April 3, 1956 J. KRUITHOF ET AL 2,740,844

FLAT X-BAR SWITCH

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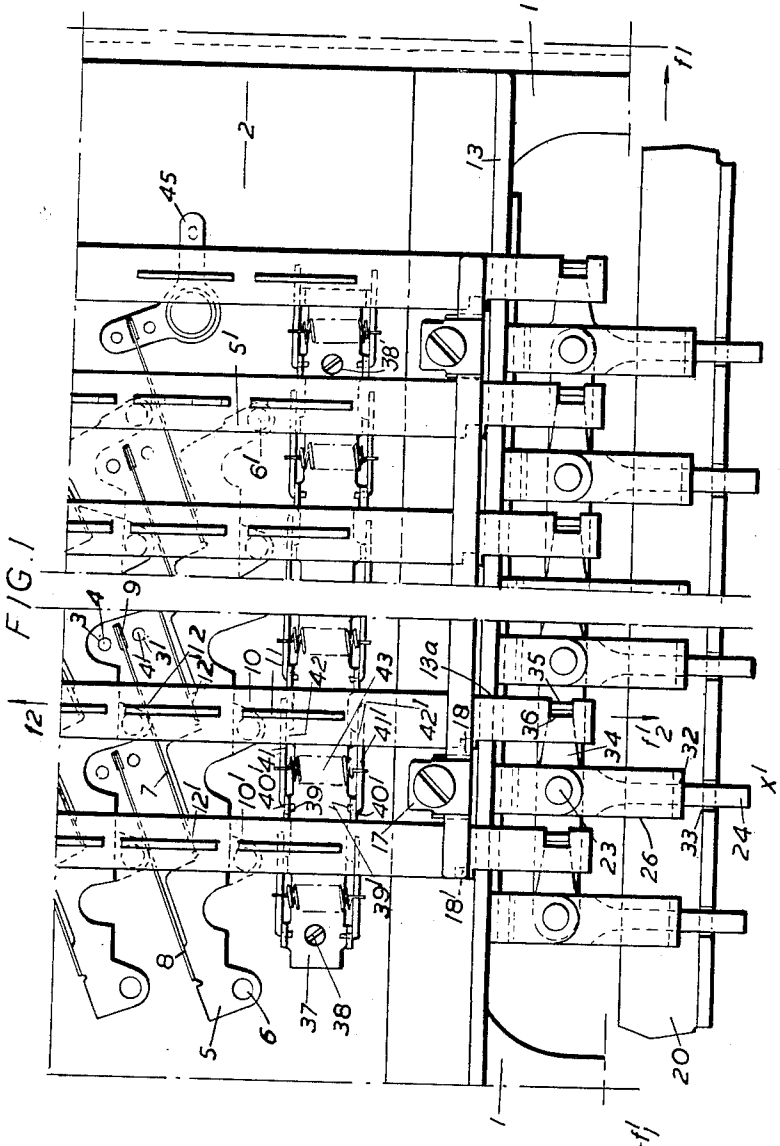

FIG. 1

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Filed April 3, 1952 4 Sheets-Sheet 2

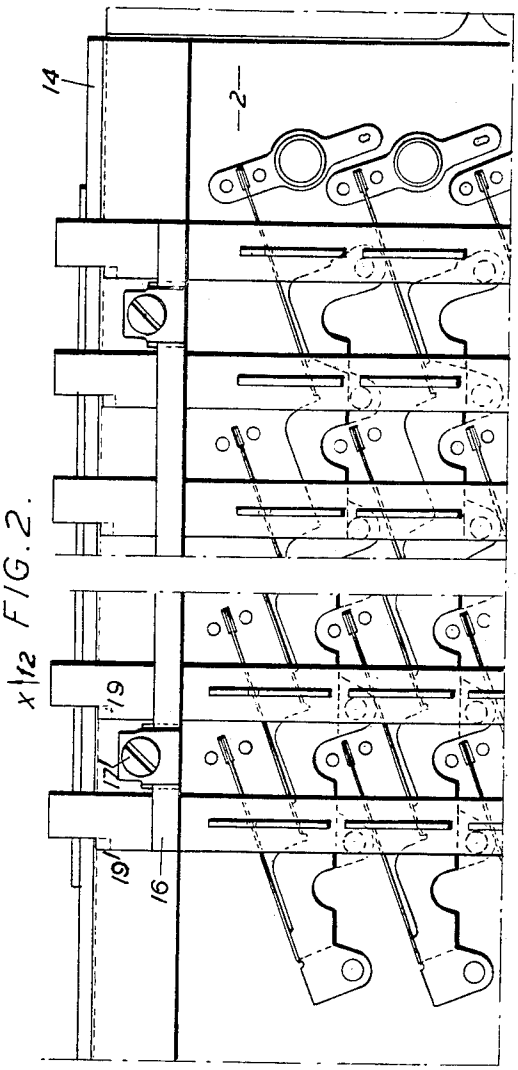

FIG. 2.

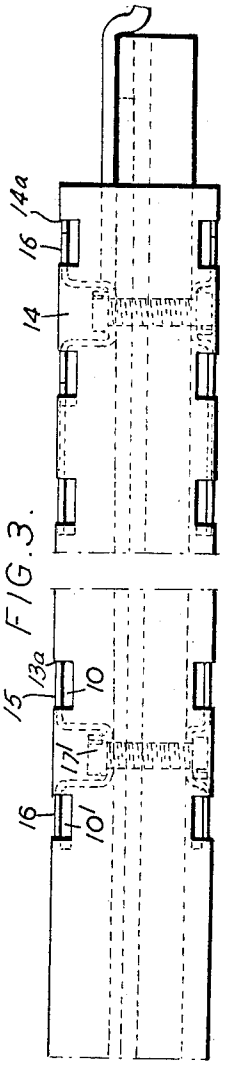

FIG. 3.

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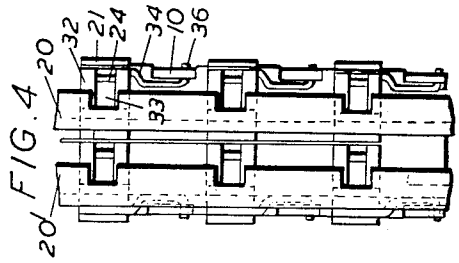

FIG. 4

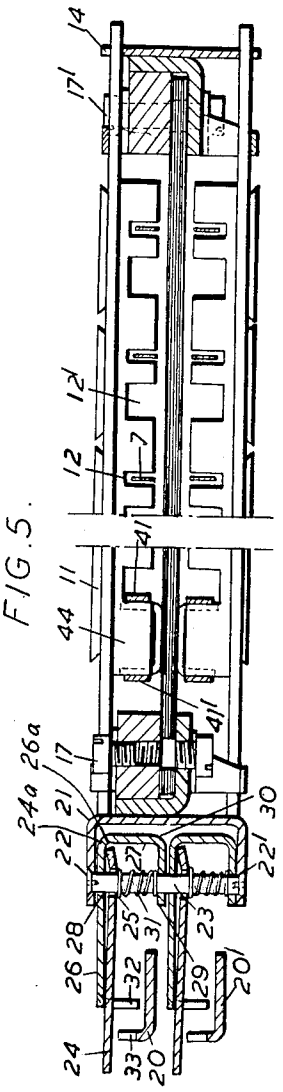

FIG. 5.

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FIG. 6

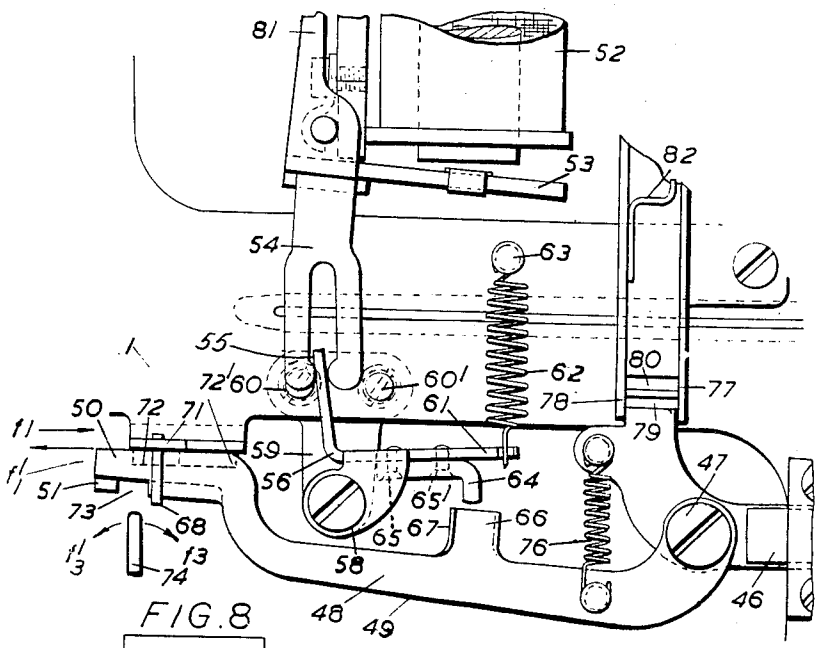


FIG. 8

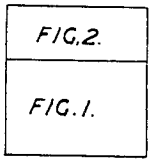
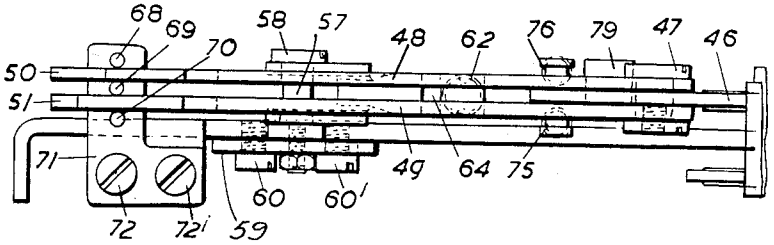


FIG. 7.



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Patented Apr. 3, 1956

2,740,844

FLAT X-BAR SWITCH

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Application April 3, 1952, Serial No. 280,253

Claims priority, application Netherlands April 13, 1951

7 Claims. (Cl. 179—27.54)

The invention relates to a flat electric switch to be used for example in telecommunication systems and affords the possibility of connecting one inlet with a selected one out of a plurality of outlets. Further, a combination of such switches can be used, whereby some essential parts function in common for several switches. In this manner a multi-switch is obtained which may then perform a connection between any out of a plurality of inlets and a selected outlet.

Such switches are already known and have for example been disclosed in U. S. Patent No. 2,651,682, and in our co-pending application filed April 3, 1952, bearing Serial No. 280,252, entitled "Electric Switch."

The present invention relates to a particular manner in which an individual switch is constructed. "Individual switch" here indicates a switch giving access from one inlet to any out of a plurality of outlets.

The main object of the invention is to obtain an individual switch which has the smallest possible dimensions while at the same time is economical to manufacture and fully reliable in its operation.

Another object of the invention is to realize a switch whose smallest dimension, i. e. thickness, is as reduced as possible whereby a large number of such switches may be piled up on top of one another to obtain a multi-switch of reasonable dimensions.

A feature of the invention relates to an electric switch with a plurality of outlets and comprising a first set of fixed parallel conductors, i. e. outlet conductors, a second set of parallel conductors substantially perpendicular to those of the first set and a set of contact fingers movable substantially perpendicular to both sets of conductors and designed to effect contact between a group of conductors of the second set and a group of conductors of the first set corresponding to a particular finger, said conductors of the second set carrying resilient contact extensions which may be displaced, by said contact fingers, into contact with corresponding conductors of the first set, the displacement occurring in a plane perpendicular to the direction of the conductors of the first set.

The first set of fixed parallel conductors might extend in a vertical direction, while the conductors of the second set and the resilient contact extensions thereof extend in a horizontal plane, the contact fingers being also located in a horizontal plane and substantially at right angles to the conductors of the second set. In this way, by having the contact extensions movable in a horizontal plane, no additional height will be necessary to permit the displacement of the contact extensions, whereby the height of the switch will be kept to a minimum, being limited to the height of the fingers compatible with a satisfactory cooperation between the finger and the contact extensions associated therewith.

Another feature of the invention resides in the fact that said resilient contact extensions extend at an angle, e. g. 20°, from the direction of the fixed part of the conductors of the second set and are inserted in narrow slots provided in the contact fingers, to permit the latter to

drive their free ends into contact with corresponding conductors of the first set.

These above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings which represent:

Fig. 1, a plan view of the front part of the switch;

Fig. 2, a plan view of the rear part of the switch;

Fig. 3, an elevation view of the rear part of the switch;

Fig. 4, an elevation view of the front part of the switch;

Fig. 5 shows a sectional side view of the switch taken along $x—x'$;

Fig. 6 shows a plan view of a mechanism used for driving the contact fingers;

Fig. 7 shows a front view of the mechanism shown in Fig. 6;

Fig. 8 shows the manner in which Figs. 1 and 2 should be assembled.

Referring to Figs. 1 and 2, the latter shows the essential part of the switch which comprises a main bracket **1** of suitably rigid material on which is mounted an insulated plate **2** which forms an adequate base-plate for both types of conductors. Holes such as **3** and **3'** are pierced in the insulated plate **2** to permit the insertion, perpendicularly to the base-plate **2**, of fixed conductors **4** and **4'** belonging to a first set of conductors, while by means of suitable screws, another set of conductors may be fixed on the insulated plate **2**. These conductors are constituted by flat metal strips such as **5** which are fixed on the insulated plate **2** by means of screws such as **6** and which comprise contact extensions such as **7** which have been obtained by bending an edge of conductor **5** in a vertical plane at **8**. It will be observed that this contact extension **7** carries at its free end a coating of precious metal **9** which, when moved, will come into contact with the fixed conductors such as **4** or **4'**. Extending traversely across the contact extensions **7** are a plurality of spaced actuating fingers **10**, **10'**. The contact extension **7** will be driven into contact with the fixed conductor by the finger **10**, which finger is provided with a vertical part **11**. The part **11** is provided with slots such as **12** (Fig. 5) in which the extension **7** is engaged. On the other hand, it will be observed from Fig. 5 that the vertical part **11** is also provided with wider slots **12'** which will prevent the mechanical association of a contact extension with a finger controlling contact extensions along another line. For example, finger **10'** when it is displaced, will not come into contact with extension **7** since the latter fits within the slot **12'** which slot is sufficiently wide to clear extension **7** in either its neutral or displaced position.

As shown best in Fig. 3, the fingers, i. e. **10** and **10'** are guided in slots **13***a* and **14***a* in the vertical parts **13** at the front end, respectively and **14** at the rear end to avoid lateral displacements. They are also maintained in a vertical direction by means of the clips **15** (front end) and **16** (rear end), which clips are fixed to the main bracket as shown in Fig. 3, by means of the screws **17** and **17'** and enclose the fingers within slots **13***a* and **14***a*, respectively. The fingers **10** and **10'** are provided with shoulder portions **18** (front end) and **19** (rear end), designed to permit displacements of the fingers longitudinally in either sense and to limit in the direction of arrow f'_2 (Fig. 1) the horizontal displacement under the control of the driving mechanism.

As shown in Figs. 1 and 5, the latter incorporates a clutch mechanism which can first be associated with a driving device which acts in common for a whole row of fingers such as **10** and which is constituted by the horizontal bar **20**. On the other hand, the clutch mecha-

nism is also associated with the end of the finger to which it relates.

The clutch mechanism is held in a U-shaped part 21 which is fixed to the vertical part 13 of the main bracket 1 and which is provided with two holes 22 and 22' at its free ends in which a pivot 23 is held. A first clutch lever 24 is rotatably mounted on the pivot 23 and is provided with a hole 25 which, as shown in Fig. 5, is somewhat larger than the diameter of the pivot 23 whereby vertical displacements of the free end of the lever 24 are permissible. This first clutch lever 24 is mounted immediately below the upper part 26 of the second clutch lever 27 which is also rotatably mounted on the pivot 23 by means of holes 28 and 29 respectively provided in its upper part 26 and in its lower part 30. This second clutch lever 27 cannot, however, suffer vertical displacements since the holes 28 and 29 closely correspond with the diameter of the pivot 23.

As shown in Fig. 5, the first clutch lever 24 is slightly bent at its end 24*a* which end acts as a point of fulcrum against the inside portion 26*a* of the upper part 26 of the second clutch lever 26 by means of the spring 31 which spring is held in place by pivot 23 is between the first clutch lever 24 and the lower part 30 of the second clutch lever 26. As shown in Fig. 5, the outer end of part 26 is bent downwardly at right angles and is in the form of a fork 32 which fits around the free end of the first clutch lever 24.

When it is desired to effect a contact between the horizontal metal strip 5 (and also the remaining horizontal strips in the same plane), and the vertical conductors 4 or 4' (and also the other vertical conductors associated with the other horizontal metal strips), the operation of the mechanism is as follows:

First, finger 10 which is that which will establish the connection, will be preselected by means of a mechanism (not shown) which will cause the free end of the first clutch lever 24 to be displaced downwardly so that it will be inserted in a corresponding slot 33 provided in the horizontal bar 20. If a pile-up of switches such as that shown in Figs. 1 and 2 is used to form a multiswitch, such preselecting mechanism may be constituted by so-called vertical or select bars which are well known in the crossbar switch technique and which serve a vertical row of fingers such as 10.

When the first clutch lever 24 has been displaced downwardly under the action of the preselecting mechanism, the horizontal bar 20 can then be displaced longitudinally in either sense whereby it will cause the first clutch lever 24 to rotate around the pivot 23. For the sake of convenience it will be assumed that a connection is desired with conductors such as 4 whereby the horizontal bar will have to be displaced in the sense of the arrow f_1 (Fig. 1).

During the downward displacement of the first clutch lever 24, the second clutch lever 27 is not affected since the first clutch lever 24 is free to slide inside the fork 32. When the first clutch lever 24 is driven by the horizontal bar 20, the second clutch lever 27 will rotate in a counter-clockwise manner around the pivot 23 by reason of the force exerted by lever 24 against the side of forked end 32. The second clutch lever 27 is formed as a bell crank having a portion 34, which is at right angles to its arm 26, and which will also rotate in a counter-clockwise manner; its end 35 being inserted in a slot 36 provided at the front end of the finger 10 and will drive said finger in the sense of the arrow f_2 whereby the contact extensions such as 7, which are inserted in the slots such as 12, will be driven so that their ends 9 will contact the vertical wires such as 4.

It is evident that if a connection with the vertical wires such as 4' is desired, a displacement of the finger in the direction of the arrow f'_2 is necessary and the horizontal bar 20 should then be displaced in the sense of the arrow f'_1.

It will be observed that in order to obtain a well defined rest position for the fingers such as 10, a centering mechanism has been provided (Figs. 1 and 5) which comprises a U-shaped profiled bar 37 mounted on the insulated plate 2 by means of the screws 38, 38'. The vertical projections such as 39 and 39' on this part 37 are provided with apertures such as 40 and 40' which are used as pivoting points for the small centering levers 41 and 41'. These centering levers 41 and 41' are normally held against adjacent projections 42 and 42' by means of the spring 43. The free ends of the centering levers 41 and 41' cooperate with the vertical part 11 of the finger 10 by abutting against the front and rear sides, respectively of part 44 in the manner shown in Fig. 5 wherefrom it will be appreciated that when the finger is displaced either in the sense of the arrow f_2 or in the sense of the arrow f'_2, the centering lever 41 or the centering lever 41' will rotate around its pivot being driven by the part 44 whereby energy will be stored in the spring 43 which will become tensioned.

In this manner, when the force which maintains the finger in an actuated position is released, this energy will be used to return the finger to its original rest position which is therefore well defined. It will be observed that when the horizontal bar 20 has been displaced after the first clutch lever 24 had been depressed, the means which caused said first clutch lever 24 to be depressed can now be released since the horizontal bar 20 will remain associated with the first clutch lever 24 via the slot 33 due to the frictional pressure exerted thereagainst by the side of the slot. This frictional pressure should be sufficient to overcome the tension of spring 43 and also the back pressure exerted on the contact extensions such as 7 which is transmitted to the finger 10 via the side of the narrow slot 12.

Considering Fig. 5, it will be noted that the U-shaped part 21 is used to house two clutch lever mechanisms on top of one another, the bottom one being used in conjunction with the horizontal bar 20' for the operation of another set of contact fingers which are located below the insulated plate 2. These contact fingers are identical to those located on top of the insulated plate 2 and mounted thereon in a similar fashion. Also, as indicated in dotted lines on Figs. 1 and 2, horizontal strips such as 5' (dotted lines) will be mounted below the insulated plate 2 by means of screws such as 6'. The upper and lower screws such as 6 and 6' are shown to be staggered since it is assumed that they are made of conducting material such as metal, so as to avoid a short-circuit between top and bottom horizontal strips, which is obviously undesirable since those strips belong to different inlets. However, if these screws were made of insulated material, such staggering would no longer be necessary and a single screw could readily hold both the top and bottom horizontal strips against opposite sides of insulating plate 2.

Referring to Figs. 1 and 2, the last contact extension on the right-hand side of each horizontal metal strip is shown to lead to an inlet terminal such as 45 for the strip 5 and this permits an additional selection as explained in detail in our said copending application Serial No. 280,252. As shown, these last contact extensions are controlled in the same manner by means of a contact finger identical to those already described.

The mechanism for causing the displacement of the horizontal bar such as 20 will now be described with reference to Figs. 6 and 7. It should be assumed that the horizontal bar 20 (Fig. 1) terminates into the end part 46 (Fig. 6) which is provided with a screwed pivot 47 on which two auxiliary levers 48 and 49 are mounted on top of one another, as shown in Fig. 7. Except for their end parts 50 and 51, these levers are substantially identical and can be brought into a clutch position when the electro-magnet 52 corresponding with the horizontal bar 20 is energized. At this moment, the armature 53 will be attracted towards the core of the electro-mag-

net 52 whereby the forked extension 54 is rotated in a counter-clockwise manner thereby driving the arm 55 of an intermediate lever 56 which is mounted by means of a screw 58 on an auxiliary bracket 59 fixed to the main bracket 1 by means of the screws 60 and 60' in a clockwise manner around its pivot 57.

The other arm 61 of the intermediate lever 56 will rotate in the same manner exerting a pull on the restoring spring 62, the other end of which is fixed at 63 to the main bracket 1. A small extension 64 is mounted on the arm 61 via the screws 65 and 65' and when the electro-magnet 52 is energized, extension 64 will press against the projections 66 and 67 which are integral parts of the auxiliary levers 48 and 49, respectively. Both levers 48 and 49 will, therefore, rotate in a counter-clockwise manner around their pivot 47, their free ends 50 and 51 sliding along the guide pins 68, 69 and 70 which are used to guide these free ends and which are mounted on a small bracket 71 screwed to the main bracket 1 by means of the screws 72 and 72'.

It will be observed that the slot 73 which is formed between the ends 50 and 51 of the auxiliary levers 48 and 49 will then be brought in line with the horizontal bar 20 and in this position will surround the edge of a profiled bar 74 which extends in the vertical direction and which can be pivoted either in the sense of the arrow f_3 or in the sense of the arrow f'_3. Once this profiled bar 74 is engaged in the slot 73, it can then be rotated in the sense of the arrow f_3 or in the sense of the arrow f'_3 whereby it will drive either the auxiliary lever 48 in the sense of the arrow f_1 or the auxiliary lever 49 in the sense of the arrow f'_1. In the first case, the horizontal bar 20 will be longitudinally displaced in the sense of the arrow f_1 and in the other case, in the sense of the arrow f'_1.

During either displacement, the projections 66 and 67 will slide along the extension 64 until, in the second case, the face of the projection 67 will slide off extension 64 and the auxiliary lever 49 falls back in a clockwise manner under the action of the spring 75 which had become tensioned when the auxiliary levers were first rotated. In the first case, the lever 48 will be the one to fall back but this time under the action of the spring 76 which had become tensioned in the same manner as the spring 75. At this moment, the vertical bar 74 which in the second case maintained the auxiliary lever 48 in its actuated position by frictional pressure against the end 50, can be returned to its original position as shown in Fig. 6. In this case, the lever 48 will then be able to fall back alongside the lever 49. If the vertical bar 74 had been rotated counter-clockwise (in the sense of arrow f'_3), the lever 49 will then fall back when the vertical bar 74 has returned to its original position.

It will be noted that in either actuated position, the horizontal bar 20 is held by the end 64. Due to the slight staggering of the projections 66 and 67, when it is desired to return the horizontal bar to its original position, this will occur under the back pressure exerted either by the cantilever spring 77 or by the cantilever spring 78 adjacent the bent part 79 integral with the end part 46 of the horizontal bar 20; the stop member 80 fixed to the main bracket 1 defining the rest position of said cantilever springs; the spring 77 exerting a force in the direction of f'_1 and spring 78 exerting a force in the direction of f_1. This will occur as soon as the electro-magnet 52 is de-energized whereby under the action of the restoring spring 62, the end 64 will return to its original position shown on Fig. 6 thereby releasing the auxiliary levers 48 and 49. The staggering of the projections 66 and 67 is therefore advantageous since the restoring spring 62 will have to overcome the frictional pressure exerted between the sides of the projections and the extension 64. Since in either case the extension 64 is only in contact with one of the projections 66 or 67, this means a reduction of the release pull which has to be provided by the spring 62 and accordingly of the armature pull which must be exerted by the armature 53 of the electro-magnet 52 to overcome the tension of spring 62.

The part 81 on the opposite side of the forked extension 54 is used to control electrical contacts (not shown) depending upon the electrical condition of the electro-magnet 52, while the part 82 which is integral with the cantilever spring 78, is used to control electrical contacts (not shown) when the horizontal bar is displaced.

The mechanism described above is somewhat similar to those disclosed in U. S. Patent No. 2,623,404 and in Belgian Patent No. 495,155 but has the advantage of using simpler parts.

The vertical bar 74 is essentially a part of a servo-mechanism which is used in common for a plurality of horizontal bars 20, in an analogous manner as the common means used to depress a whole vertical row of first clutch levers such as 24. For the horizontal bar 20' which is located immediately below the horizontal bar 20, it is of advantage to use a mechanism similar to that shown in Fig. 6 but located at the opposite end of the bar 20, whereby this can be repeated for each set of two individual switches in a vertical pile-up, thereby enabling the height of the switch to be independent of the size of the mechanism shown in Fig. 6.

As stated above, and as shown more particularly on Fig. 5 which has been drawn at an appreciably enlarged scale, the height of a pair of individual switches is relatively small; a distinct advantage. It is to be avoided that this advantage should not be lost due to the size of the operating mechanism for the horizontal bars. As shown in Fig. 7, the parts used do not have an appreciable height and by using the smallest dimension of the electromagnet 52 in a vertical direction and also due to the alternance of the operating mechanisms at both ends of the horizontal bars, we may avoid losing the benefit of an individual switch having a very small height.

For example, 24 double individual switches could be piled up on top of one another together with the operating mechanisms for the horizontal bars which are mounted on the main brackets 1; the total height of the multi-switch thus obtained being limited to 48 centimetres.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

We claim:

1. An electric multi-switch for use in switching systems comprising a first set of fixed spaced parallel conductors, a second set of spaced parallel conductors substantially perpendicular to those of said first set, each of said second conductors having a first portion in a first plane, a plurality of separated second portions disposed in a row, each in second parallel planes perpendicular to said first plane and to said first conductors, the planes of said second portions being disposed at an acute angle to the axis of said row, each of said second portions disposed in overlapping relation to the adjacent second portion of said second conductor and in switching relation between different of said first conductors, a plurality of spaced, parallel control finger means disposed in a third plane, said third plane perpendicular to said first and second planes and to said first conductors, said finger means including means for engaging corresponding second portions of said second conductors, means for actuating said finger means in a direction parallel to said third plane whereby the second portions of said second conductors are selectively actuated to contact predetermined of said first conductors.

2. An electric multi-switch as claimed in claim 1, wherein each of the second portions of said second conductors comprises a fixed part and a resilient part having

a free end, said finger means engaging said portions at a point between said parts.

3. An electric multi-switch as claimed in claim 1, further comprising a base member of insulating material, a number of said second conductors fastened to one side of said member, the balance of said second conductors fastened to the other side of said member, said member having a plurality of spaced apertures therethrough, each of said first conductors adapted to pass through a different one of said apertures.

4. An electric multi-switch as claimed in claim 1, wherein each of said finger means comprise a member having a plurality of spaced slots in one side thereof, alternate slots being of a size sufficiently small enough to engage corresponding second portions of said second conductors, and intervening of said slots being of a size sufficiently large enough to permit movement of said member without engaging corresponding adjacent second portions of said second conductors.

5. An electric multi-switch as claimed in claim 1, wherein said means for actuating said finger means comprises an actuating bar lying in a plane parallel to said first plane and adjacent an end of said finger means and adapted to move in a direction parallel to its longitudinal axis, said bar having a plurality of slots therein, a plurality of first clutch levers each adapted to clutch said finger means with said actuating bar, said levers having rest positions and operated positions, means for selectively urging said levers to their operated position, said levers in their operated positions adapted to be selectively urged within the slots of said bar, a plurality of translating levers, both said clutch levers and said translating levers corresponding in number to each of said finger means, said translating levers coupled between said clutch levers and said fingers and adapted to translate the direction of motion of said actuating bar to a direction parallel to the longitudinal axes of said finger means.

6. An electric multi-switch as claimed in claim 5, further comprising means for maintaining said clutch levers in clutched position with said bar after selective urging thereof and after withdrawal of said urging, said means comprising the walls of the slots in said bars and spring restoring means coupled to said fingers for restoring said fingers to normal position after release of said clutch levers by said maintaining means.

7. An electric multi-switch as claimed in claim 5, wherein said means for actuating said finger means further comprises a pivoting actuating element, an electromagnet having a cooperating armature, a pair of interponent members pivotally mounted to one end of said actuating bar, resilient means adapted to normally urge said interponent members out of the path of said actuating element, a pivotally mounted extension element disposed between said armature and said interponent members, said extension element adapted to urge an end of said interponent members in the path of said actuating element under control of said electromagnet, said extension element having a portion adapted to latch an actuated interponent member in operated position under control of said electromagnet, resilient means coupled to said actuating bar for returning said bar to normal position after said extension element has unlatched said actuated interponent member.

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