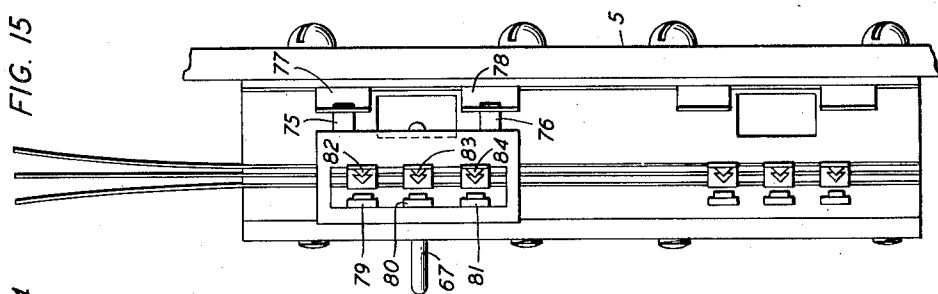
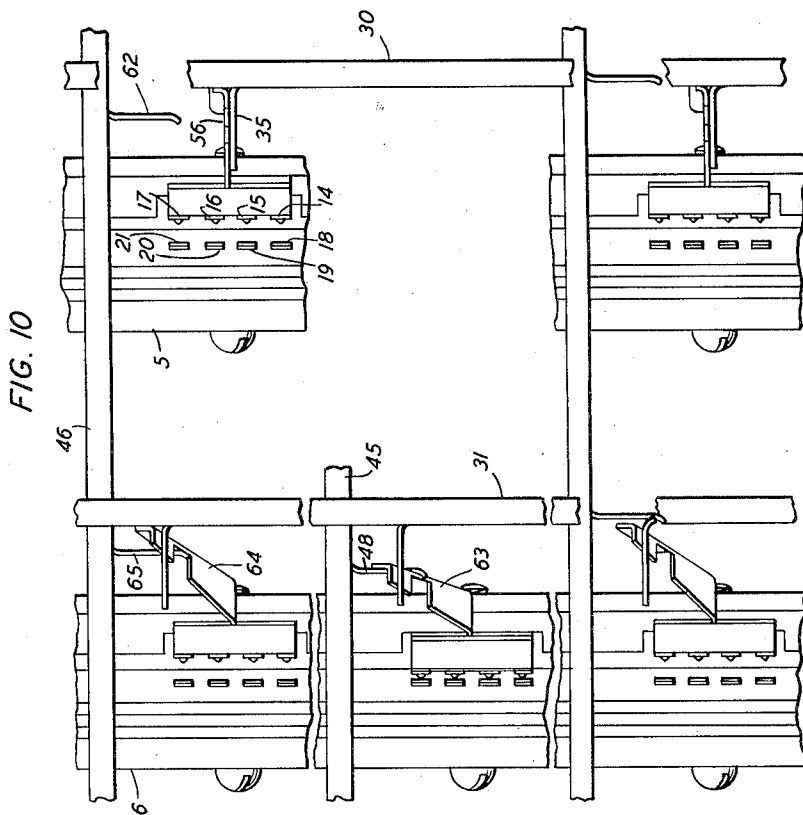
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SWITCH

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5 Sheets-Sheet 4



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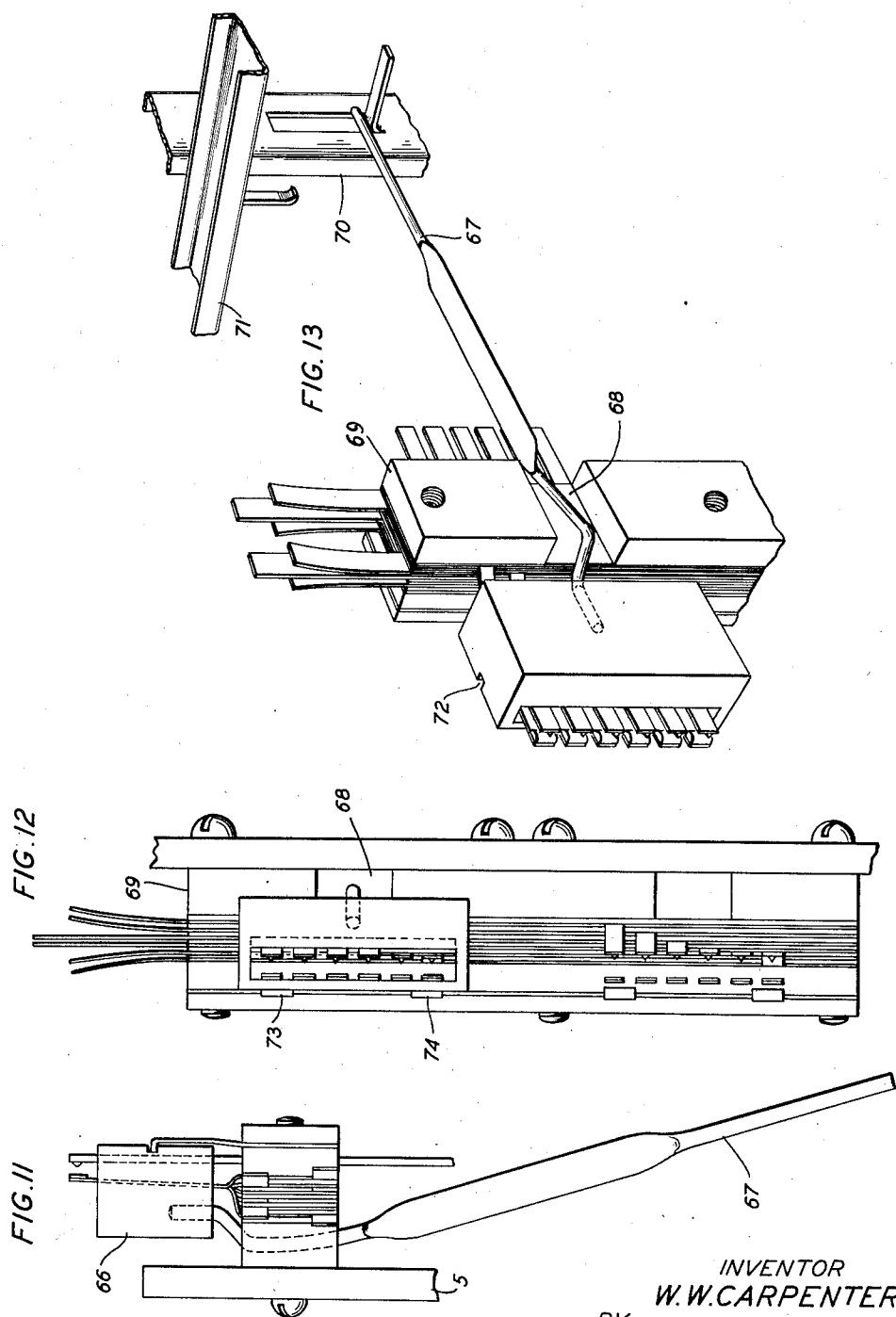
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SWITCH

Filed Oct. 22, 1935

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,060,176

SWITCH

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Application October 22, 1935, Serial No. 46,075

12 Claims. (Cl. 179—27.54)

This invention relates to automatic switches and particularly to switches of the cross-bar type.

An object of the invention is to simplify the construction and to increase the dependability of the mechanism for operating the contact springs of a cross-bar switch.

Another object is to control the setting and releasing movements of the actuating bars with respect to each other to prevent the occurrence of unstandard operations, such as those resulting in double connections.

A further object of the invention is to reduce the load imposed upon the operating magnets, thus minimizing the current consumption and increasing the efficiency of the switch.

The present invention, which has the foregoing and other objects, relates in general to improvements in switches of the cross-bar type in which a plurality of spring contact sets are arranged in coordinating rows and are selectively and separately operable by the conjoint action of one of a plurality of select bars and one of a plurality of hold bars. A switch of this kind is disclosed in the application of J. N. Reynolds, Serial No. 702,453, filed December 15, 1933, granted as Patent 2,021,329, November 19, 1935.

According to a feature of the present invention, each set of cross-point contact springs is operable by a unitary selecting and actuating element, individual to the set of springs, comprising an insulating card or block which serves to hold the springs of the set in alignment and also to move the springs into contact with each other and an actuating finger, one end of which is secured to said block. This finger is yieldable in one direction so that the free end thereof can be flexed to a selecting position by a select bar without imparting any movement to said insulating block. The finger is inflexible in a second direction to the force applied to the free end thereof by a hold bar, whereby both the finger and the insulating block are moved or rocked under the action of the hold bar to cause the closure of the contact springs. This actuating unit is held in place by a spring or other suitable means and can be detached readily for adjustment or replacement.

Another feature is a switch so constructed that an operated hold bar, following the opening of the circuit of the magnet that has been holding the bar in its operated position, is prevented from fully restoring to normal, provided some select bar is positioned at the time preparatory to the establishment of another connection through the switch. This prevents the possibility of a

hold bar releasing fully to its normal position stop and then rebounding to a point where it contacts with the newly operated select bar to inadvertently close the corresponding set of contacts.

A still further feature is a switch in which the select and actuating fingers for an entire row of contacts are flexed to their select positions by a select bar which is moved by an operating magnet, and in which a spring acting on the bar assists the magnet to move the bar to its operated position against the tension of the several select fingers. The tension of the assisting spring can be so chosen that it is somewhat less than the combined force of the select fingers. In this way the force required by the operating magnet is reduced to a minimum.

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

The invention is illustrated in the accompanying drawings wherein Figs. 1 to 10, inclusive, show the essential parts of one embodiment; Figs. 11, 12 and 13 show a modification of the contact operating mechanism; and Figs. 14 and 15 show a further modification of the contact operating mechanism.

Fig. 1 is a front view showing the switch as a whole with certain of the duplicate elements eliminated to conserve space;

Fig. 2 is a vertical sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a partial horizontal sectional view taken along the line 3—3 of Fig. 1;

Figs. 4 and 5 are details of the spring contact structure;

Fig. 6 is an enlarged top view, taken along line 6—6 of Fig. 1, of one of the spring contact operating elements;

Fig. 7 is a rear view of one of the vertical multiple contact strips;

Figs. 8 and 9 are perspective views showing the details of the contact operating mechanism;

Fig. 10 is an enlarged front view of the switch showing the relative operative positions of some of the elements;

Fig. 11 is an enlarged view of a modified form of the operating element;

Fig. 12 is a front view of a vertical contact strip showing the operating element of Fig. 11 in place;

Fig. 13 is a perspective view of the operating mechanism shown in Figs. 11 and 12;

Fig. 14 is an enlarged view of a further modification of the operating element; and

Fig. 15 is a front view of the contact strip showing the element of Fig. 14 in place.

While the present invention is illustrated in connection with a cross-bar switch of the type in which the bars are operated in a longitudinal or sliding movement, it is not so limited but may be applied to switches of other types, such as those utilizing the rotary-bar principle. A switch of this latter kind is shown and described in the Reynolds patent above mentioned. Also many of the other constructional elements of the switch may be varied without departing from the spirit of the invention.

Referring now to the drawings, and first to Figs. 1 to 10, a detailed description will be given of the construction and operation of the switch. The frame of the switch comprises the U-shaped horizontal members 1 and 2 and the vertical side members 3 and 4, which are secured by welding or any suitable method to said horizontal members. Mounted within the frame thus formed by the members 1, 2, 3 and 4 are ten vertical contact spring assembly units, only three of which units are illustrated in Fig. 1. The several elements, including the contact springs, comprising each one of these vertical units, are mounted on vertical supporting plates, such as plates 5, 6 and 7. The supporting plates 5, 6, 7 fit into notches in the frame members 1 and 2 and are secured thereto by means of screws 8 and 9. The spring contact strips, one of which is shown enlarged in Figs. 6 and 7, are secured by screws to the vertical plates 5, 6 and 7. The vertical multiple consists of a plurality of strips extending the full length of the vertical assembly unit. In the drawings four of these multiple strips, 10, 11, 12 and 13, are shown. Each of the four vertical strips 10, 11, 12 and 13 has a series of integral portions extending therefrom at equally spaced intervals along the length of the vertical unit. These extending portions 14, 15, 16 and 17 form the contact springs of the vertical multiple. There are ten of these sets of vertical contact springs in each vertical unit. For each of the ten sets of contact springs multiplied vertically there is also a set of cooperating contact springs. These latter contact springs are multiplied in a horizontal direction and constitute the horizontal multiple. The horizontally multiplied contact springs are provided individually at the several cross-points of the switch. For example, the contact springs 18, 19, 20 and 21 are provided for the uppermost cross-point shown in the right-hand vertical unit of the switch. They cooperate respectively with the contact springs 14, 15, 16 and 17 of the vertical multiple, and they are multiplied horizontally to corresponding contact springs, such as springs 22, 23, 24 and 25, in the same horizontal row.

As above mentioned, the vertical multiple contact springs and the horizontal multiple contact springs are secured to the mounting plates 5, 6, 7. A clearer view of the way in which these springs are secured to the mounting plates is shown in Figs. 6 and 7. The vertical contact strips 10, 11, 12 and 13 terminate in lugs 26, 27, 28 and 29 at the bottom of the switch, to which the incoming circuit conductors may be soldered conveniently. The cooperating horizontal contacts extend to the rear of the switch at each cross-point and terminate in soldering lugs as illustrated in Fig. 2. Strap conductors soldered to these lugs across the rear of the switch form the horizontal multiple. The spring

contact structure of the switch thus far described is one comprising ten vertical rows of contact sets, each row having ten sets of contacts therein, giving in all one hundred separately operable sets of circuit-making contacts.

These contact sets are selectively operated by means of two sets of cooperating bars, ten vertical bars and ten horizontal bars. Each of the vertical bars 30, 31 and 32 is prepared from channel stock of some suitable material, and at each of the cross-points the vertical bar is provided with a horizontally extending finger, such as fingers 33, 34 and 35 on bar 30. These fingers are formed by punching out a portion of the material of the bar as is best seen in the perspective view in Figs. 8 and 9. The several vertical bars are provided individually with vertical operating magnets 36, 37, 38, each having an armature 39 to which the corresponding vertical bar is attached. The upper end of the vertical bar, such as bar 30, is supported by a spring 40 secured to the overturned portion 41 of the supporting plate 5.

The energization of the magnet 36 moves the bar 30 from its normal position as seen in Fig. 2 upwardly in a longitudinal direction to its operated position, and the spring 40 at the upper end of the bar tends to assist the magnet in moving the bar to the operated position. The reason for this will be explained more fully hereinafter.

The horizontal operating bars 44, 45, 46 intersect the vertical bars at the cross-points. These horizontal bars are similarly made of channel stock, and each bar has a downwardly projecting integral finger at each of the several cross-points. These fingers 47, 48, 49 may be seen on the bar 45 in Fig. 1. The horizontal bars are also provided with individual operating horizontal magnets 50, 51, 52. The bar 46, for example, is secured to an armature 53 of the horizontal magnet 52 in such a way that the energization of the magnet slides the bar in a horizontal direction to the left as viewed in Figs. 1 and 3. The bar 46 is restored to its normal position by the retractile spring 54. The other horizontal bars are similarly provided with armature attachments and retractile springs.

Each of the several cross-points is provided with a separately operable contact operating unit. This unit is more clearly disclosed in Figs. 6, 8, 9 and 10. It comprises a plate 55 of insulating material and a flexible finger 56 riveted thereto. The rear end of the plate 55 is provided with a slot which engages the overturned edge of the metal strip 57, which in turn is secured to the vertical mounting plate. The pressure of the vertical contact springs 14, 15, 16 and 17 against the plate 55 holds it securely in position with the notch engaging the strip 57. On the other hand, by seizing plate 55 and applying to it a twisting force, the resiliency of the contact springs permits its entire removal from the switch. The forward end of the insulating plate 55 has a projecting edge 58 which bears against all of the springs 14, 15, 16 and 17 of the vertical set and holds them in proper alignment with respect to the cooperating horizontal springs 18, 19, 20 and 21. With the contact operating unit in place the operating finger 56 rests on the projection 35 of the vertical bar 30. Because of the shape of the finger 56 it possesses a certain amount of flexibility in a vertical direction and rests on the projection 35 of the vertical bar 30 thereby tending to hold the bar in its normal position. Be-

cause of the stiffened portion 59 the finger 56 is substantially rigid in a horizontal direction. The purpose of this will be explained hereinafter. Each of the remaining contact operating fingers of the switch are constructed and arranged in this manner. With all of the operating fingers in a vertical row bearing on the corresponding projections 33, 34, 35 of the vertical bar 30, an appreciable amount of force in exerted tending to hold the bar in its normal position. This force must be overcome by the operating magnet 36 when the bar is moved against the tension of these fingers. And it is for the purpose of neutralizing the cumulative effect of the several operating fingers that the spring 40 is provided. This spring aids the operating magnet, and the tension it exerts may be so chosen as to overcome the load when a considerable number of the operating fingers are bearing on the bar without, on the other hand, neutralizing to too great an extent the force when a smaller number of the operating fingers are resting on the bar.

A brief description will now be given of the operation of the switch shown in Figs. 1 to 10, inclusive. Assume that it is desired to close the contacts of the set shown in the upper right-hand corner of Fig. 1. To do this the vertical magnet 36 is energized to position the vertical select bar 30, flexing each of the operating fingers 56, 60 and 61 upward to a point opposite the corresponding finger on the horizontal bar. Next the horizontal magnet 52 is energized to move the horizontal holding bar 46 to the left. As the bar 46 moves to its operated position, the finger 62 thereon engages the flexed operating finger 56 and moves it to the left. As the finger 56 is moved in this direction, it presses the edge 58 of the insulating plate 55 against the vertical contact springs 14, 15, 16 and 17, flexing these springs into engagement with the cooperating horizontal contact springs 18, 19, 20 and 21. Since the finger 56 is rigid with respect to a force supplied in the horizontal direction the bar 46 does not flex the finger in a horizontal direction, all of the force of the bar being applied to the movement of the contact springs. The vertical or select magnet 36 is now deenergized, permitting the vertical bar 30 to restore to normal position. The flexed and operated finger 56, however, is held in its operated position to maintain the contacts closed by the continued operation of the hold bar 46. The finger 62 on the bar 46 has a slight hook on its lower end which prevents the flexed finger from escaping when the setting finger 35 on the vertical bar is withdrawn. The contacts in their operated condition are seen in Fig. 9. When it is desired to restore the switch, the horizontal holding magnet is released permitting the bar 46 to withdraw to its normal position. As bar 46 moves toward its normal position, the tension of operating finger 56 causes it to escape from the hooked portion of the finger 62 and to return to its position resting on the finger 35 of the vertical bar, and the operated contacts are permitted to open.

Assume now that a contact set has been closed by the conjoint operation of bars 30 and 46 and that the bar 46 is about to be released to restore these contacts. Assume also that just before the horizontal bar 46 is released another vertical bar such as bar 31 is operated preparatory to the operation of another set of contacts. The bar 31 flexes the operating fingers such as fingers 63, 64 in the vertical row which it controls. Referring particularly to Fig. 10, it will be seen that the

finger 64 moves to a position in the path of the finger 65 on the horizontal bar 46 that is about to restore to normal. Since the finger 64 is on the back side of the finger 65, the latter finger is obstructed in its movement; therefore, the bar 46 which has begun its restoration is temporarily arrested and prevented from fully restoring to normal. The proper horizontal bar 45 for establishing the second connection is now operated, and shortly thereafter the vertical bar 31 is permitted to restore. When this happens, the selecting finger 64 is withdrawn from its obstructing position, and the partially restored horizontal bar 46 is allowed to assume its normal position. The reason for arresting a restoring horizontal bar at this stage in the operation is to prevent it from rebounding from its normal position to a point where it engages the operated selecting finger 64 sufficiently to close the contacts of the corresponding set, thus effecting a false connection. The rebounding action of the bar may be increased by the residual magnetism in the operating magnet and also by the inductive effect of adjacent magnets.

The modified form of operating finger disclosed in Figs. 11, 12 and 13 has the same function as the one already described. It comprises an insulating block 66 having a rectangular aperture extending therethrough. One end of the flexible operating finger 67 is securely embedded in the insulating block 66. The block 66 and the finger 67 therefor form a unitary removable structure. With the selecting finger in place the insulating block 66 rests on the cooperating contact springs, the movable ends projecting through the aperture. The finger 67 passes through a slot 68 in the contact spring supporting strip 69 and projects to a point where it cooperates with the vertical and horizontal bars 70 and 71. The insulating block 66 has a slot 72 therein which, when the unit is in place, receives spring clips 73 and 74 to hold the unit firmly in position.

The operation of this modified structure is similar to the one already described. The movement of the vertical bar 70 flexes the spring finger 67 upwardly into the path of the projecting finger on the horizontal bar 71. This upward movement of the spring finger 67 causes no movement of the insulating block 66. When the horizontal bar 71 is moved, the finger 67 is advanced without flexing in a horizontal direction. This causes the insulating block to pivot about the springs in such a manner as to force them into contact engagement with each other. When the horizontal bar is finally released, the mechanism restores to its normal position.

The other modification of the contact operating finger is shown in Figs. 14 and 15. Here the insulating block 66 and the spring operating finger 67 are the same as those shown in Figs. 11, 12 and 13. The method of holding the block 66 in position, however, is somewhat different. In this case instead of using the slot 72 and the engaging springs 73 and 74, the block 66 is provided with pins 75 and 76 which project a slight distance from the surface thereof. These pins engage holes in springs 77 and 78 secured to the vertical mounting unit. As in the case of the modification shown in Figs. 11, 12 and 13 the successive vertical and horizontal operations of the finger 67 of the device shown in Figs. 14 and 15 cause the block 66 to pivot about the springs 79, 80, 81 thereby forcing the flexible cooperating contact springs 82, 83 and 84 into contact-making engagement with the first mentioned springs.

What is claimed is:

1. In a selective switch, a set of normally open contact springs, a combined contact selecting and operating unit individual to said contact set comprising an insulating block and a selecting and actuating finger one end of which is secured to said block, means acting upon said finger to flex the same without moving said block, and means acting upon said finger to move it and said block in unison to effect the closure of said contact springs.

2. In a selective switch, a set of normally open contact springs, an insulating member movably supported in proximity to said contact springs, an actuating element having one end secured to said insulating member, a bar acting upon the free end of said element to flex the same without moving said insulating member, and a second bar acting upon the free end of said element to move both the element and the insulating member to effect the closure of said contact springs.

3. The combination in a selective switch of a plurality of sets of normally open contact springs, actuating elements, one for each set of springs, each element comprising an insulating member and a selecting and actuating finger, said insulating member serving to hold said contacts in alignment, one end of said finger being secured to the insulating member, and means coacting with the free end of any one of said fingers for moving the corresponding insulating member to close the corresponding set of contact springs.

4. The combination in a selective switch of a set of contact springs, an insulating block engaging said springs, a finger having one end secured to said block and supported thereby, said finger being flexible when force is applied in one direction to the free end thereof and inflexible when a force is applied in a different direction to said free end, and means acting upon the free end of said finger to move said block and close the springs of said set.

5. The combination in a selective switch of a set of contact springs, an insulating member engaging said springs and holding them normally in alignment, a finger having one end secured to said insulating member, said finger being flexible when force is applied in one direction and inflexible when force is applied in a different direction to the free end of said finger, means acting upon said finger in said first-mentioned direction to flex the free end thereof to a select position without moving said insulating member, and means acting in said second direction upon the flexed finger to move both the finger and the insulating member to effect the closure of said contact springs.

6. In a selective switch, a set of contact springs, an insulating block having an aperture therein, said springs extending through said aperture and being held in alignment by said insulating block, an actuating element having one end secured to said insulating block, means for moving said actuating element, and means for thereupon moving both said element and insulating block to effect the closure of said contact springs.

7. The combination in a selective switch, a set of contact springs comprising a plurality of pairs, the springs of each pair being arranged in opposing relation and normally extending with their contacts open, an insulating block having an aperture therein through which the free ends of said contact springs extend, the opposing

springs of each pair resting against the opposite sides of said aperture and being held in alignment thereby, a selecting and operating element secured to said insulating block, means for positioning said element without moving the insulating block, and means acting upon the positioned element for moving said block to force the springs of each of said pairs into engagement with each other.

8. The combination in a selective switch of a plurality of separately operable contact sets, a plurality of select bars, a hold bar, individual operating and releasing means for each of said bars, means responsive to the conjoint operation of a select bar and a hold bar for selectively operating a set of contacts, said contacts being held operated following the release of the select bar by the continued operation of the hold bar, and means for preventing the release of said hold bar during the time another of said select bars is in operated position.

9. In a switch, a plurality of separately operable contact sets, a plurality of select bars, a hold bar, individual operating and releasing means for each of said bars, means responsive to the combined operation of a select and hold bar for selectively operating a set of contacts, said contacts being held in operated condition following the release of the select bar by the continued operation of the hold bar, and means controlled by another of said select bars when advanced to its operated position for preventing the full release of said hold bar.

10. In a switch, a plurality of contact sets, a plurality of select bars, a hold bar, individual magnets for operating said bars, individual means for restoring said hold bar to its normal position upon the deenergization of the magnet individual thereto, means responsive to the conjoint operation of a select bar and a hold bar for selectively operating a set of contacts, said contacts being held operated by the continued energization of the hold magnet following the release of the operated select bar, and means controlled by another of said select bars when moved to its operated position for preventing the release of said hold bar in case the individual magnet is deenergized while said last mentioned select bar is in its operated position.

11. The combination in a switch of a plurality of contact sets arranged in a row, a plurality of flexible selecting and actuating fingers, one for each contact set, a bar for said row of contact sets, each of said fingers engaging said bar and exerting thereon a force tending to hold the bar in its normal position, an operating magnet for moving said bar to its actuated position against the tension of all of said fingers, and separate means acting on said bar to assist said magnet to move the bar to its actuated position.

12. The combination in a switch of a plurality of contact sets arranged in a row, flexible selecting and actuating elements, one for each of said contact sets, a bar for said row of contact sets, each of said flexible elements engaging said bar and exerting thereon a force tending to hold the bar in its normal position, operating means for moving said bar to its actuated position against the tension of said flexible elements, and resilient means acting on said bar in opposition to said flexible elements to assist said operating means.

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