Jan. 24, 1939. O. F. FORSBERG 2,144,839

SWITCH

Filed Oct. 6, 1935 1 Sheet—Sheet 1

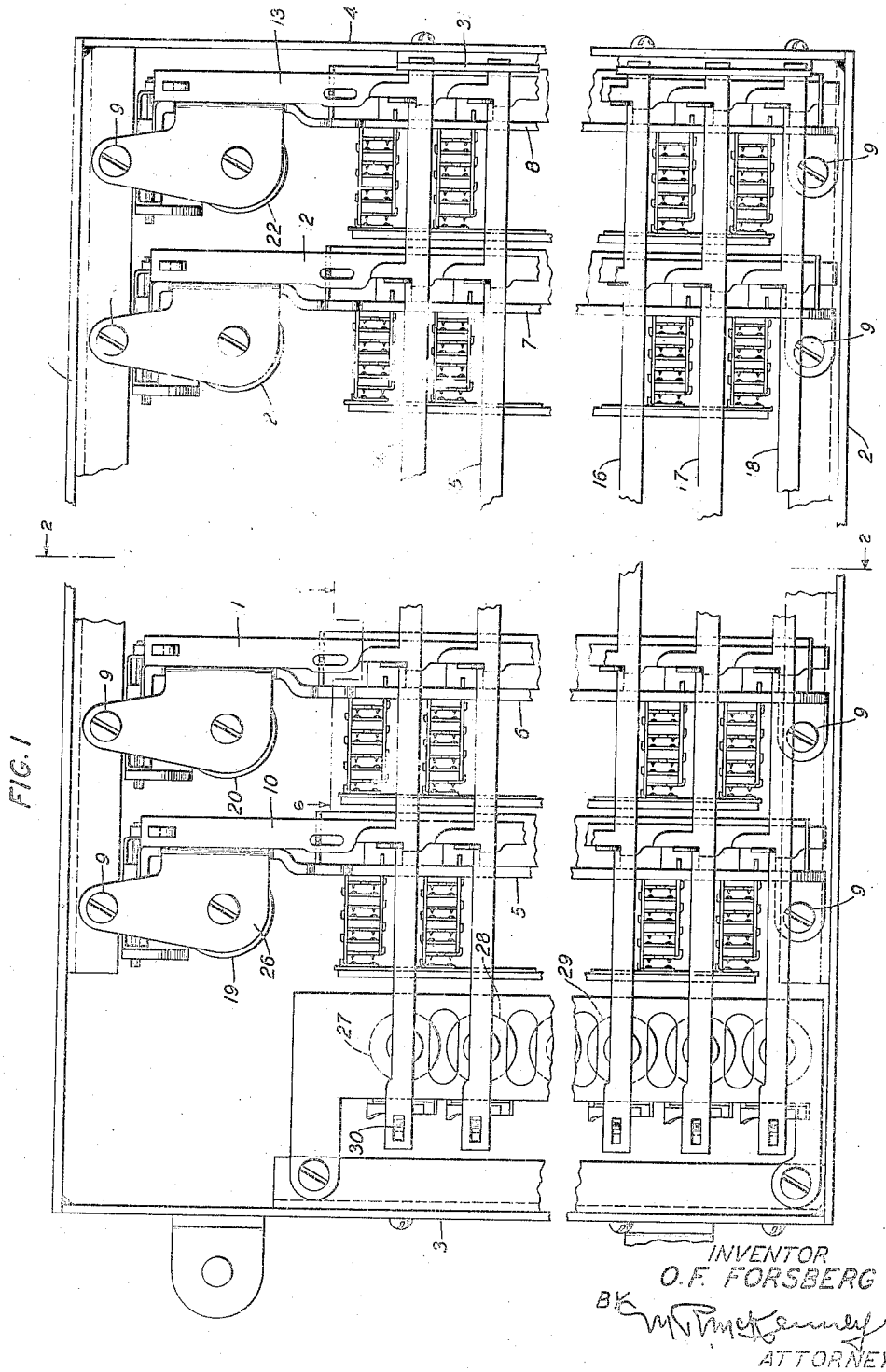

FIG. 1

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FIG. 2

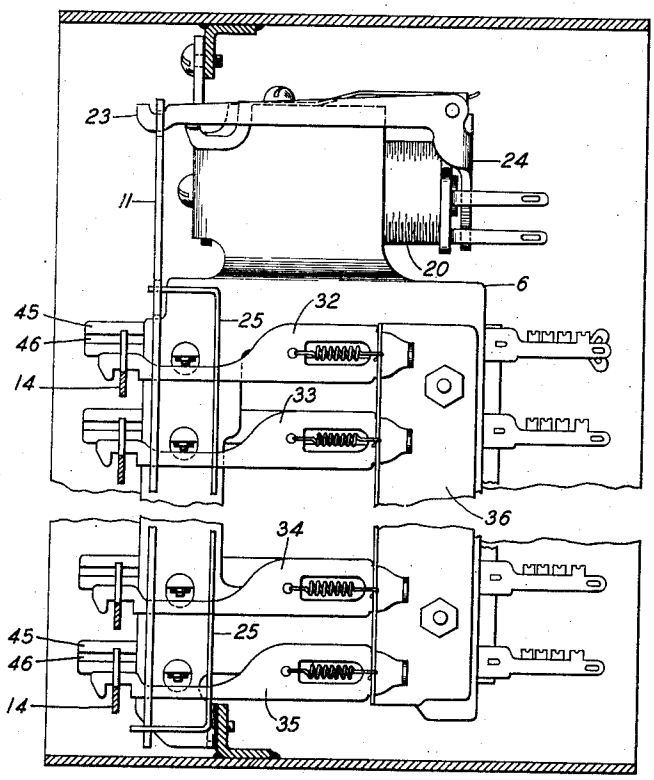

FIG. 3

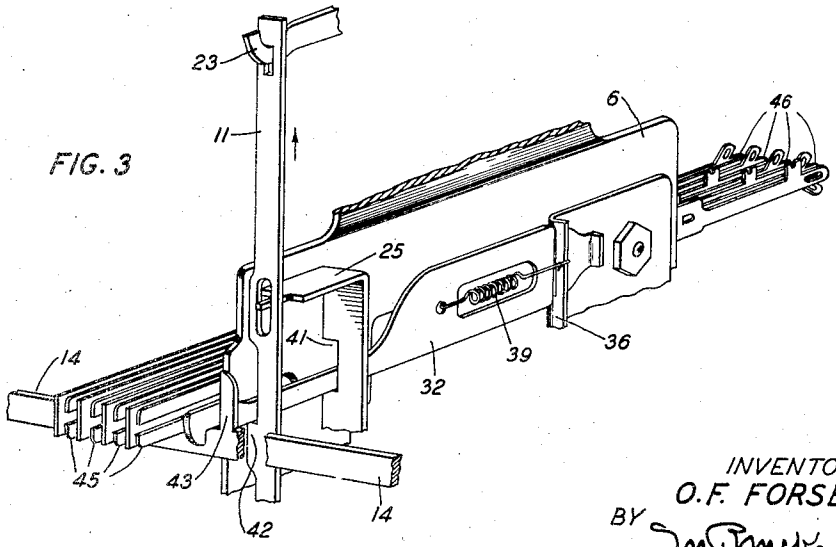

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FIG. 4

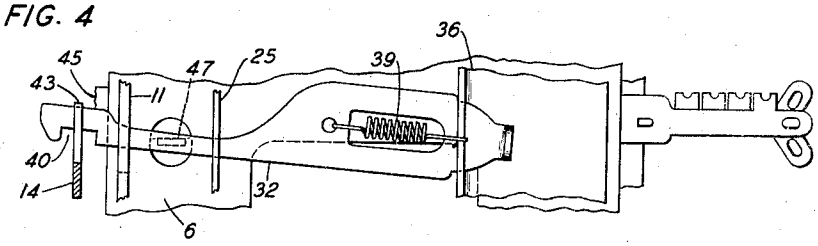

FIG. 5

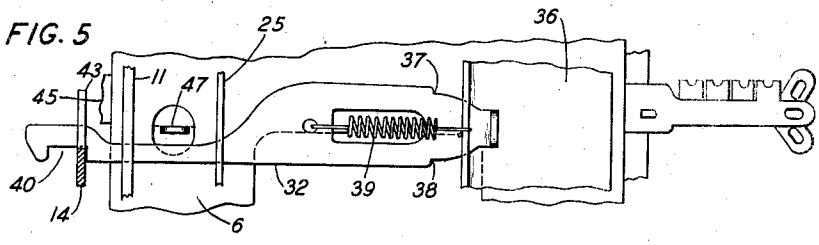

FIG. 6

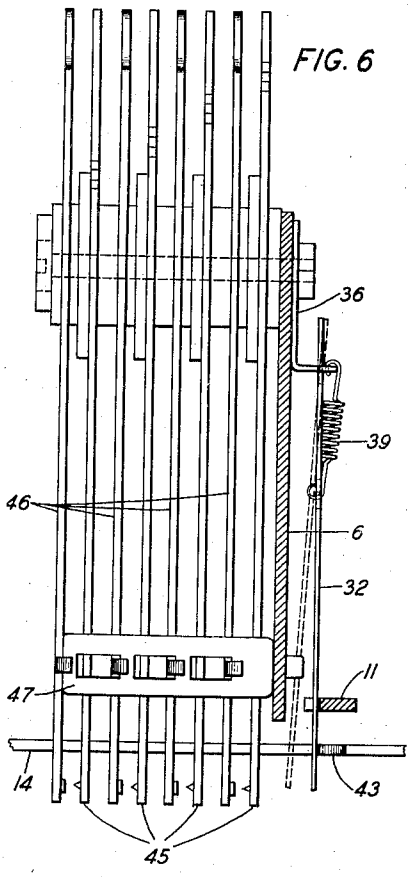

FIG. 7

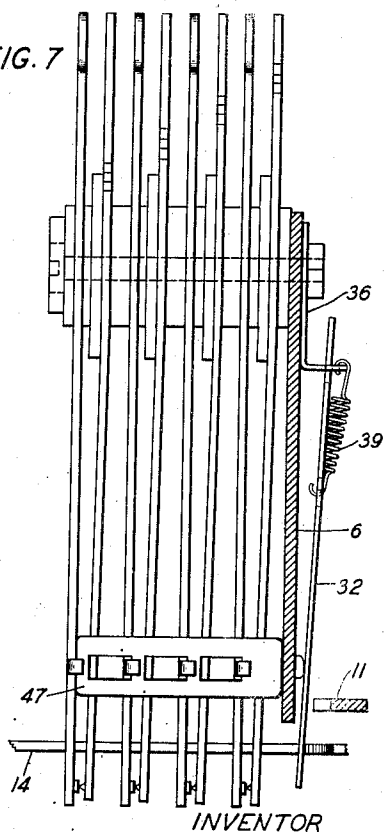

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FIG. 8

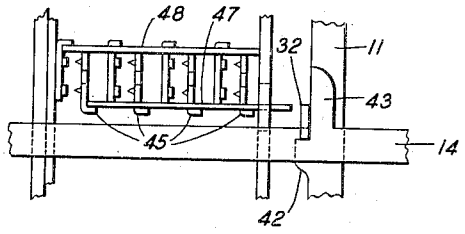


FIG. 9

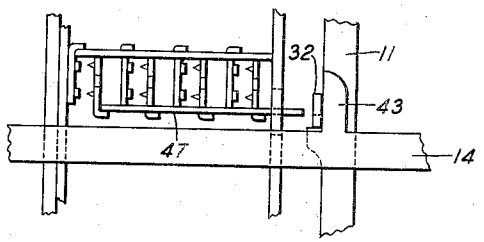


FIG. 10

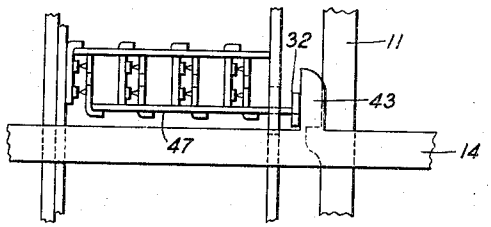
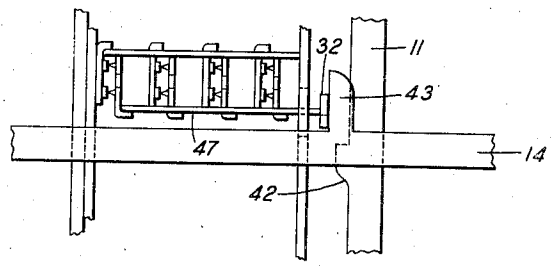


FIG. 11



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Patented Jan. 24, 1939

2,144,839

UNITED STATES PATENT OFFICE

2,144,839

SWITCH

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Application October 16, 1935, Serial No. 45,174

13 Claims. (Cl. 179—27.54)

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

The objects of the invention are to simplify the construction of selective switches, to increase the reliability of their operation, to facilitate the assembly and replacement of their parts, to increase their wearing qualities, and to effect other improvements therein.

Various kinds of cross-bar switches have been designed heretofore. In some of these flexible actuating fingers are controlled by the conjoint action of two bars to effect the closure of a contact set. In others rigid actuating devices are provided at the cross-points instead of the flexible fingers for controlling the contact sets.

A feature of the present invention is a switch of this general character having rigid elements or fingers for actuating the contacts at the cross-points and in which each finger has one end loosely fixed in a slot of the supporting member in such a way that the free end of the finger is movable in any direction about the fixed end as a center. The setting of the actuating finger is effected by the conjoint movement of the operating bars, and the finger in turn causes the closure of the contacts. The actuating finger is provided with shoulders at its fixed end which engage the supporting member and determine the normal position of the finger with respect to said member, and it is held in this position by a small helical spring. In the setting operation the finger is moved against the tension of the spring in two principal directions, and, when released, it is returned by the spring directly to its normal position since it is capable of universal movement.

This construction has the advantage that the actuating fingers are free from any inherent flexibility and do not tend to participate in a vibrating action when they are suddenly released from the operated position. Also they are not liable to become bent or distorted, causing the switch to fail in its operation or to perform a false operation. Another advantage is that the actuating fingers are held in the assembled position by means of their springs alone. This facilitates the initial assembly of the parts and also the ready removal of any finger in case replacement is necessary. A further advantage is that the actuating finger can be made of relatively heavy stock, giving improved wearing qualities and longer life.

The foregoing and other features of the invention will be discussed in detail in the following specification and will be set forth in the appended claims.

In the drawings, which also constitute a part of the specification;

Fig. 1 is a front plan view of the switch as a whole with certain duplicate parts broken away and removed to conserve space;

Fig. 2 is a side view, partly in plan and partly in cross-section, taken along the line 2—2 in Fig. 1;

Fig. 3 is an enlarged perspective showing the contact operating mechanism located at one of the cross-points of the switch;

Fig. 4 is a side view showing one of the contact operating elements;

Fig. 5 is a similar view showing the element partly removed from the mounting strip that supports it;

Figs. 6 and 7 are top views of a set of contact springs in their open and closed positions, respectively; and

Figs. 8 to 11, inclusive, are diagrams showing successive steps in the selection and operation of a set of contact springs.

This invention is applicable in general to switches of the cross-bar type in which the bars of a plurality of sets cooperate with each other to bring about the selective operation of a desired set of circuit-making contacts. A switch of this kind is shown and described in the patent to J. N. Reynolds, 1,953,503 of April 3, 1934. In the Reynolds patent and in the switch illustrated herein the cross-bars are operated in a longitudinal or sliding movement. Other switches of this general kind make use of rotary cross-bars, and it should be understood that the present invention may also be applied to switches of this kind.

Referring now to the drawings, the frame of the switch illustrated therein comprises the upper and lower members 1 and 2 and the side members 3 and 4. These four members are secured to each other in any suitable manner, as by means of welded joints.

The contact sets and the contact operating mechanisms are mounted in units on the vertical mounting plates 5, 6, 7, 8, etc. These plates are secured by means of screws 9 to the upper and lower frame members 1 and 2. The number of these vertical units is variable and depends upon the desired capacity of the switch. One convenient capacity for switches of this kind is afforded by providing ten of these vertical units. For larger switches as many as twenty vertical units may be used. The contact bank which is formed

by the spring contacts carried by the several mounting units may be considered as divided into two multiples, a horizontal multiple and a vertical multiple. The horizontal contact sets appearing at successive cross-points along a horizontal row may be multipled together by means of strap wires which are soldered to the terminals provided at the rear of the switch, as seen in the several figures. The cooperating vertical contacts appearing at successive cross-points in a vertical row may be formed integrally with each other by stamping them from metal sheets, and each such multiple strip may be provided with a terminal projecting to the rear of the switch for external connections. These latter connecting terminals are also illustrated in the drawings, and they are well understood in the art. To effect a connection between the horizontal and vertical contact springs at any particular cross-point, it is necessary to select the cross-point and to move the springs into engagement with each other. This is accomplished by means of the contact selecting and operating mechanisms which will be described hereinafter. Before taking up the operating mechanisms, however, a description will first be given of the cross-bars which control the selection and operation of these mechanisms.

The cross-bars of the switch comprise two sets, the vertical or select bars **10**, **11**, **12** and **13**, etc. and horizontal or actuating bars **14**, **15**, **16**, **17**, **18**, etc. These vertical bars are operated in a longitudinal manner by corresponding vertical magnets **19**, **20**, **21**, **22**. The vertical bar **11**, for instance, is suspended on the extension **23** of the armature **24** of the corresponding vertical magnet **20**. The lower end of the bar **11** is fixed for movement up and down in a slot in the guide plate **25**. The vertical magnets are mounted, respectively, on the vertical mounting plates. For example, the magnet **19** is mounted on the bracket **26** which is integral with the vertical mounting plate **5**. The same is true of the remaining vertical magnets. The horizontal bars **14**, **15**, **16**, etc., are also mounted for longitudinal movement by their corresponding horizontal magnets **27**, **28**, **29**, etc. The bar **14**, for example, is supported at one end on the extension **30** of the armature of magnet **27**, and at the other end this bar is fixed for slidable movement in a guide plate **31** secured to the frame member **4**. Similarly, the remaining horizontal bars are mounted for longitudinal movement. Suitable springs, not disclosed, are provided for restoring the bars to their normal positions after they have been operated by the horizontal magnets. The number of horizontal bars may be varied and will be determined by the desired capacity of the switch. A convenient number of horizontal bars is ten for switches of this kind.

Coming now to the contact operating mechanisms, these may be more clearly understood from a reference to Figs. 2 to 7. The essential element of the contact operating mechanism is a flexibly mounted rigid operating finger. Each set of contacts at the several cross-points of the switch is equipped with one of these fingers. In Fig. 2 four of these operating fingers, **32**, **33**, **34**, **35**, located in the same vertical row, are illustrated. These four operating fingers, and others not shown in the drawings, are associated with the vertical bar **11** and with the corresponding vertical row of contact sets. They are supported by a strip **36** which is bolted to the vertical supporting plate **6**. The operating finger **32**, for instance, has one of its ends tapered and formed to present shoulders **37** and **38**, as seen more clearly in Figs. 4 and 5. When in position the finger **32** rests in a slot in the strip **36** with the shoulders **37** and **38** bearing against the strip **36** and firmly held in position by the retractile spring **39**. The receiving slot for the finger is sufficiently large to permit the finger to move freely in all directions about the fixed end as a center, the retractile spring **39** always acting to restore the finger to the normal position shown in Figs. 2 and 3. The free end of the finger **32** is provided with a notch **40** which embraces the corresponding horizontal bar **14**. When in its normal position as seen in Fig. 3, the finger **32** rests lightly on the bottom of notch **41** in the guide member **25** and lightly on the integral shoulder **42** formed on the vertical bar **11**. Moreover, with the finger **32** in its normal position it rests on the horizontal bar **14** adjacent the corresponding projection **43** on said horizontal bar.

The set of contact springs located at the point of crossing of the vertical bar **11** and the horizontal bar **14** and which are controlled by the operating finger **32** at that cross-point comprise a number of movable springs **45** and an equal number of cooperating stationary springs **46**. The movable springs **45** are the ones which have their terminals at the rear of the switch and which are multipled to other movable springs in the same horizontal row. The stationary springs **46** may, as hereinbefore explained, be multipled with other springs in the same vertical row. The movable springs **45** are secured to a movable insulating plate **47** so that any movement imparted to the plate causes all of the springs **45** to move in unison therewith. The stationary cooperating springs **46** have their free ends secured to the stationary insulating plate **48**. The end of the movable plate **47** is so located with respect to the operating finger **32** that, when the finger is raised vertically from its normal position and is then moved horizontally, said finger engages the plate **47** and forces the movable springs into contact with the corresponding stationary springs. When the elements are in their normal position, however, as seen in Figs. 2 and 3, the finger **32** lies somewhat below the end of the plate **47** so that any movement of the finger in a horizontal direction merely causes it to pass in under the plate **47** without causing any movement of the contact springs.

A description will now be given of the manner in which the different parts of the switch function to selectively operate a desired set of cross-point contacts. Assume for this purpose that it is desired to close the contact springs **45** and **46** at the cross-point with which the operating finger **32** is associated. To this end the vertical magnet **20** is first energized to lift the vertical bar **11**. The upward movement of the bar **11** causes the shoulder **42** to lift the operating finger **32** against the tension of its spring **39** to a position (Figs. 4 and 9) where the finger **32** lies opposite the end of the insulating plate **47**. In executing this movement the finger **32** pivots about its upper shoulder **37** which is held by the spring **39** firmly against the supporting plate **36**, the free end of the finger describing a small vertical arc. Following this the horizontal magnet **27** is energized to draw the horizontal bar **14** toward the left as seen in Figs. 1 and 3. As the bar **14** moves toward the left, the projection **43** thereon encounters the free end of the finger **32** and swings the finger in a horizontal arc about its fixed end as a pivot. This horizon-

tal tilting movement of the finger **32** results in a further tensioning of the spring **39** which tends to withdraw the finger back to its normal position. As the finger **32** is thus moved by the bar **14**, it engages the insulating plate **47** and forces the movable springs **45** into engagement with the stationary springs **46**. This position of the parts is illustrated in Figs. 7 and 10. Finally the vertical magnet **20** is deenergized, permitting the vertical bar **11** to restore to its normal position. The continued energization of the horizontal magnet **27** holds the horizontal bar **14** and the finger **32** against the plate **47** to maintain the closed set of contacts in its operated position. This condition is illustrated in the diagram of Fig. 11.

To release the closed set of contacts, it is only necessary to deenergize the magnet **27**, permitting the horizontal bar **14** to restore to its normal position. When the bar **14** restores, it releases the finger **32**, and the spring **39**, which has been tensioned by both the vertical and horizontal movements of the finger, now restores the finger to its normal position in its slot in the supporting strip **36**.

Each of the several cross-points in the switch is similarly equipped with an operating finger; and each of the vertical bars corresponding to a particular vertical row of contacts is provided with a shoulder, such as the shoulder **42**, for raising the corresponding finger; and each of the horizontal bars relating to a horizontal row of contacts is provided at every cross-point with a projection, such as the projection **43**, for imparting a horizontal movement to the corresponding operating finger. Whenever a vertical bar is raised, it raises all of the operating fingers which at the time are in their normal positions. However, since the operation of the vertical bar is usually followed by the operation of a single horizontal bar, only one of these elevated fingers becomes effective to close a set of contacts, and the remaining fingers associated with the vertical bar are restored to their normal positions when the bar is later released. Similarly, whenever a horizontal bar is moved, it advances all fingers **32** in a horizontal direction. Since, however, only one of these fingers has been previously elevated, it alone will be effective in the closure of a set of contacts, and the remaining fingers will pass under the corresponding insulating plates, such as plate **47**, without disturbing the associated contact springs.

With the construction herein disclosed the assembly and repair work on the switch is considerably simplified. The operating fingers **32** can be assembled by merely slipping the tapered end into the receiving slot in the mounting strip **36** and attaching the retractile spring **39**. In a similar manner any one of these fingers may be withdrawn at will without disturbing other parts of the switch. Fig. 5 shows one of the fingers in a partially withdrawn position. The operating fingers are made of fairly heavy material and are, therefore, capable of withstanding the wearing action caused by the repeated operation of the bars. Also when released they do not vibrate and return to a point where they are likely to be caught by a bar, operating at that instant, to cause the false closure of contact sets.

What is claimed is:

1. The combination in a switching mechanism of a set of contacts, a supporting member having an aperture therein, a contact operating element with one end loosely fixed in said aperture and supported by said member, means for displacing said element in a plurality of different arcuate movements about its fixed end as a center, and means responsive to the movement of said element for operating said contacts.

2. The combination in a switching device of a set of contacts, a supporting member having an aperture therein, a contact operating element supported by said member with one end loosely fixed in said aperture, a spring for holding said element in a normal position relative to said member, means for displacing said element from its normal position in two different arcuate movements about its fixed end as a center, and means responsive to the movement of said element for operating said contacts.

3. The combination in a selective switch of a set of contacts, a supporting member having an aperture therein, a non-flexible contact actuating finger with one end loosely fixed in said aperture and supported by said member, means for displacing said finger in a plurality of different movements about its fixed end as a center, and means responsive to the movement of said finger for controlling said contacts.

4. The combination in a selective switch of a set of circuit making contacts, a stationary supporting plate having an opening therein, a rigid actuating finger supported by said plate with one end extending into said opening, means for moving the other end of said finger in two separate arcuate movements, each in a different plane, and means operated by said finger for closing said contacts.

5. In a selective switch, a set of contacts, a supporting plate having a slot therein, an actuating element, one end of which projects into said slot and is provided with shoulders which bear against the plate to fix said element in its normal position, a spring for holding said element in its normal position, means acting against the tension of said spring for displacing said element from its normal position, and means responsive to the movement of said element for controlling said contact set.

6. In a selective switch, a set of contacts, a supporting plate having a slot therein, a rigid actuating finger, one end of which extends into said slot and is provided with shoulders which bear against the plate to fix said finger in its normal position with respect to said plate, a spring joining the finger and plate for holding said finger in its normal position, means acting against the tension of said spring for displacing said finger in a plurality of directions, and means controlled by the finger for operating said contacts.

7. In a cross-bar switch, sets of contacts, a mounting plate having a lineal series of apertures therein, rigid actuating fingers, one for each aperture, each finger having one end loosely fixed in its aperture for free movement in a plurality of directions, springs for holding the respective fingers in position, an operating bar for moving the free ends of said fingers in a line parallel to the line of said apertures, other operating bars for moving the free ends of said fingers at an angle to the line of said apertures, and means controlled by any one of said fingers for operating a corresponding one of said contact sets.

8. The combination in a switching mechanism of a set of circuit contacts, a supporting member, a contact operating finger, rigid throughout its length and having one of its ends detachably

mounted on said supporting member for universal movement with respect thereto, resilient means for holding said finger against detachment from said supporting member, operating means for moving said finger in a plurality of directions, and means responsive to the movement of said finger for operating said set of contacts.

9. The combination in a switch of a set of circuit making contacts, a stationary supporting member, a rigid contact operating finger having one end loosely and detachably mounted on said stationary member for universal movement with respect thereto, resilient means for holding said finger in its normal position and for preventing its detachment from said supporting member, operating means for moving said finger in a plurality of directions, and means responsive to the movement of said finger for operating said contact set.

10. The combination in a switching device of a set of circuit making contacts, a stationary supporting plate, a rigid contact operating finger detachably engaging said plate and supported thereby for universal movement with respect thereto, a spring interconnecting said plate and finger for holding said finger in its normal position and for preventing its disengagement from said plate, selective means for displacing said finger in a plurality of directions, and means responsive to the movement of said finger for operating said set of contacts.

11. The combination in a switching mechanism of a set of contacts, a stationary supporting member, a rigid contact operating element having one end mounted on said supporting member for universal movement with respect thereto, means for displacing the free end of said element in a plurality of different movements, and means responsive to the movement of said element for operating said contacts.

12. The combination in a switch of a set of contacts, a stationary supporting member, a contact operating element mounted on said stationary support for movement in all directions with respect to said support, said element being rigid throughout its length, means for moving said element, means responsive to the movement of said element for operating said set of contacts, and means for restoring said element to its normal position.

13. The combination in a switch of a set of contacts, a stationary supporting member, a contact operating finger, rigid throughout its length, and having one of its ends loosely mounted on said supporting member for universal movement with respect thereto, operating means for moving said finger in a plurality of directions, and means responsive to the movement of said finger for operating said set of contacts.

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