March 18, 1958 J. A. BURWELL 2,827,518

DAMPING MEANS FOR CROSSBAR SWITCH SELECTING FINGER

Filed July 22, 1954

FIG. 1

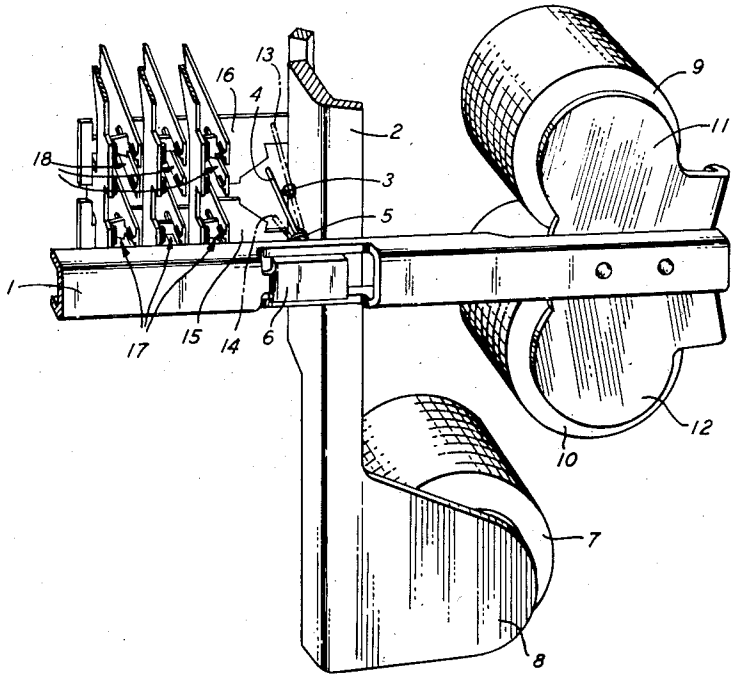


FIG. 2

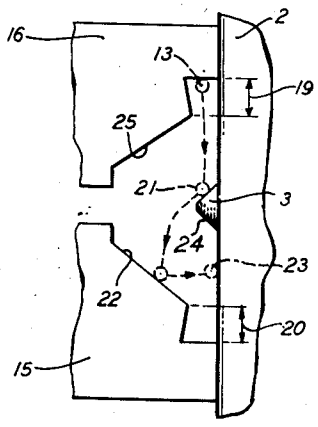


FIG. 3

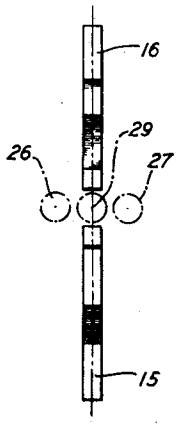
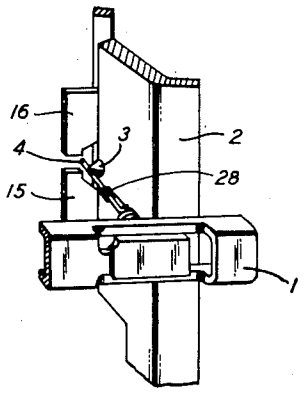


FIG. 4



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DAMPING MEANS FOR CROSSBAR SWITCH SELECTING FINGER

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16 Claims. (Cl. 179—27.54)

This invention relates to improvements in switching devices and particularly to improvements in automatic switches of the crossbar type.

Crossbar switches of the type to which the present invention is applicable are well known in the art and are exemplified in Patent 2,021,329 issued to J. N. Reynolds on November 19, 1935. A switch of this general type comprises groups of horizontal and vertical bars which are employed to actuate sets of contacts at the crosspoints of said bars. A flexible selecting finger is attached to each horizontal bar at each position where said bar is crossed by a vertical bar. On the rotation of a horizontal bar the selecting fingers mounted thereon move into a position where subsequent operation of a vertical bar will, due to the position of the displaced selecting fingers, operate a card that causes a movable set of contacts to engage with a fixed set of contacts at the crosspoint of said two operated bars.

The selecting finger in such switches usually comprises a straight, flexible wire having a helically coiled portion at one end thereof. The coiled portion of the wire is attached to the horizontal, or select, bar in any suitable manner, and allows for resilient movement of the straight portion in any direction in accordance with the particular requirements of selecting fingers for this type of switch. When a horizontal, or select, bar is released from the operated position, the selecting fingers associated therewith, previously displaced, will vibrate for a short period after the select bar has itself come to rest. These vibrations may result in spurious and undesired operations of the switch. The immediate subsequent operation of another horizontal and vertical bar after a horizontal bar is deactivated may cause the vertical, or hold, bar to engage both the vibrating finger of the bar previously released and the finger of the bar subsequently operated and thus cause a double connection.

To lessen the possibility of such double connections it has often been necessary to design crossbar switching circuits with adequate time, between the release of the selecting finger or vertical bar and the operation of another vertical bar, to allow the finger vibration to diminish. This practice is expensive and places limitations on ultimate switching capacity.

A spurious operation is also possible in a manner other than the intentional operation of a hold bar very shortly after the finger is released from an operated position. False operations can result if, after release, the selecting finger continues to vibrate and the released hold bar rebounds sufficiently from its stop to again engage the selecting finger, causing an undesired operation of the contacts at the particular crosspoint.

Cognizant of these dangers inherent in the unguarded time interval immediately after release of a selecting finger, prior art devices have been directed toward reduction of the period of excessive finger vibration. My Patent 2,039,630 and 2,117,702, granted May 5, 1936, and May 17, 1938, respectively, disclosed devices for diminution of the period during which intense vibrations occur.

One object of this invention is to provide a simple device which will completely obviate the possibility of spurious operation as a result of selecting finger vibration, both on the operation of a selecting finger and on the release thereof.

Other objects of this invention are to improve the construction, reliability and accuracy of switches of the crossbar type.

The invention accomplishes these and other objects by providing an angular projection affixed to the vertical or hold bar to change the direction of motion of the selecting finger when said finger releases. The selecting finger is caused to strike against and rebound from the sloping surface of the angular projection on the hold bar and other angular surfaces on the crosspoint contact operating cards, whereby the energy of the vibrating finger is absorbed outside of an area in which false operations may result if the vertical or hold bar is actuated.

The invention is illustrated in the accompanying drawings in which:

Fig. 1 shows a fragmentary perspective view of the crossbar switch structure provided with damping means constructed in accordance with my invention;

Fig. 2 shows a side elevation of the crosspoint contact operating cards and a conical projection affixed to the vertical or hold bar, and illustrates, in addition, the direction of travel of a selecting finger upon release from its operated position;

Fig. 3 shows various exemplary horizontal positions of the cone on the vertical or hold bar with respect to a vertical plane that bisects the actuating surfaces of the two associated crosspoint contact operating cards; and

Fig. 4 is a perspective view of a portion of the switch of Fig. 1 shown in a position assumed when the hold bar is fully operated, clearly illustrating the clearance for the finger between the cone and the cards.

Referring now to the drawings, and particularly to Fig. 1 thereof, the switch structure to which my invention may be applied may comprise a horizontal or select bar **1**, a vertical or hold bar **2**, and a damping cone **3**. The selecting finger **4** is attached by its helically coiled portion **5**, of which structure only part is shown in the drawing, to a member **6** of the select bar **1**. A vertical bar actuating magnet or hold magnet **7** operates, when actuated, the armature portion **8** of the vertical bar **2**. Upper and lower horizontal or select bar actuating magnets **9** and **10** function to actuate the select bar armature portions **11** and **12**, respectively. When select bar actuating magnet **10** is actuated, it operates select bar armature **12**, rotating the select bar **1** in an upward direction and causing selecting finger **4** to move to its upper position **13**, shown in dotted lines.

When select bar actuating magnet **9** operates armature portion **11**, select bar **1** is caused to rotate in a downward direction, moving selecting finger **4** to its lower operated position **14**. When selecting finger **4** is either in its lower or upper operated positions, the subsequent operation of the vertical hold bar **2** will move the selecting finger **4** against the crosspoint contact operating cards **15** and **16**, respectively. The lateral movement of the cards **15** or **16** will result in the engagement of contact sets **17** or **18**, respectively.

Referring now to Fig. 2, it will be seen that when the selecting finger is in the upper operated position **13** or elsewhere in the upper latching zone **19** immediately on the release of the select bar and with the vertical or hold bar **2** also in the released position, or if the finger is positioned in the latching zone **19** upon release of the vertical bar **2** with the horizontal bar **1** previously in the released position, the resiliency of the selecting finger will cause it to spring free and tend to overthrow into the lower

latching zone 20, in which a subsequent operation of the hold bar 2 would cause a spurious operation.

In my invention the selecting finger is positively prevented from overthrowing into the opposite latching zone by interposing the conical projection 3 in its vibratory path. As shown in Fig. 2, the selecting finger upon release from its upper latching zone 19, will strike the upper surface 21 of conical projection 3, rebound therefrom, strike the angular surface 22 of the lower contact operating card 15, rebound once more and strike the vertical surface 23 of the vertical or hold bar 2, eventually achieving a stable or neutral position adjacent to the conical projection 3. My invention thus achieves the desired objects by effectively preventing an overthrow of the selecting finger into the lower latching zone 20 upon its release from the upper latching zone 19 and vice versa. Although the operation of the selecting finger upon release from the upper latching zone 19 has just been described, it will be seen that the conical projection 3 effects the same result in preventing the overthrow of the finger into the opposite latching zone when it is released from an operated position in the lower latching zone 20.

The angular projection 3 above referred to as a damping cone may be other than conical in shape, that is, it may be wedge shaped, semispherical, elliptical, etc. Investigations have indicated that an elliptical projection having an angle of approximately 40 degrees with respect to the hold bar and a height of around 0.070 inch will perform satisfactorily, and that a forward position of the projection such as that shown at 27 in Fig. 3 is satisfactory from the standpoint of finger clearance and performance.

The height and shape of the cone should be such that when the selecting finger is released from an operated position in the latching zone 19 or 20 in Fig. 2, it will strike the sloping surfaces 21 or 24, respectively. It will be noted that the angular surfaces of the contact operating cards 22 and 25 are utilized as rebound surfaces against which the selecting finger will strike as explained above.

The location of the conical projection 3 on the hold bar 2 is such that the apex of the cone lies in a horizontal plane which is approximately midway between the two associated cards 15 and 16. In the present embodiment, the cone 3 is illustrated as affixed to the hold bar 2, but it will be observed by those skilled in the art that its location may be elsewhere and not on the hold bar 2 at all, i. e., it may be located on a stationary surface or part of the supporting frame structure for the switch, provided that the selecting finger will strike against the cone upon release from its operated position to achieve the damping effect above described.

Fig. 3 illustrates further that the horizontal position of the cone on the hold bar with respect to a vertical plane 29 which bisects the actuating surfaces of the two associated cards 15 and 16 may be such that the center of the cone lies in the same vertical plane 29, in a plane 26 behind said vertical plane 29 or in a plane 27 in front of said vertical plane 29. In Fig. 3 the select bar (not shown) would be positioned to the right of the cards 15 and 16 and the selecting finger would be projecting therefrom toward the conical projections shown in dotted outline.

Referring now to Fig. 4 it will be seen that when the hold bar 2 is in the fully operated position and the select bar 1 is in the inactivated position, the selecting finger 4 will have adequate clearance between the cone 3 and the cards 15 and 16. As a result, the interposition of the cone in the normal vibratory path of the selecting finger will not interfere with the ordinary operation of the switch when the selecting finger is in the operated or unoperated positions.

Fig. 4 also shows a damping member in the form of a helical coil 28 mounted on the coiled portion of the selecting finger, and loosely wrapped around the straight portion, adapted to vibrate out of phase with the natural vibrations of the selecting finger. The damping member 28, which is omitted in Fig. 1 for clarity, operates in conjunction with the conical projection 3 to reduce vibrations by impact of the selecting finger against said helical coil 28.

The presence of the member 28 provides the means for curtailing vibrations of the selecting finger upon intentional movement into the latching zones when the select bar is actuated. Thus, through the conjoint operation of the damper 28 and the conical projection 3, the selecting finger is damped both on operation and release. A comprehensive disclosure concerning damping member 28 is included in my Patent 2,039,630 granted May 5, 1936, which is hereby incorporated by reference.

It is understood that the embodiment of my invention described above is exemplary only, it being obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

What is claimed is:

1. In a crossbar switch, a flexible selecting finger, a support for said finger at one end thereof, a vertical bar positioned adjacent to said finger and adapted to engage the free end thereof, and a projecting element on said bar interposable in the vibratory path of said finger, thereby to damp its vibratory motion when said element is so interposed.

2. A crossbar switch according to claim 1 wherein said selecting finger includes a member loosely supported thereon, and having a natural period of vibration out of phase with the natural period of vibration of said selecting finger, thereby to damp said selecting finger on impact with said member.

3. In a crossbar switch, a flexible selecting finger, a rotatable horizontal bar to which one end of said finger is secured, the free end of said finger traversing a vertical arc on the rotation of said bar, two groups of contacts, a pair of sloped-surface cards each notched at opposite ends, said cards being oppositely and movably positioned adjacent to said groups of contacts and to the free end of said finger, thereby to cause said finger to engage a notch on the vertical movement thereof, a vertical bar positioned adjacent to said finger and adapted to impart horizontal movement thereto when engaging a notch, thereby to move one of said cards to operate one of said groups of contacts, and a projecting element on said vertical bar positioned to deflect said finger in its release against the sloped surface of one of said cards, thereby to prevent the free end of said finger from entering the opposite notch.

4. A selecting means for crossbar switches comprising a set of contacts, a flexible selecting finger including a coiled portion at one end thereof, supporting means for said finger at said coiled end adapted to move said finger from a normal position to one of two operated positions, a vertical bar adapted to move against said selecting finger when actuated, thereby to actuate said set of contacts, and an angular projection on said vertical bar against which said selecting finger strikes upon release from an operated position, thereby to prevent overthrow of said selecting finger into the other of said operated positions.

5. A crossbar switch according to claim 4 wherein said selecting finger includes a wire comprising a helically coiled portion and a straight portion, said coiled portion of said wire surrounding the straight portion of the selecting finger, said straight portion of said wire being affixed to a loop in the coiled portion of said selecting finger, thereby to damp said selecting finger on impact with said wire.

6. In a crossbar switch, a plurality of contact sets, a selecting finger having a comparatively straight portion and a helically coiled portion, supporting means for said finger to which said helically coiled portion is affixed, said supporting means being adapted to move said select-

ing finger from an unoperated to an operated position, sloped-surface contact operating cards oppositely disposed adjacent to said selecting finger, a vertical bar adapted to move said selecting finger against one of said cards when said selecting finger is in the operated position, thereby to operate the associated contact set, and an angular projection on said vertical bar positioned for said selecting finger to strike thereagainst on release, and rebound therefrom and from the sloping surface of said contact operating card, thereby to expend the vibratory energy of said selecting finger.

7. A crossbar switch comprising horizontal and vertical bars, two separately operable contact sets at each intersecting point of said bars, two oppositely disposed cards each individual to one of said two contact sets, selecting fingers affixed to said horizontal bars at each point where said horizontal bars intersect said vertical bars, each of said fingers controlling the movement of two of said cards, a particular contact set being operated by the rotation of one of said horizontal bars in either direction and the subsequent movement of a vertical bar against the associated selecting finger, whereby said selecting finger bears against the chosen contact operating card to close the selected contact set, and an angular projection on each of said vertical bars individual to each of said selecting fingers, each of said projections being positioned for the associated selecting finger to strike against said projection on release and to rebound therefrom and from the sloping surface of the opposite contact operating card, thereby to expend the vibratory energy of said selecting finger.

8. A crossbar switch according to claim 7 wherein said angular projection is positioned on said bar with the center thereof lying in the vertical plane that bisects the actuating surfaces of said contact operating cards and in a horizontal plane midway between said cards.

9. A crossbar switch according to claim 7 wherein said angular projection is positioned on said bar with the center thereof lying adjacent to the vertical plane bisecting the actuating surfaces of said contact operating cards.

10. A crossbar switch according to claim 7 wherein said angular projection is elliptical in shape, said projection having a height of substantially 0.070 inch, the sides of said projection being disposed at an angle of substantially 40 degrees with said bar.

11. In a crossbar switch, support means for said switch, a contact set, a flexible selecting finger, a notched contact card adjacent to said selecting finger, horizontally disposed means for supporting said finger at one end thereof and adapted to move it from an unoperated to an operated position in the notch of said card, a vertical bar adapted to move the free end of said selecting finger against said card when said selecting finger is in the operated position, thereby to cause said card to actuate said contact set, and an elevated projecting element positioned on said switch support means contiguous to the free end of said selecting finger, whereby upon release of said finger from the operated position the free end thereof will strike against said projecting element to curtail its vibratory motion.

12. In a crossbar switch, a flexible selecting finger, a support for said finger at one end thereof adapted to move said finger from a normal position to one of two operated positions, a vertical bar positioned adjacent to said finger and adapted to engage the free end thereof, and an angular projection on said vertical bar against which said selecting finger strikes upon release from an operated position, thereby to prevent overthrow of said selecting finger into the other of said operated positions upon the release of said horizontal bar, said vertical bar having previously been released.

13. In a crossbar switch, a flexible selecting finger, a rotatable horizontal bar to which one end of said finger is secured, the free end of said finger traversing a vertical arc between a normal position and two operated positions on the rotation of said bar, a vertical bar positioned adjacent to said finger and adapted to impart horizontal movement thereto when actuated, and a projecting element on said vertical bar positioned to deflect said finger upon release from an operated position, thereby to prevent return of said finger to either of said operated positions upon release of said horizontal bar, said vertical bar having previously been released.

14. In a crossbar switch, a plurality of contact sets, a selecting finger having a comparatively straight portion and a helically coiled portion, supporting means for said finger to which said helical portion is affixed, said supporting means being adapted to move said selecting finger from an unoperated to two operated positions, sloped surface contact operating cards oppositely disposed adjacent to said selecting finger, a vertical bar adapted to move said selecting finger against one of said cards when said selecting finger is in the operated position, thereby to operate the associated contact set, and an angular projection on said vertical bar positioned for said selecting finger to strike thereagainst and rebound therefrom and from the sloping surface of said contact operating cards to prevent return of said finger to either of said operated positions upon release of said horizontal bar, said vertical bar having previously been released.

15. A crossbar switch according to claim 14 wherein said selecting finger includes a wire comprising a helically coiled portion and a straight portion, said coiled portion of said wire surrounding the straight portion of the selecting finger, said straight portion of said wire being affixed to a loop in the coiled portion of said selecting finger, thereby to damp said selecting finger on impact with said wire.

16. In a crossbar switch, a flexible selecting finger, support means for said finger at one end thereof adapted when actuated to move said finger from a normal position to one of two operated positions, a vertical bar positioned adjacent to said finger and adapted when actuated to engage the free end thereof, and a projecting element on said bar interposable in the vibratory path of said finger to prevent entrance of said finger into either of said operated positions upon release of said support means from an actuated position, said vertical bar having previously been released.

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