

June 30, 1936.

S. J. STOCKFLETH

2,045,971

SWITCHING MECHANISM

Filed Sept. 6, 1935

5 Sheets-Sheet 1

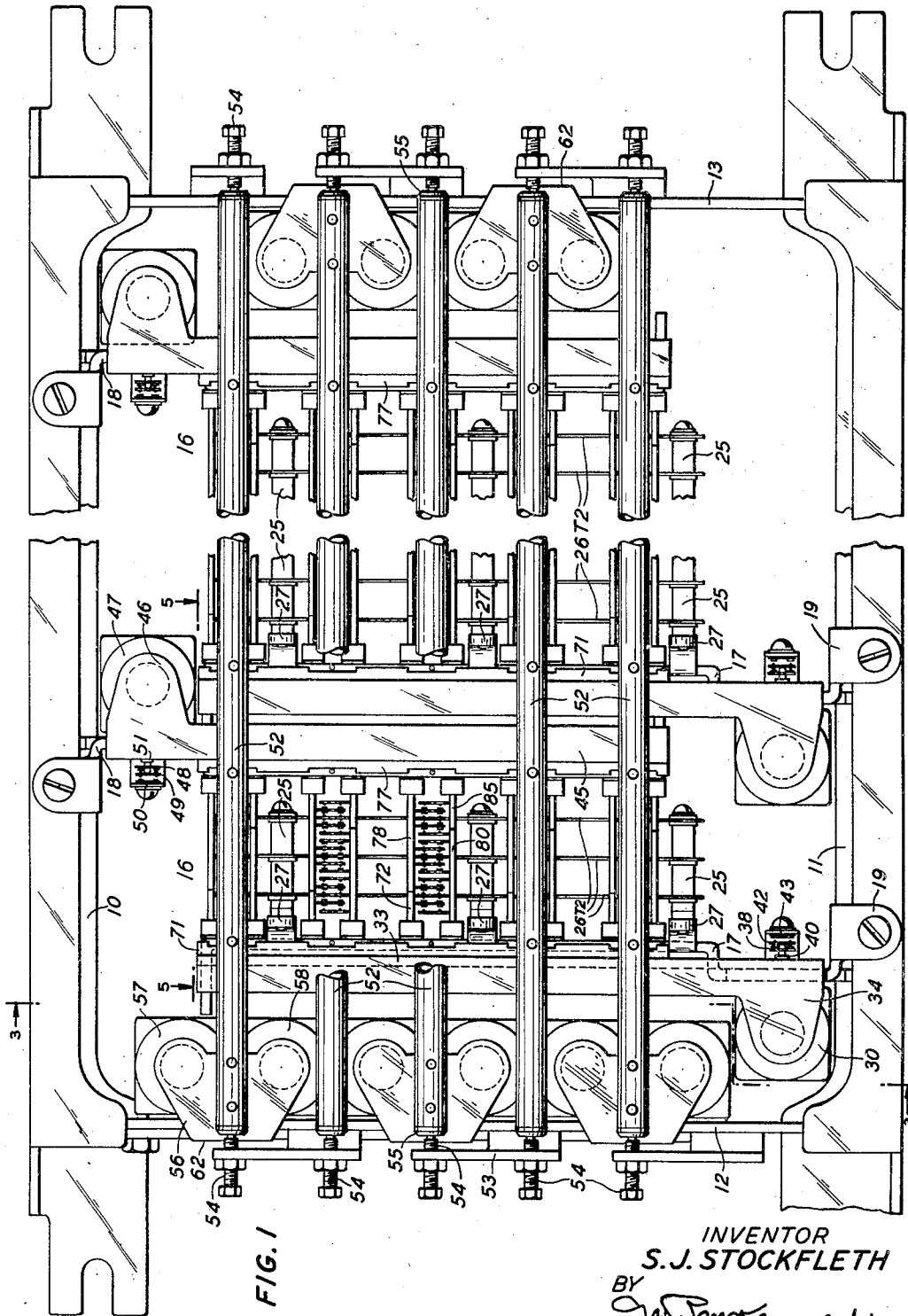


FIG. 1

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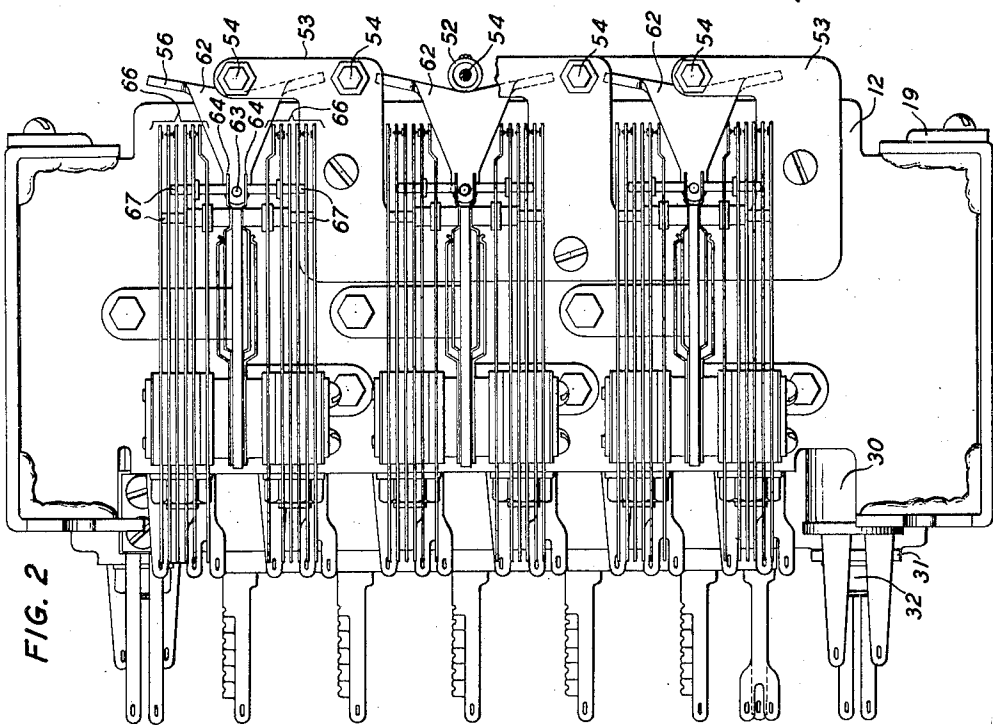
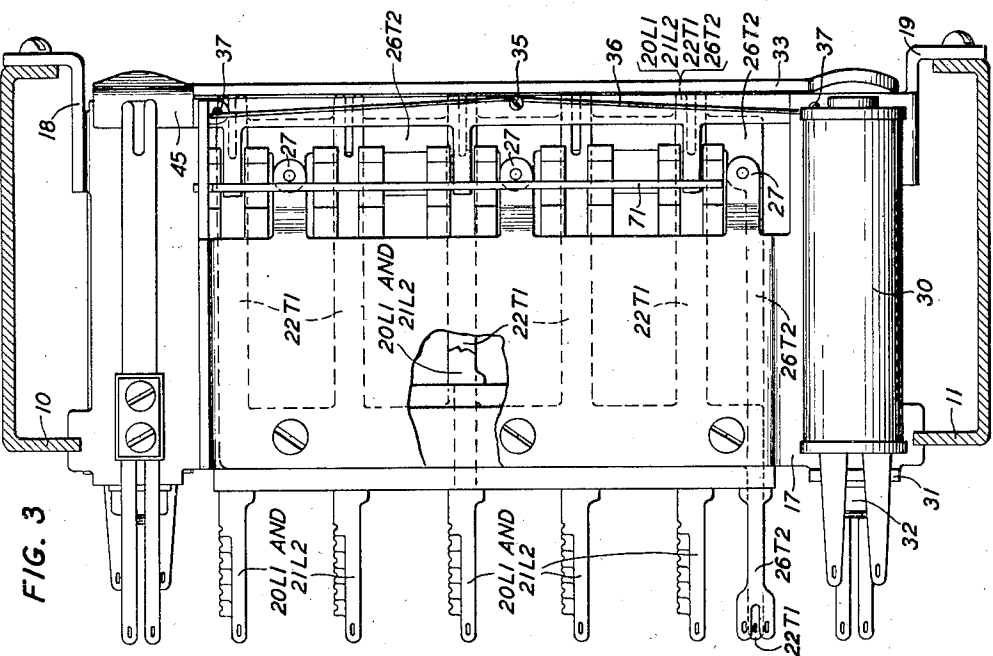
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SWITCHING MECHANISM

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5 Sheets-Sheet 2



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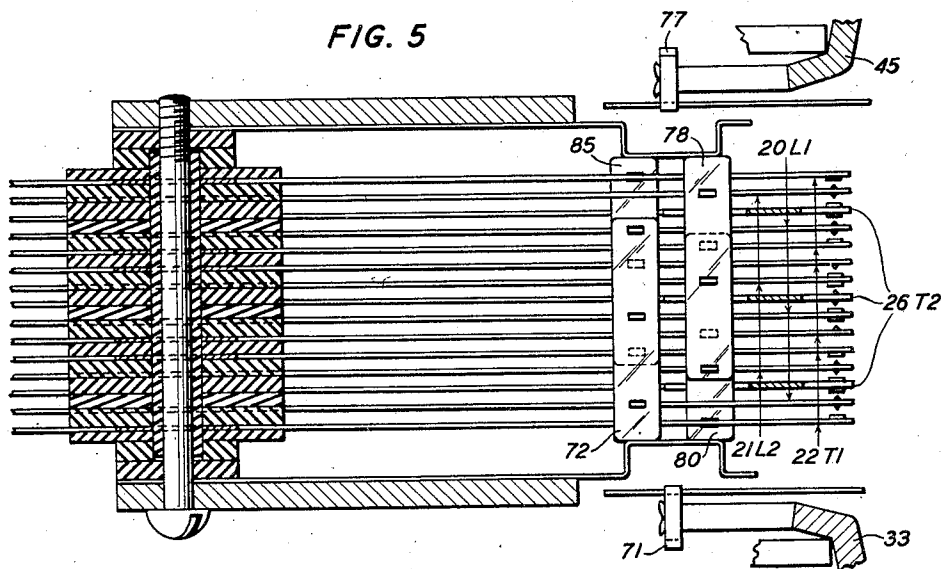
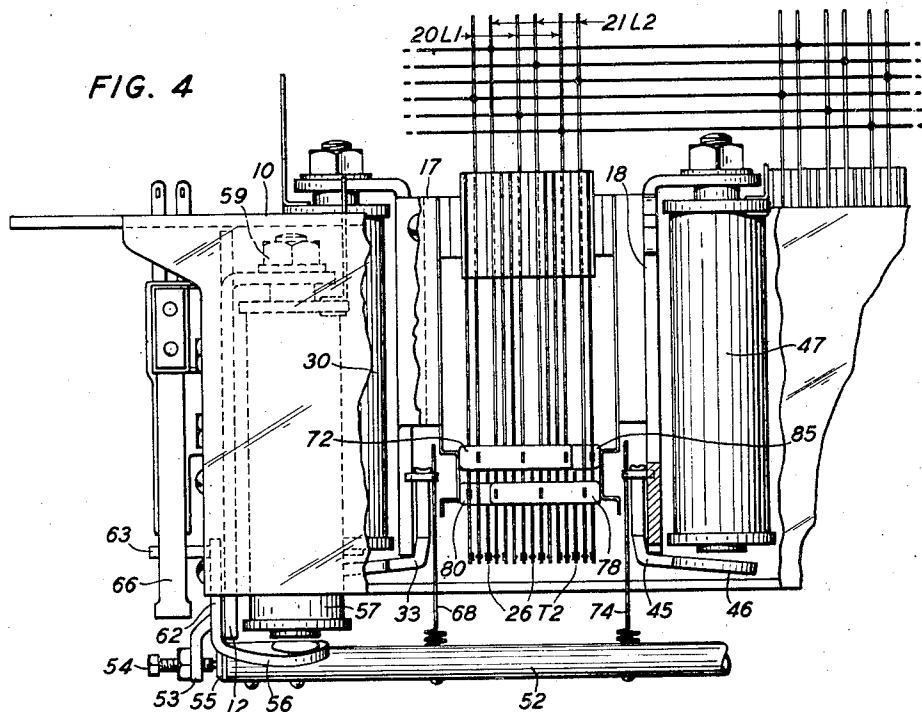
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SWITCHING MECHANISM

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5 Sheets-Sheet 3



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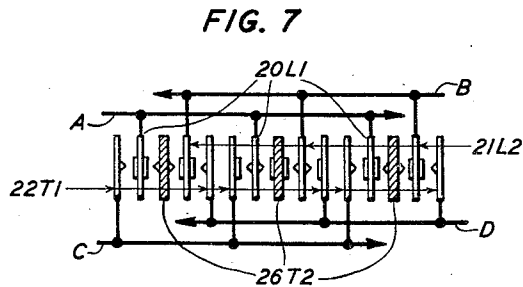
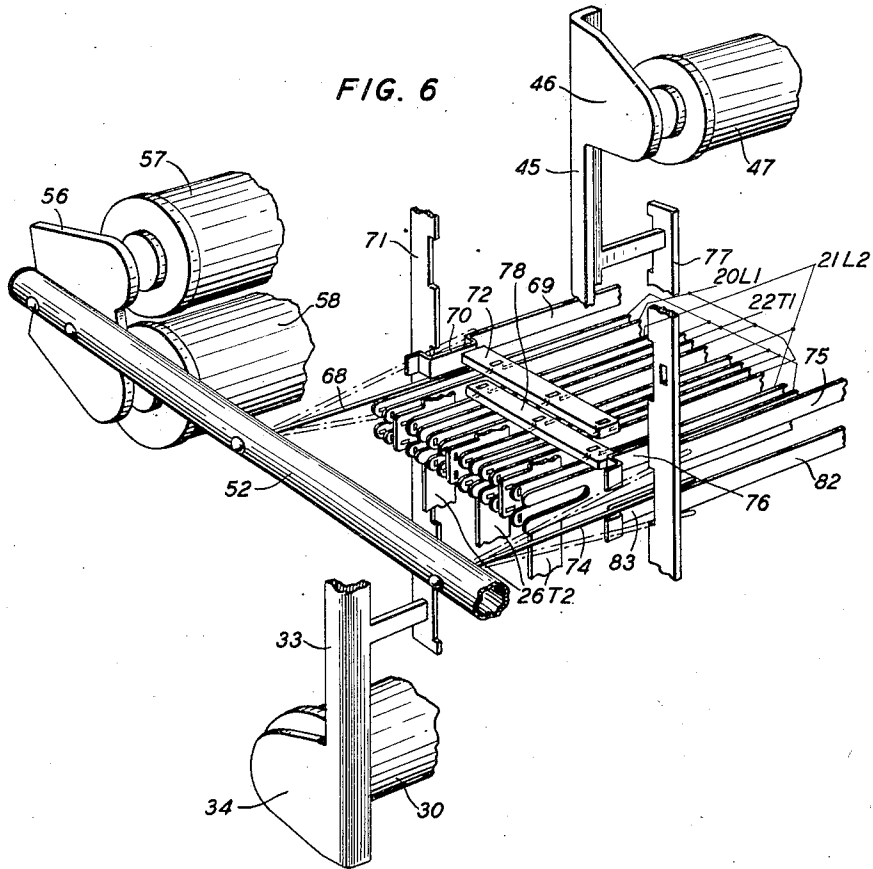
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SWITCHING MECHANISM

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5 Sheets-Sheet 4



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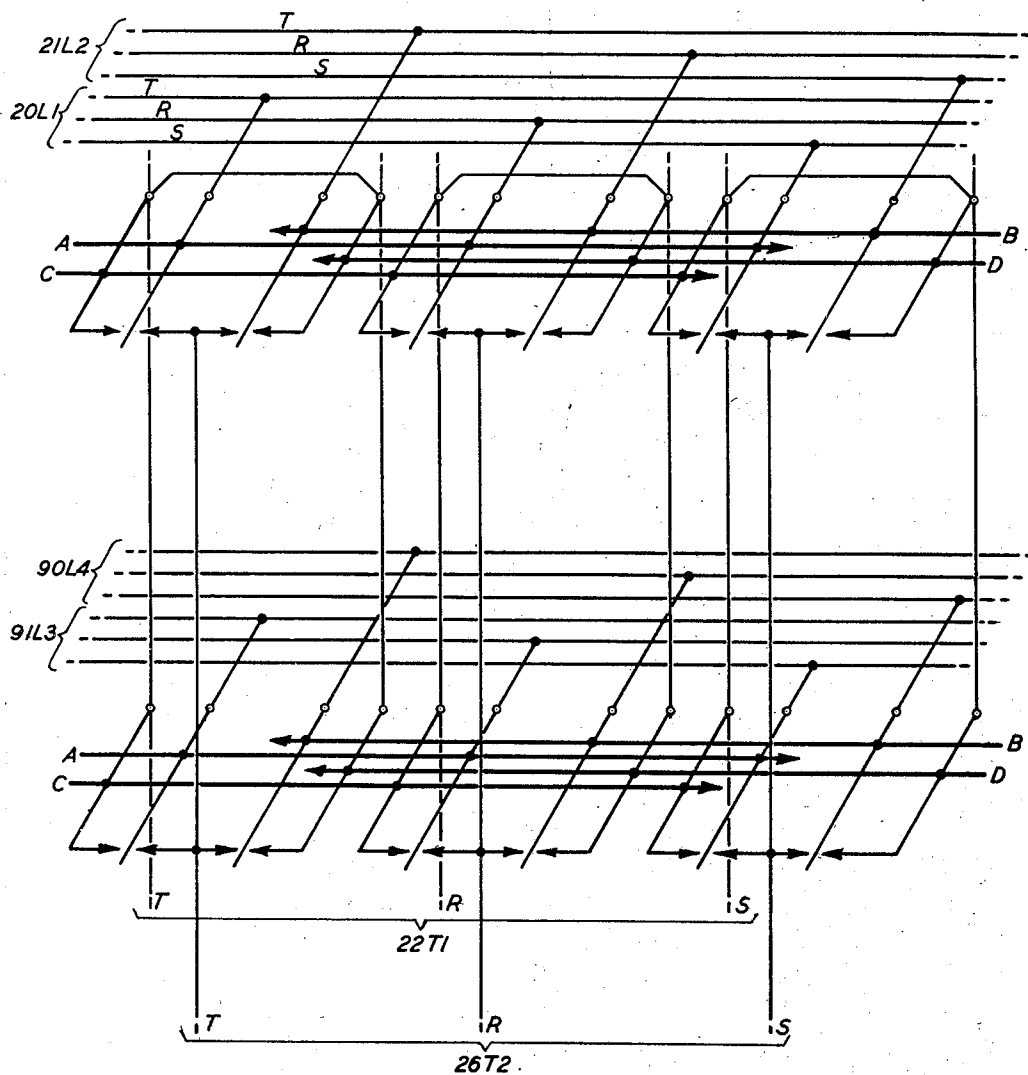
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SWITCHING MECHANISM

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FIG. 8



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UNITED STATES PATENT OFFICE

2,045,971

SWITCHING MECHANISM

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Application September 6, 1935, Serial No. 39,431.

7 Claims. (Cl. 179—27.54)

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

It is an object of the invention to provide an improved and simplified switch structure of this type particularly in regard to the contact making arrangements.

Cross-bar switches of the types on which the present invention is an improvement are well known in the art and consist essentially of a number of sets of contact strips arranged in horizontal rows with corresponding intersecting sets arranged in vertical rows and 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 two sets of contact strips at any intersecting point by the rotation of one corresponding intersecting member of each group.

Cross-bar switches of this type have also been provided where the number of intersecting members of one group, for example, horizontally located bars, is half that of the intersecting members 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 strips for operation by a single movement of a bar in the larger group. Cross-bar switches of these types have also been provided in which the sets of contact strips have been doubled at the intersecting points to double the capacity of the switch, but for these switches outside means is provided for selecting one or the other of two sets of connections made at an intersecting point by the switch.

It is in connection with these types of switches in the prior art that the present invention has been disclosed although it should be understood that the improvements forming the subject-matter of the present invention are applicable to other types of switches without departing from the spirit of the invention.

A feature of the applicant's invention is an arrangement of contact strips and operating bars whereby the operation of a horizontal bar and either one of a pair of vertical bars causes the establishing of any one of four different connections between horizontal and vertical strips at a common intersecting point of said strips.

Another feature is the arrangement of the horizontal bars for rotation in opposite directions and the arrangement of the vertical bars so that one

bar of each pair is rotatable in one direction and the other is rotatable in the opposite direction for the establishing of any of the four different connections at the common intersecting point of a horizontal bar and a pair of vertical bars.

The horizontal rows of contact strips may represent lines and the vertical strips trunks. With this assumption the operation of a horizontal bar in one direction and the operation of either one of a pair of vertical bars will establish connections between either a first line and first trunk or a second line and a first trunk, and, if the horizontal bar is rotated in the opposite direction and either one of a pair of vertical bars is rotated, connections will be established between either the first line and the second trunk or the second line and the second trunk.

Thus it is possible with this arrangement of bars and contact strips to concentrate the strips in more compact units or common intersecting points containing contacts of two lines and two trunks and yet by a single operation of two intersecting bars secure the same choices of connections as in former structures in the prior art in which the contacts of two lines and two trunks were combined at each intersecting point but in which the aid of outside control means was necessary to choose between either of two connections established at the intersecting point by the operation of a horizontal and a vertical bar.

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

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

Fig. 2 is a 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 and omitting the horizontal bars.

Fig. 4 is a fragmentary top view of the switch shown in Fig. 1.

Fig. 5 is a fragmentary cross-section of a vertical assembly unit taken on line 5—5 of Fig. 1.

Fig. 6 is a fragmentary perspective view of the switch showing portions of a horizontal and a vertical bar, the operating magnets therefor and the arrangement of the contact strips controlled by said bars in accordance with this invention.

Fig. 7 shows in diagrammatic form the arrangement of the contact strips at one cross-connecting point and indicating the directions of movement of these contacts when operated.

Fig. 8 is a diagrammatic representation of four lines and two trunks at two cross-connecting points and the circuit connections therefor.

Referring now to the drawings, the invention has been illustrated in connection with a switch structure of the same general type as the one disclosed in the Patent 2,012,329 of November 19, 1935 to J. R. Reynolds. In general the switch comprises a frame consisting of two horizontal U-shaped upper and lower frame members 10 and 11 and two L-shaped vertical frame members 12 and 13. Between the horizontal frame members 10 and 11 are mounted vertical assembly units 16. Each of these units comprises two vertical left-hand and right-hand plates 17 and 18. Plate 17 is connected to frame member 11 by means of a lug 19 and a screw to the member 11. The plate 18 is similarly attached to frame member 10. Between plates 17 and 18 are mounted the various contact strips to be operated upon at five different cross-connecting points in four different ways at each cross-point as will be hereinafter described. In Fig. 1, two of the cross-points are exposed by the removal of portions at the second and third horizontal bars to show front views of the strips at these points. Between the plates 17 and 18 at the rear thereof are mounted five rows of horizontal contact strips. Each row contains the horizontal strips of three conductors each of a pair of lines. The conductors of a pair of these lines have been designated in Figs. 3 to 8 with the numeral 20L1 and 21L2. In the same mounting at the rear is also located the vertical contact strips of one trunk marked in Figs. 3 to 8 22T1. All of these strips extend toward the front of the unit. The horizontal rows being individual lines, while the trunk is connected through from one row to another as shown in Fig. 3. At the front of the plates and attached to plate 17 by means of bolts and insulated plates indicated by the numeral 25 are the spaced vertical contact strips of a second trunk indicated in Figs. 3 to 8 by the numeral 26T2. These bolts and plates 25 are connected as shown in Figs. 1 and 3 to plate 17 at lugs 27. Thus the present switch shows a capacity of ten lines in five horizontal rows with two lines in each row and represented at five cross-points in the row, and a capacity of ten trunks in five vertical rows with two trunks in each row.

On plate 17 there is mounted an operating magnet 30 secured to an angular projection 31 on the plate 17 by means of a nut 32. On the plate 17 is also mounted a vertical bar 33, of an L-shaped cross-section and integral therewith is an armature 34 in position to be attracted by the magnet 30 to rotate the bar 17. The bar 17 is mounted to rock on an edge of plate 17 as shown in Fig. 5, and the bar 33 is held in place by means of a screw 35 secured to the plate 17 and engaging the center portion of a straight wire spring 36, the ends of which are held by screws 37 in lugs on plate 17. A spring member 38 is secured on the back of plate 17 and engages through stud 4 on one side of the L-shaped vertical bar 33 to hold it in normal or non-operated position. This spring 38 also serves as one of the off-normal springs to engage with other off-normal springs 42 and 43. These springs operate when the bar 33 is rotated. On the plate 18 is mounted corresponding operating members such as the vertical bar 45 with its armature 46 and operating coil 47 with a spring 48 engaging other off-normal springs 49 and 50, the spring 48 serving to hold the vertical bar 45 in normal position through the medium of a stud 51. The vertical bar 45 is held in the same manner as the vertical bar 33 to the

plate 18 by springs and screws corresponding to spring 36 and screws 35 and 37.

The horizontal bars 52 are mounted in front of the vertical bars on bracket 53 secured to the vertical L-shaped side members 12 and 13 of the frame. Bearing screws 54 secured in the brackets 53 extend through bearing sleeves 55 secured to the ends of the horizontal bars 52 for the rotation of the bars. The upper horizontal bar 52, referring to Fig. 1, has its butterfly armature 56 at its left-hand end, while the remaining bars have their armatures at alternately opposite ends, that is, the second bar from the top has its armature on the right hand, the third bar has its armature on the left hand, etc. The butterfly armature 56 extends upwardly and downwardly from the bar 52 in front of the cores of upper and lower magnets 57 and 58, respectively, to cause the horizontal bar to be rotated in a clockwise direction by the magnet 57 and in a counter-clockwise direction by the magnet 58. Each bar 52 is therefore controlled by two magnets. These magnets are mounted in pairs on the inwardly projecting sides of the L-shaped vertical frame members 12 and 13 by means of extensions of the cores entering holes in the sides of said members and nuts 59 screwed on to said extensions. The L-shaped frame members 12 and 13 therefore form suitable return pole-pieces for the magnets. The armature 56 has a projection or member 62 bent practically at right angles to the armature towards the rear of the structure outside of the frame members 12 and 13. To the member 62 is secured an outwardly projecting stud 63 which extends between the snubbing springs 64 for the purpose of quickly restoring the horizontal bar 62 to normal position. The off-normal spring pile-ups 66 mounted on the bracket 53 are located in two groups opposite the snubbing springs and are controlled by the rotation of the bar 52 to be operated through studs 67 to close various connections as the bar 62 is operated in one direction or the other.

The operation of the switch and the arrangement of the contact strips will now be described. Connections may be established between the individual strips in either of the two sets 21L1 or 22L2 in the first horizontal row of contact strips and the individual strips of either of the two sets of corresponding vertical contact strips 22T1 or 26T2 in the first left-hand assembly unit looking at Fig. 1. Similarly connections may be made between either of the two lines in any horizontal row and either of the two trunks in any vertical assembly unit. These connections may be established by the operation of a corresponding horizontal bar in a clockwise or counter-clockwise direction and either of the two corresponding vertical bars in a vertical assembly unit at the point where these horizontal and vertical bars cross. The general operations of the switch may best be described in connection with Figs. 6, 7 and 8. Fig. 6 shows a portion of a horizontal bar 52, a portion of two associated vertical bars 33 and 45 and portions of the contact strips at the intersecting cross-point which is sufficient to clearly understand the method of operation, while the Figs. 7 and 8 aid in understanding the circuit connections. If, for example, a connection is desired between the strips of line 20L1 and trunk 26T2 the horizontal bar 52 is rotated in a counter-clockwise direction by the energization of magnet 58. This will place the usual selecting finger 68 of the bar 52 in a position in front of the special spring 69 and across the U-shaped portion 70 75

thereof. Then the vertical bar 33 is rotated in a clockwise direction by the energization of the vertical magnet 30. The rotation of the vertical bar 33 causes the member 71 attached thereto to press the selecting finger 68 against the spring 69. As this spring is in line with the insulation member 72 which is attached to all of the strips of line 20L1, it will move this member towards the right and thus cause the strips of line 20L1 to make contact, respectively, with the corresponding stationary trunk strips 26T2. Figs. 7 and 8 illustrate how three conductors of line 20L1 will be connected with the corresponding three conductors of trunk 26T2 by the movement of the line strips towards the right as indicated by the arrow A. If a connection is desired between line 21L2 and trunk 26T2 the horizontal bar 52 will be operated in a counter-clockwise direction as before by the energization of magnet 58, this will place the selecting finger 74 of bar 52 in position in front of the special spring 75 and across the U-shaped portion 76 thereof. Then the vertical bar 45 is rotated in a counter-clockwise direction by the energization of the vertical magnet 47. The rotation of the vertical bar causes the member 77 connected to the vertical bar to press the selecting finger 74 against the spring 75, thus in turn causes the insulation member 78, connected to the strips of line 21L2, to move towards the left to make these strips of line 21L2 make contact, respectively, with the corresponding vertical stationary strips of trunk 26T2. This movement is illustrated in Figs. 7 and 8 by the arrow B. If a connection is desired between line 20L1 and 22T1, the horizontal bar 52 is operated in a clockwise direction to cause finger 68 to be placed in position in front of a special spring (not shown) but identical with spring 69 and located below the spring 69 and across a U-shaped portion of this spring. Then the vertical bar 33 is rotated in a clockwise direction by the energization of the vertical magnet 30. The rotation of this vertical bar causes the member 71 to press the obstruction finger against the special spring (not shown) which then causes the insulation member 80, (shown in Figs. 1, 4, and 5) connected to the vertical strips of trunk 22T1, to move towards the right to make contact respectively with corresponding horizontal strips of line 21L1. This movement is illustrated in Figs. 7 and 8 by the arrow C. If a connection is desired between line 21L2 and trunk 22T1, the horizontal bar 52 will be operated in a clockwise direction by the horizontal magnet 57 to place the selecting finger 74 in front of the spring 82 and across the U-shaped portion 83 thereof. Then the vertical bar 45 is rotated in a counter-clockwise direction by the operation of the vertical magnet 47. The rotation of the vertical bar 45 causes the member 77 connected thereto to press the selecting finger 74 against spring 82. This in turn causes the insulation member 85 connected to the corresponding horizontal strips of trunk 22T1 to make these strips contact with corresponding horizontal strips of line 22L2. This movement is illustrated in Figs. 7 and 8 by the arrow D. Thus it will be noted that by the rotation of the horizontal bar 52 in either of two directions and by the rotation of either of the two vertical bars 33 and 45, four different types of connections may be established at the common cross-point of said bars. After a vertical bar has been operated, it will maintain the corresponding selecting finger in the engaged position and the horizontal bar 52 may be returned to its normal position. The re-

turn of the horizontal bar will place the remaining selecting fingers of this bar in a neutral position and this bar may now be used to initiate connections at other points. It is therefore evident that a concentration of contact strips may be made at only five cross-connecting points for each set of two vertical bars of five assembly units in each of five horizontal rows, to wit, at a total of twenty-five cross-points in the switch. It should, of course, be understood that any other number of vertical bars and corresponding number of horizontal bars may be employed for large 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 the release of the actuated magnet 30 or 47 to return the associated vertical bar 33 or 45 to normal position. Fig. 8 shows the circuit connections for lines 20L1 and 21L2 at one cross-point to trunks 22T1 and 26T2 and for lines 90L1 and 91L2 at another cross-point to trunks 22T1 and 26T2, the various arrows indicating the movements of the various strips to establish these connections.

While the 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 is illustrative of only a single embodiment of the invention.

What is claimed is:

1. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, horizontal and vertical bars, and means effective by the operation of a horizontal bar and either of a pair of vertical bars for establishing either one of four different connections between horizontal and vertical strips at a common intersecting point of said strips.

2. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, horizontal and vertical bars, and means effective by the rotation of one horizontal bar in either direction and the rotation of either one of a pair of vertical bars in one direction only for establishing either one of four different connections between horizontal and vertical strips at a common intersecting point of said strips.

3. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, horizontal bars, means for rotating said bars in either direction, vertical bars arranged in pairs, means for rotating one bar in each pair in one direction and the other bar in the opposite direction, and means effective by the rotation of one horizontal bar in either direction and the rotation of either of the two bars of a vertical pair for establishing any one of four different connections between horizontal and vertical strips at a common intersecting point of said strips.

4. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, the horizontal strips representing terminals of lines and the vertical strips representing terminals of trunks, said strips being arranged at each intersecting point so that connections may be made at each intersecting point between a first line and a first or second trunk, or between a second line and a first or second trunk, horizontal and vertical intersecting bars, means for operating said bars, and means responsive to the operation of one horizontal and either one of the vertical

adjacent bars for establishing any one of said four kinds of connections at the intersecting points of the operated bars.

5 In a cross-bar switch, horizontal and vertical operating bars, horizontal and vertical rows of intersecting contact strips arranged so that two adjacent rows of horizontal strips and two adjacent rows of vertical strips have their contacts arranged in a single group at each of the
10 intersecting points of said four rows of strips, and means effective by the operation of a horizontal bar and either of a pair of vertical bars for establishing connections between contacts of a single group in either of four different combination of contacts, each combination constituting contacts of a horizontal row of strips and contacts of a vertical row of strips in said group.

6. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, the horizontal strips representing terminals of lines and the vertical strips representing terminals of trunks, said strips being arranged at each intersecting point in four groups, one group comprising strips of a first line and a first trunk, a second group comprising a second line and a first trunk, a third group comprising a first line and a second trunk, and a fourth group comprising a second line and a second trunk, horizontal and vertical intersecting bars, and means effective
20 by the operation of one horizontal bar and either of two adjacent vertical bars for establishing connections between contact strips representing a line and a trunk at the corresponding intersecting point of said bars at any one of the four groups.

7. In a cross-bar switch, horizontal and vertical rows of intersecting contact strips, the horizontal strips representing terminals of lines, the vertical strips representing terminals of trunks, said strips being arranged at each intersecting point in four groups, one group comprising strips of a first line and a first trunk, a second group comprising a second line and first trunk, a third group comprising a first line and a second trunk, and a fourth group comprising a second line and
10 a second trunk, horizontal bars and means for rotating said bars in either direction, vertical bars arranged in pairs, and intersecting said horizontal bars, means for rotating one bar in each pair of vertical bars in one direction and
15 the other bar in the opposite direction, and means for establishing connections at either a first group between a first line and a first trunk by the rotation of a horizontal bar in one direction and the rotation of a vertical bar of a pair
20 or at a second group between a second line and a first trunk by the rotation of the same horizontal bar in the same direction and the rotation of the other vertical bar of the pair, or at a third group between a first line and a second trunk
25 by the rotation of the horizontal bar in the opposite direction and the rotation of the first-mentioned vertical bar, or at a fourth group between a second line and a second trunk by the rotation of the horizontal bar in the last-mentioned direction and the rotation of the second-mentioned vertical bar.

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