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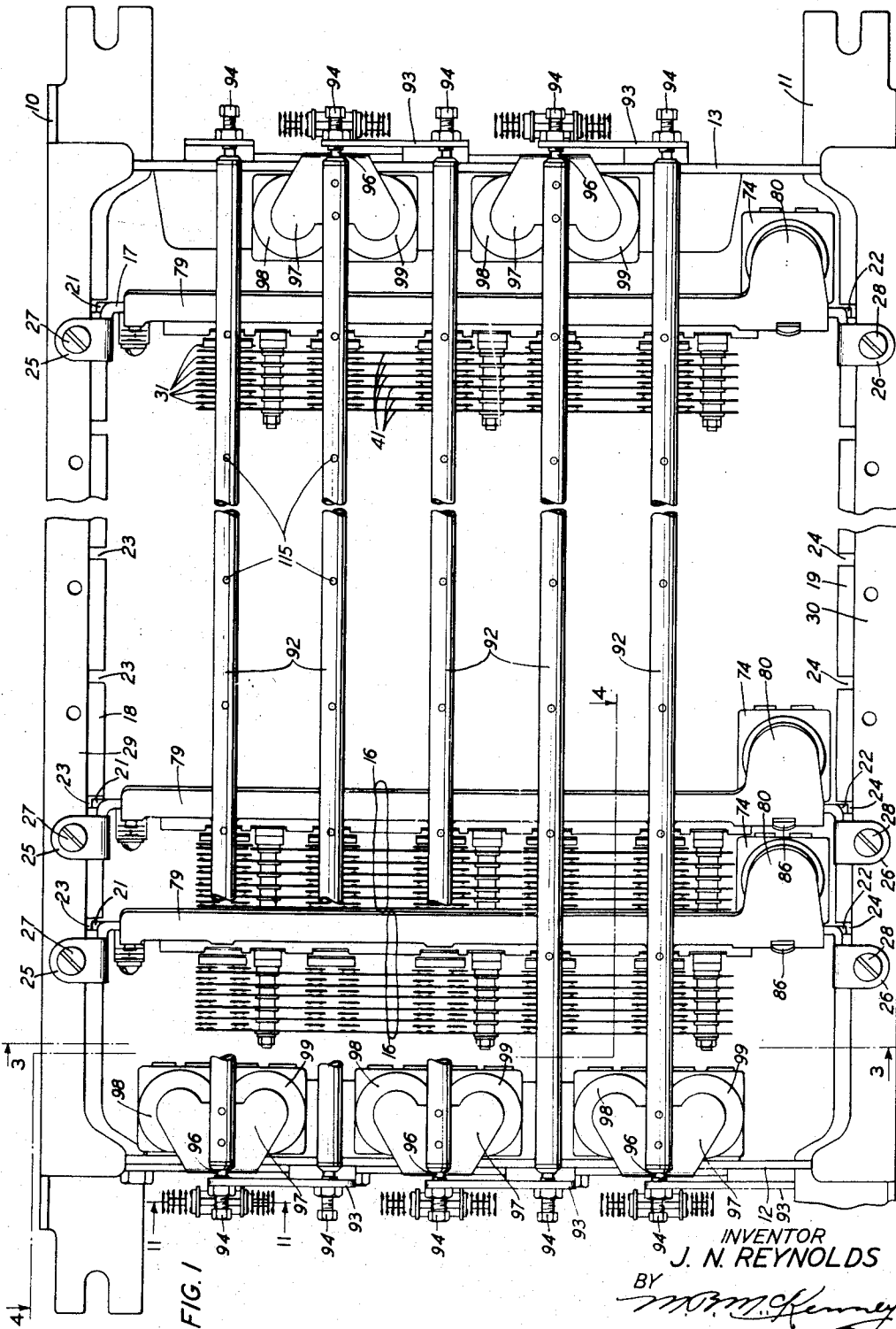
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2,021,329

SWITCHING MECHANISM

Filed Dec. 15, 1933

4 Sheets-Sheet 1



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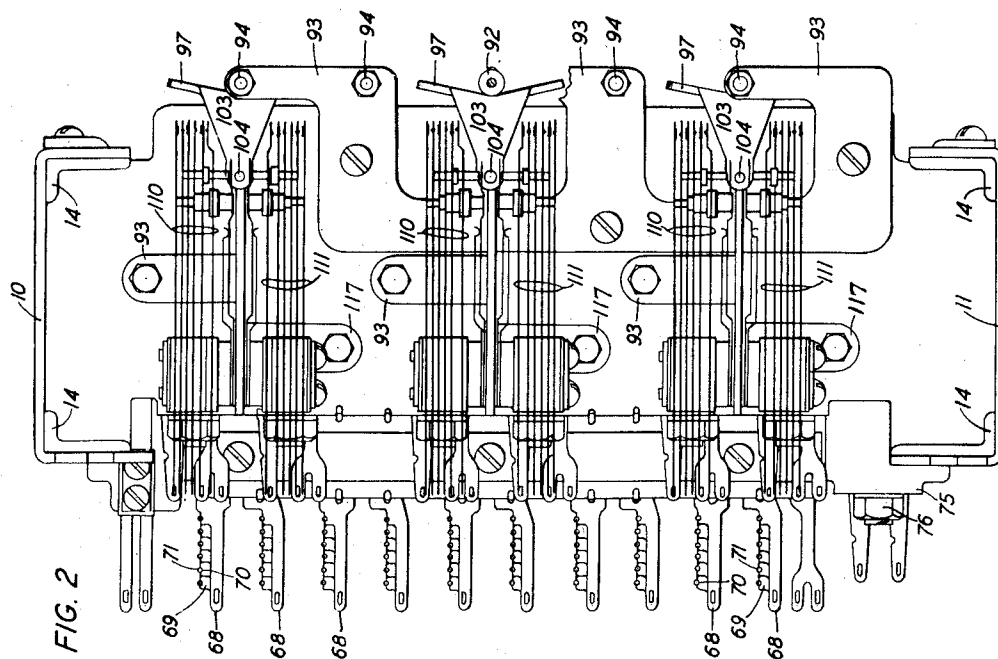
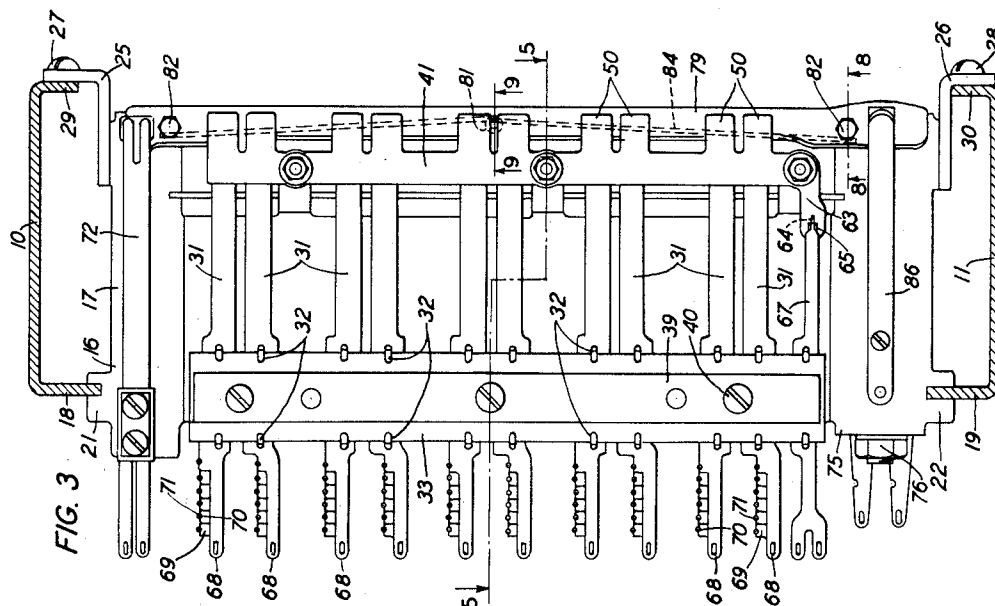
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SWITCHING MECHANISM

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4 Sheets-Sheet 2



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SWITCHING MECHANISM

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FIG. 4

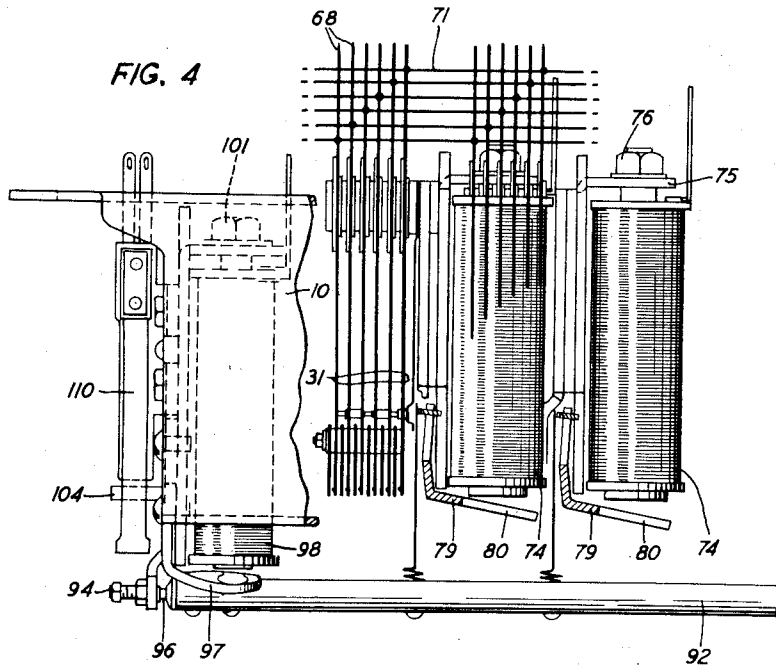


FIG. 5

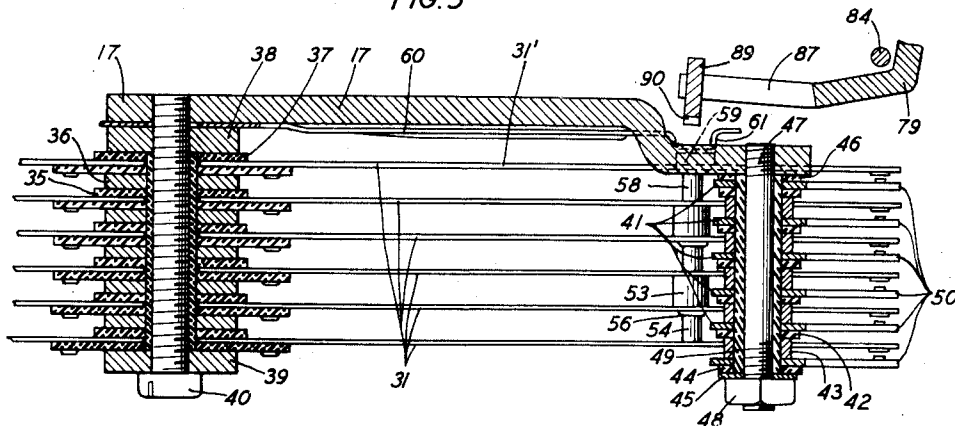
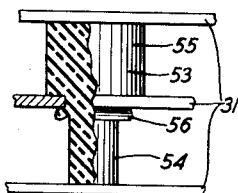


FIG. 6



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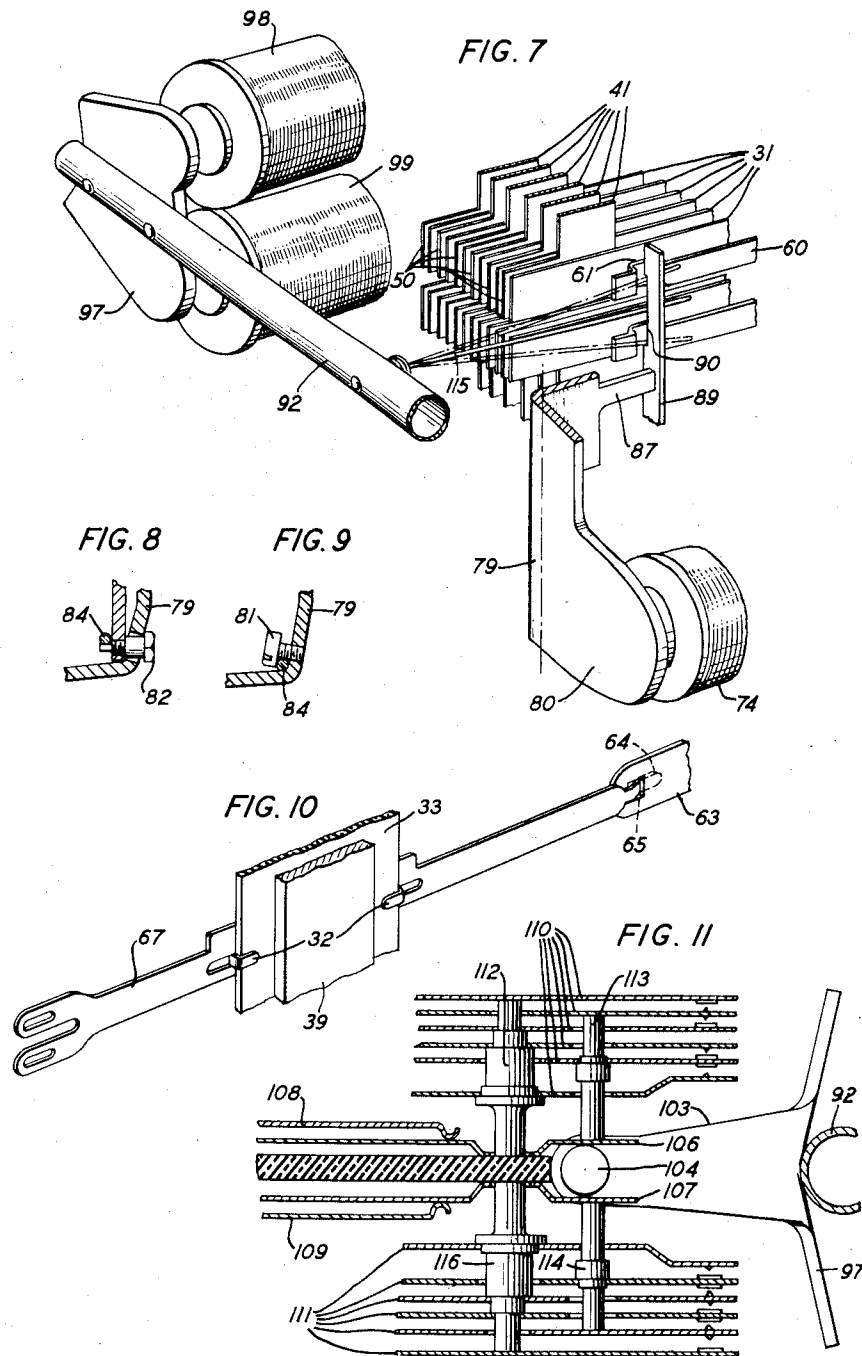
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SWITCHING MECHANISM

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4 Sheets-Sheet 4



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SWITCHING MECHANISM

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8 Claims. (Cl. 179—27.54)

This invention relates to improvements in the switching mechanism and particularly to switches of the cross-bar type for use in establishing connections.

It is an object of the invention to provide an improved and simplified switch structure of this type, inexpensive to manufacture, and of a low maintenance cost.

Cross-bar switches of the particular type on which the present invention is an improvement are well known in the art and consist essentially of a number of contact sets arranged in horizontal rows and corresponding sets arranged in vertical rows, with one set of each kind adjacent intersecting points of said rows, and means including one group of operating members intersecting another group of such members controlled by magnets. Connections may be established between the two sets of contacts at any intersecting point by the rotation of one corresponding intersecting member of each group.

Switches of this type have also been provided where the number of intersecting members or bars of one group, for example, the horizontally located bars, is half that of the intersecting members or bars of the other group or vertically located bars. In this case the rotation of a bar of the smaller group in either of two directions controls the selection of one or another horizontal row of contact sets for operation by a single movement of a bar in the larger group.

It is in connection with this latter type of switch that the present invention has been disclosed, although it should be understood that many of the improvements forming the subject matter of the present invention are applicable to other types of cross-bar switches without departing from the spirit of the invention.

A feature of the switch structure embodying the applicant's invention is a frame having four members welded together at the ends at right angles with the two horizontal members of a U-shaped cross-section and the two vertical members of an L-shaped cross-section, with the sides of the U-shaped member and one side of the L-shaped member turned inward towards the center of the frame.

Another feature of the switch structure resides in the construction and mounting of the assembly unit, a plurality of which are arranged in the vertical rows in the frame and on which the contact sets, vertical magnets and vertical operating bars are mounted. This unit consists of a plate secured at the rear of the frame by means of projecting lugs registering in slots in one side

of the U-shaped upper and lower members of the frame and secured at the front of the frame by means of screws to the other side of the U-shaped upper and lower members of the frame. This enables the ready removal of any individual assembly unit without disturbing any other part of the structure.

On each of these units are mounted in a vertical position in the front of the unit contact strips representing a vertical row of contact sets and on the rear of the unit are mounted in a horizontal position groups of contact springs each group representing a contact set of a different horizontal row, each of said groups of contact springs extending towards the front of the unit and in a position to make contact with contact strips at their corresponding cross-connecting points in their corresponding horizontal rows. Accordingly another feature of this invention is to mount a separate set of terminals in the rear of the unit and connect these terminals with corresponding vertical contact strips so that the circuit connections from the vertical contact strips may be made in the rear of the switch in the same position as the circuit connections for the terminals of the horizontal rows of the contact springs.

In switches of this kind the vertical bars are mounted on the vertical units and operate when actuated not only the contact strips at the selected cross-connecting points but also off-normal contacts mounted on the unit. The horizontal bars also operate off-normal contacts mounted in the switch structure on the outer side of the L-shaped frame members. The rotation of a horizontal bar in one direction operates one set of off-normal springs and the rotation of this bar in the opposite direction operates another set of off-normal contact springs. To maintain this horizontal bar in a neutral position and to prevent chattering or disturbing of the off-normal contact springs on the return of the bar to the neutral position after having been actuated in either direction requires suitable damping means. It is a feature of the present invention to provide two snubbing springs for this purpose on each side of a finger projecting from a bell crank on this bar to return the bar to normal condition and dampen its tendency to vibrate after it has been returned to normal position and thus prevent it from chattering the off-normal contacts.

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

Fig. 1 shows a front view of a cross-bar switch embodying the features of this invention;

Fig. 2 shows the left hand side view of the switch shown in Fig. 1;

Fig. 3 is a vertical cross-section of the switch taken on line 3—3 of Fig. 1;

Fig. 4 is a cross-section of the switch taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross-section of an assembly unit taken on line 5—5 of Fig. 3;

Fig. 6 is a fragmentary view partly in section of one of the operating studs for the horizontal spring in an assembly unit;

Fig. 7 is a fragmentary perspective of the switch showing portions of a horizontal and a vertical bar, their operating magnets and contact sets controlled by said bars.

Figs. 8 and 9 show details of cross-sections of the mounting means for the vertical bars taken on lines 8—8 and 9—9 respectively of Fig. 3.

Fig. 10 shows the construction of a terminal connection for a vertical spring; and

Fig. 11 is the cross-section taken on line 11—11 of Fig. 1 showing the snubbing spring for a horizontal bar and the off-normal contacts controlled by said bar.

Referring now to the drawings and primarily to Figs. 1, 2 and 3 the structure comprises a frame including a U-shaped upper horizontal frame member 10 and a U-shaped lower horizontal frame member 11 and vertical side frame members 12 and 13, said side members being of L-shaped cross-section and welded to the horizontal frame members 10 and 11 at points 14. The sides of the horizontal frame members 10 and 11 and one side of the L-shaped vertical frame members are turned inward towards the center of the switch structure. Between the horizontal frame members 10 and 11 are mounted vertical assembly units 16. Each of these units comprises a vertical plate 17 secured to the rear sides 18 and 19 of the upper and lower horizontal frame members 10 and 11 by means of lugs 21 and 22 engaging slots 23 and 24, respectively, in said sides 18 and 19. The plate 17 is fastened in the front to the front sides of the horizontal frame members 10 and 11 by means of bent lugs 25 and 26 on said plate 17 secured by means of screws 27 and 28 to the front sides 29 and 30, respectively. On each of these plates 17 is mounted at the rear thereof a series of ten sets of horizontal spring contact strips 31. In each set these strips have cut-out lugs 32 clamped on insulation plates 33 and piled one on top of the other with intermediate insulation plates 35 and metal spacing plates 36. An outer metal spacing plate 38 is provided on one side and an outer insulating plate 37 and an outer metal spacing plate 39 are provided on the other side of this pile-up and all these parts are connected together and secured to the plate 17 by means of screws 40 as shown clearly in Fig. 5. At the front portion of plate 17 is secured a group of vertical contact strips 41 separated by intermediate insulation washers 42 and metal spacing bushings 43. An outer insulation washer 44 and metal spacing washer 45 are provided on one side and an outer insulation washer 46 is provided on the other side of this pile-up and all these parts are connected together and secured to the plate 17 by means of a bolt 47 screwed into the plate 17 and a nut 48 screwed on the bolt 47. The bolt 47 is surrounded by an insulation bushing 49. Three of these bolts 47 and associated spacing and insulation parts are provided for each pile-up of strips 41 as shown in Fig. 3. Each vertical strip is provided with

projections or contact making portions 50 which register with contacts on the corresponding horizontal strips 31 that extend between adjacent projections 50 to make connections between corresponding vertical and horizontal strips when the horizontal strips are operated.

The horizontal strips 31 are spaced apart by means of studs 53. Each of these studs 53 is secured to one strip and spaces the strips on either side thereof as shown in Fig. 6. These studs have a turned down portion 54 and an enlarged portion 55, the turned down portion projecting through a hole in a strip 31 and said turned down portion which may be slightly of a larger diameter at its base is ring-staked to form a flange 56 to hold the stud to the strip. This ring-staking of the turned down portion 54 may be done with the insulation stud cold so that the ring-staking will cause the material to cold flow to form the flange 56 around the edge of the hole of the strip.

The strip 31' of the group 31 is provided with a special stud 58 similar to stud 53 except that its enlarged portion 59 engages an additional strip member 60 secured to the plate 17 in the same pile-up as strips 31. A bent-in U-shaped portion 61 of strip 60 is engaged by this portion 59. The purpose of this strip 60 and its U-shaped portion 61 will become apparent hereinafter in connection with the description of the operation of the switch. As shown particularly in Figs. 3 and 10 each vertical contact strip 41 is provided with a rearwardly extending lug 63 having an aperture 64 into which a finger 65 of a terminal 67 is inserted and soldered thereto. The terminals 67 are secured in the same pile-up as the horizontal strips and project to the rear of the switch structure for the establishing of connections to the vertical strips. The horizontal strips extend to the rear of the switch structure into terminals 68 which have lugs 69 extending upwardly in a staggered relation. Each of these lugs is provided with a groove 70. These lugs and grooves of each group are so located and related to each other that the lugs and grooves of the corresponding groups in the adjacent assembly units may be cross-connected with straight bare wires 71 laid in the grooves and soldered thereto. The staggered relation of the lugs and grooves is such that said wires for each horizontal row of horizontal strips form parallel lines and the wires for the different rows of horizontal strips form horizontal layers. This arrangement is shown particularly in Figs. 2, 3 and 4. It should be understood, of course, that said cross-connections may be varied to suit various conditions such as, for example, portions only of each horizontal row of horizontal strips may be cross-connected together. At the upper rear portion of the plate 17 is mounted horizontally a series of off-normal springs 72 that extend forward to be engaged by the corresponding vertical bar when operated as will be explained hereinafter to establish off-normal connections.

On each plate 17 there is mounted at the bottom an operating magnet 74 secured by its core to an angular projection 75 on the plate 17 by means of the nut 76. On the plate 17 is also mounted the corresponding vertical bar 79 having an L-shaped cross-section and a projecting armature 80 positioned to be attracted by the core of the magnet 74 to rotate the bar 79. The vertical bar 79 is mounted to rock on an edge of the plate 17, as shown in Figs. 8 and 9. The bar

79 is held in place by means of screw 81 secured to the bar and screws 82 secured to the plate 17 and engaging a straight wire spring 84 with screws 82 holding the upper and lower ends on a projection on the screw 82 and screw 81 holding the middle portion of the spring 84. A spring member 86 is secured on the back of the plate 17 to engage one side of the L-shaped vertical bar 79 at its lower end to hold it in normal or non-operated position. The upper end of the vertical bar 79 is provided with an angular projection that engages a stud on the off-normal springs 72 to cause the operation of these springs when the bar 79 is rotated. The side of the vertical bar 79 projecting inwardly in a more or less parallel position in relation to the plate 17 is provided with prongs or projections 87 which are connected to a vertical member 89. This member is secured at a right angle to the projections 87 and is provided with slots 90 for the operation of the switch as will presently be described. This construction is particularly shown in Figs. 5 and 7. The horizontal bars 92 are mounted in front of the vertical bars on brackets 93 secured to the vertical L-shaped side members 12 and 13 of the frame. Bearing screws 94 secured in the brackets 93 extend into bearing sleeves 96 secured to the ends of the horizontal bars 92 for the rotation of the bars. The upper horizontal bar 92, referring to Fig. 1, has its armature 97 secured at its left hand end while the remaining bars have their armatures secured at alternate opposite ends, that is the second bar from the top has its armature on the right hand end, the third bar has its armature on the left hand end, etc. This armature 97 extends upwardly and downwardly from the bar 92 in front of the cores of an upper and a lower magnet 98 and 99 to cause the horizontal bar 92 to be rotated in a clockwise direction by magnet 98 and in a counter-clockwise direction by the magnet 99. Each bar is therefore controlled by two magnets. These magnets are mounted in pairs on the inwardly projecting side of the L-shaped vertical frame members 12 and 13, by means of bolts 101 entering holes in the sides of said members and screwed into the cores of said magnets. The L-shaped frame members 12 and 13 therefore form suitable yoke pieces or return pole pieces for the magnets. The armature 97 has a projection or member 103 bent at practically right angles to the armature proper towards the rear of the structure outside of the frame member 12. This projection is shown clearly in Fig. 11. To the end of the member 103 is secured an outwardly projecting stud or bar 104 which extends between the snubbing springs 106 and 107. These snubbing springs project toward the rear of the structure and are secured to the rear of a special off-normal spring mounting bracket 117 as shown in Fig. 2. These snubbing springs 106 and 107 are reinforced by snubbing springs 108 and 109 respectively to prevent the bar 92 from vibrating, after returning to normal position from having been rocked in the clockwise to counter-clockwise direction. The purpose therefore of these double snubbing springs 106 and 108 on one side and 107 and 109 on the opposite sides of the stud 104 is to quickly restore the horizontal bar 92 to the normal position and quickly dampen any possible vibration thereof. The off-normal spring pile-ups mounted on the bracket 117 are located on the upper and lower sides of the stud 104. The upper pile 110 is controlled by the rotation of the bar 92 in the counter-clockwise di-

rection, looking at Fig. 11 and the lower pile-up 111 is controlled by the rotation of the bar 92 in a counter-clockwise direction. To properly control these springs, for example the pile-up 110, certain springs are held in the normal condition by a stud 112 by resting under tension on shoulders on said stud 112, while the springs in this pile-up to be operated are controlled by stud 113 engaging as shown in Fig. 11 the second and fifth springs of the pile-up. The stud 113 may 10 for this purpose be secured to the second spring by ring-staking in the same manner as the studs 53 for the horizontal contact strips. These springs may be operated by the stud 104 engaging, through the medium of snubbing spring 106 15 the stud 113. Similarly the spring pile-up 111 may be controlled by the stud 114 secured to the second inner spring and engaging the fifth spring, while the first, third, fourth and sixth springs rest under tension on shoulders of the stud 116. 20

Referring now to the operation of the switch, to establish a connection between the individual strips in any vertical row of contact strips and any set of corresponding horizontal contact strips in any row requires the operation of a corresponding horizontal bar in a clockwise or counter-clockwise direction and a corresponding vertical bar. The operation of the mechanism of the switch is best described in connection with Fig. 7 which shows a portion of a horizontal bar, 30 a portion of a vertical bar and portions of a corresponding vertical set of contact strips 50 and two sets of horizontal contact strips in two adjacent rows controlled by the horizontal bar. A connection, for example, with the upper set of horizontal strips and the vertical contact strips may be established by first operating the horizontal bar 92 in the clockwise direction by the energizing of magnet 99. This will place the obstruction finger 115 of bar 92 in a position in 40 front of the spring 60 of the upper set of horizontal contact strips and across the U-shaped portion 61. Then the vertical bar 79 is rotated in a counter-clockwise direction by the energization of the vertical magnet 74. The rotation 45 of the vertical bar 79 causes the member 89 to press the obstruction finger 115 against the spring 60 which through the medium of studs 58 and 53 causes all of the strips 31 to make contact respectively with the corresponding vertical strips 50. 41 at projections 50. It should be noted, of course, that the rotation of any other vertical bar would have caused the associated horizontal set of contact strips to engage with the corresponding vertical set of contact strips in the associated row. After the vertical bar 79 has operated it will maintain the obstruction fingers 115 in the engaged position, although the horizontal bar 92 may be returned to its normal position. The return of the horizontal bar will 60 place the remaining obstruction fingers 115 of this bar in a neutral position and this bar may now be used to initiate connections at other points. If the horizontal bar 92 had been moved in the opposite direction the lower horizontal row of horizontal contact strips would have been selected. The fingers 115 are tensioned to bear against the edge of member 89 in the slot 90 and the slot 90 is of such width that it will confine the upward and downward movements of the 70 finger 115 to the proper upper and lower position in front of the springs 60 of the corresponding groups of contact strips. It is therefore evident that only half the number of horizontal bars to that of the vertical bars are required.

Ten vertical bars and five horizontal bars may be provided. In Fig. 1 only three vertical bars have been shown. It is understood, of course, that any number of vertical bars and the corresponding number of horizontal bars may be employed for larger capacity switches without departing from the spirit of the invention and without changing any of the features involved in this invention. To release an established connection at a cross point all that is required is for the release of the actuated magnet 74 to return the associated vertical bar 79 to normal position. It will thus be seen that in the switch illustrated a total of ten connections may be established in succession and maintained simultaneously among the one hundred points at which connections may be made.

While this invention has been disclosed in connection with but a single form of switch, it should be understood that the various features thereof could readily be applied to other forms of switch structures without departing from the spirit thereof and that the present disclosure should only be considered as illustrative of one embodiment of the invention.

What is claimed is:

1. A cross-bar switch structure comprising a frame including two horizontal U-shaped members and two vertical L-shaped members welded together at their ends, horizontal and vertical intersecting rows of contact making strips mounted in said frame and horizontal and vertical operating bars for establishing connections between horizontal and vertical strips.

2. A cross-bar switch structure comprising four frame members welded together at their ends at right angles with two horizontal members U-shaped and two vertical members L-shaped and with the sides of the U-shaped members and one side of the L-shaped members turned inward in the structure, horizontal and vertical intersecting rows of contact making strips, horizontal and vertical operating bars, magnets for rotating said bars, means responsive to the rotation of a horizontal bar and a vertical bar for establishing connections between the horizontal and vertical strips that intersect at the intersecting point of said rotated bars.

3. A cross-bar switch comprising a frame including an upper and a lower horizontal frame member having slots therein and a left and a right vertical frame member, horizontal and vertical intersecting rows of contact making strips, horizontal and vertical operating bars for establishing connections between the horizontal and vertical strips that intersect at the intersecting point of said operating bars, assembly units arranged in vertical rows secured at the rear of said switch to the upper and lower horizontal frame members by lugs on the assembly units registering in said slots in said members and secured at the front of said switch to said horizontal frame members by means of screws, means for mounting each group of horizontal and vertical strips that form a vertical row on a corresponding assembly unit.

4. A cross-bar switch comprising a frame including four frame members welded together at their ends with the two horizontal members U-shaped and having slots in their rear sides and the two vertical members L-shaped and with the sides of the U-shaped members and one side of the L-shaped members turned inward in the structure, horizontal and vertical intersecting rows of con-

tact making strips, horizontal and vertical operating bars for establishing connections between horizontal and vertical strips, assembly units arranged in vertical rows secured at the rear of said switch to the sides of the horizontal U-shaped frame members by lugs in said unit registering in said slots in the rear sides of said U-shaped horizontal frame members and secured at the front of said switch to the front sides of said horizontal frame members by means of screws, means for mounting each group of horizontal and vertical strips that form a vertical row on a corresponding assembly unit.

5. A cross-bar switch structure comprising a frame including an upper and a lower horizontal frame member and a left and a right vertical frame member, sets of contact making strips in the form of individual groups of vertical strips arranged in vertical rows, sets of contact making strips in the form of individual groups of horizontal strips arranged in horizontal rows with each group of vertical strips intersecting one group each from all of the horizontal rows of horizontal strips that form a vertical row, horizontal and vertical operating bars for establishing connections between horizontal and vertical strips, assembly units arranged in vertical rows secured to the members of said frame and extending from the front to the rear of said frame, means for mounting one group of vertical strips on each of said units on the front portion thereof, means for mounting the groups of horizontal strips forming vertical rows on corresponding vertical units, a set of terminals for each group of vertical strips mounted on the corresponding unit on the rear portion thereof with each terminal connected to a corresponding vertical strip.

6. A cross-bar switch structure comprising a frame including an upper and a lower horizontal frame member and a left and a right vertical frame member, sets of contact making strips in the form of individual groups of vertical strips arranged in vertical rows, sets of contact making strips in the form of individual groups of horizontal strips arranged in horizontal rows with each group of vertical strips intersecting one group each from all of the horizontal rows of horizontal strips that form a vertical row, horizontal and vertical operating bars for establishing connections between horizontal and vertical strips, assembly units arranged in vertical rows secured to the members of said frame and extending from the front to the rear of said frame, means for mounting one group of vertical strips on each of said units on the front portion thereof, means for mounting each group of horizontal strips forming a vertical row on a corresponding vertical unit, a projection on each vertical strip extending towards the rear of the associated unit and having an aperture, a set of terminals for each group of vertical strips, means for mounting each set on a corresponding unit on the rear portion thereof, and a projection on each terminal extending towards the front of the corresponding unit and hooked into the aperture in the projection of a corresponding vertical strip.

7. A cross-bar switch structure comprising a frame, horizontal and vertical intersecting contact making strips, horizontal and vertical operating bars, magnets for rotating the horizontal bars in opposite directions and for rotating the vertical bars in one direction only, means responsive to the rotation of a horizontal bar in either direction and the rotation of a vertical bar for establishing con-

nections between horizontal and vertical strips at the intersecting point of said rotated bars above or below the horizontal bar depending on the direction of rotation of said horizontal bar, supporting members, two sets of snubbing springs for each horizontal bar mounted on opposite sides of an individual supporting member, each set of snubbing springs comprising a plurality of spring members cumulatively tensioned against the respective sides of said support, and means for each horizontal bar for flexing one set of the associated snubbing springs away from the side of its supporting member when said bar is moved from a neutral position in one direction and for flexing the other set of snubbing springs away from the side of the supporting member when said bar is moved from the neutral position in the opposite direction to quickly dampen the vibratory tendencies of said bar when released from an actuated position in either direction.

8. A cross-bar switch structure comprising a frame, horizontal and vertical intersecting contact making strips, horizontal and vertical operating bars, magnets for rotating the horizontal bars in opposite directions and for rotating the vertical bars in one direction only, means responsive

to the rotation of a horizontal bar in either direction and the rotation of a vertical bar for establishing connection between horizontal and vertical strips at the intersecting point of said rotated bars above or below the horizontal bar depending on the direction of rotation of said horizontal bar, supporting members, two sets of snubbing springs for each horizontal bar mounted on opposite sides of an individual supporting member, each set of snubbing springs comprising a plurality of spring members cumulatively tensioned against the respective sides of said supports, and a bell crank lever on each horizontal bar adapted to flex one set of the associated snubbing springs away from the side of the supporting member when said bar is moved from a neutral position in one direction and adapted to flex the other of said sets of associated snubbing springs away from the side of its supporting member when said bar is moved from said neutral position in the opposite direction to counteract the vibratory tendencies of said bar and crank lever when said bar is released from an actuated position in either direction.

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