Feb. 14, 1956 R. B. IMMEL ET AL 2,734,958

SWITCH

Filed July 27, 1951

Fig.1.

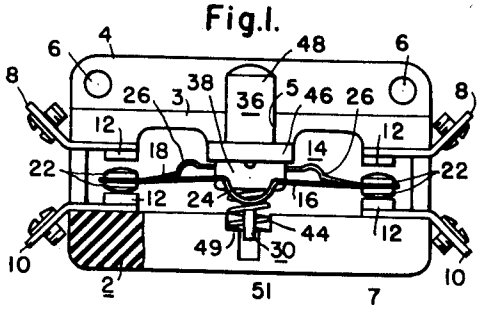


Fig.2.

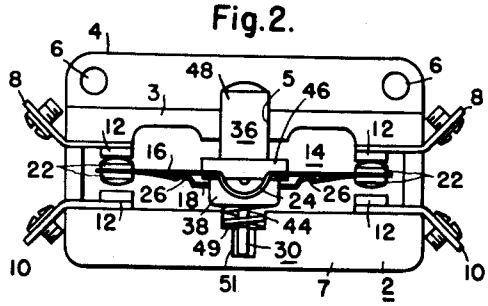


Fig.3.

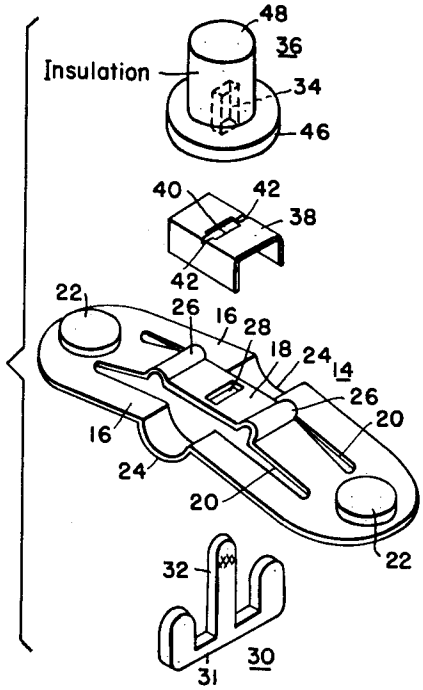


Fig.4.

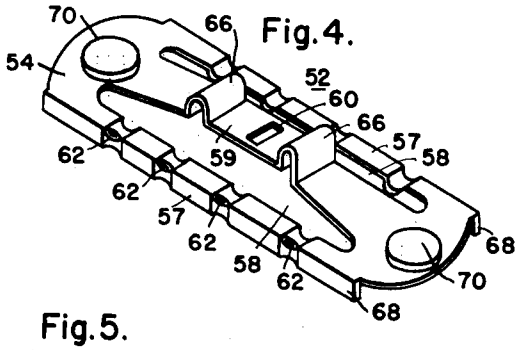


Fig.5.

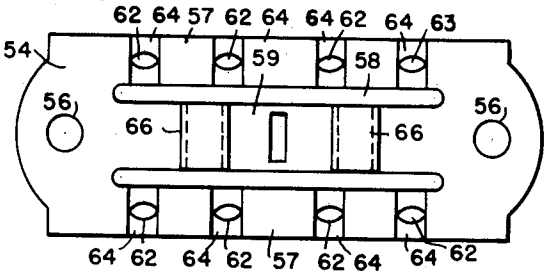


Fig.6.

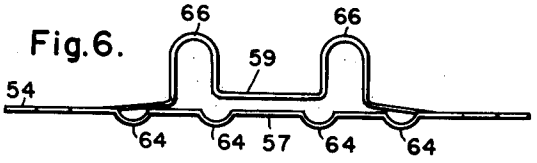
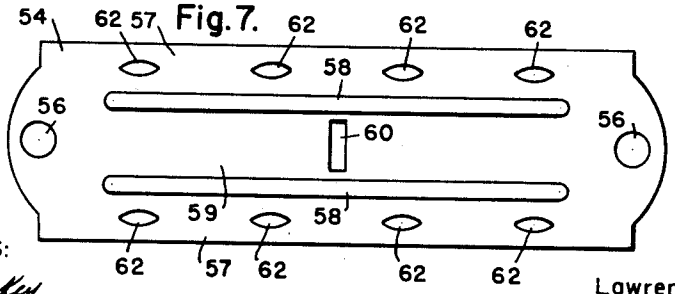


Fig.7.



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SWITCH

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16 Claims. (Cl. 200—67)

This invention relates generally to electric switches, and more particularly to such switches which operate with a snap action.

One use for this type of switch is in electric control circuits, for example in the control of automatic machinery, and for this purpose it is important that the switch be small in size, yet sturdy and reliable, and particularly that it always operate at the same point in the path of movement of its operating member.

Accordingly, one object of this invention is to provide a novel simplified form of snap acting switch which is dependable in operation.

Another object of this invention is to provide a novel form of snap acting switch having a one piece contact and snap acting member.

A further object of this invention is to provide a simplified form of switch snap-acting contact member which is capable of manufacture by a relatively simple stamping and forming operation.

Still another object of this invention is to provide a snap switch having a single snap-acting contact member which is constructed of light-weight material in a manner to be sufficiently sturdy and rugged to provide for dependability on repeated operations.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of preferred embodiments thereof, when taken in connection with the attached drawing, in which

Figure 1 is an elevation view of a switch constructed in accordance with this invention, with the cover for the switch casing removed,

Fig. 2 is a view similar to Fig. 1, but showing the switch in a different operated position,

Fig. 3 is an exploded view in perspective of the movable contact assembly,

Fig. 4 is a perspective view of a modified form of movable contact,

Fig. 5 is a plan view of the movable contact shown in Fig. 4 in an intermediate stage of its manufacture,

Fig. 6 is a side elevation view of the contact shown in Fig. 5, and

Fig. 7 is a plan view of the contact shown in Figs. 4 to 6, but at an initial stage in its manufacture.

The form of switch embodying this invention and shown in Figs. 1 to 3 of the drawing is illustrated as being mounted in an open sided casing 2 of insulating material, such as a molded insulating material. As viewed in Figs. 1 and 2 the front side of casing 2 is open, with the casing being provided with an integral mounting flange 4 projecting from the top of the casing at the back thereof, and having a pair of mounting holes 6 for the reception of mounting screws or the like, for the purpose of securing the switch casing on a suitable support.

A pair of stationary upper terminals 8 and a pair of stationary lower terminals 10 are shown as being mounted in the casing, with the terminals of each pair projecting from opposite ends of the casing through suitable end

openings. The terminals may be secured in the casing in any desired manner, such as by screws or rivets, or they may merely be laid into the open side of the casing to engage with suitably formed slots therein, and being held in merely by securing the casing cover (not shown) on the open front side of casing 2. Each of the terminals 8 and 10 are provided with stationary contacts 12 at the inner ends thereof, formed of a good electrical conducting material such as silver, preferably an alloy thereof having resistance to arcing. The contacts 12 on upper terminals 8 are supported above and in opposition to the contacts 12 on the lower terminals 10, so that a bridging contact 14 may move into bridging engagement either with the lower contacts 12 or the upper set of contacts 12, to thus form a double-throw type of switch. However, while the switch herein illustrated is of the double-throw type which has certain advantages in the switch construction comprising this invention, it is apparent that either the upper or lower set of contacts 12 could be eliminated to form a single throw type of switch, with the eliminated set of contacts being replaced by correspondingly located stops for the ends of bridging contact 14.

Bridging contact 14 is formed in a special way from a single piece of resilient electrical conducting material, preferably a copper alloy such as a Phosphor-bronze or a beryllium-copper alloy. The strip of material from which bridging contact 14 is formed should be quite thin, on the order of 8 to 10 thousandths of an inch in thickness in order to provide a resilient contact structure which is very flexible and is capable of operating with a snap action with a low operating force. Bridging contact 14 is formed from such a strip of resilient conducting material by providing a pair of longitudinally extending openings 20 which terminate short of the ends of the bridging contact to form a pair of integral outer legs 16, and a middle leg 18, joined together at their outer ends by an integral part of the strip material from which the bridging contact is formed. The outer ends of the bridging contact have contacts 22 secured thereto at both sides in any desired manner, for example as by being riveted through openings (not shown) provided in the end portions of bridging contact 14. In order to provide high flexibility and low stress, relatively large and deep semicircular portions 24 are formed in the outer legs 16 of bridging contact 14 to form in effect U-shaped spring portions. One purpose of the U-shaped spring portions 24 is to foreshorten the outer legs to cause the middle leg 18 to assume a longitudinally bowed form. However, in order to limit the amount of longitudinal bowing of middle leg 18, the latter may be crimped as at 26 to take up excess length of the middle leg and thus control the amount of bowing of this leg. In any event, the relationship between the amount of lateral deflection in the middle leg compared to that in the two outer legs is such that the foreshortening of the outer legs is greater than that of the middle leg to thus cause a predetermined amount of longitudinal bowing of the middle leg so that it will normally occupy a bowed position to one side or the other of a line connecting the outer ends of the bridging contact 14. By exerting a force on the middle leg it may be moved from one side to the other of a line connecting the outer ends of bridging contact 14, but in so doing it will lengthen the outer legs 16 by stressing the spring portions 24 thereof, with the maximum stress being encountered substantially when the middle leg 18 passes the center line connecting the outer end portions of bridging contact 14, and as soon as this point is passed the middle leg will move with a quick snap action to the opposite side of the line due to the stress stored in spring portions 24 of the outer legs 16.

Bridging contact 14 may be preassembled with a plunger

guide 30, contact guide 38, return spring 44 and operating plunger or push button 36, prior to mounting in the switch casing 2. Plunger guide 30 is generally T-shaped in form having a stem 32 which is rectangular in cross section to be received in the rectangular opening 28 provided in the middle leg 18 of bridging contact 14, and being received in a rectangular opening 34 at the inner end of operating plunger 36, and being secured therein in any desired manner, as by cementing. The operating plunger is of an insulating material, such as a molded insulating material, and has interposed between it and bridging contact 14 the bridging contact channel guide 38. This contact guide 38 receives the mid-portion of middle leg 18 of bridging contact 14, and has a rectangular shaped opening 40 for receiving the stem 32 of plunger guide 30. The purpose of contact guide 38 is to maintain bridging contact 14 in proper position in the casing and to provide for limited pivotal movement of the bridging contact about a substantially centrally located transverse axis formed by rounded pivot surfaces 42 provided in the lower surface of contact guide 38. The return operating spring 44 is also assembled on plunger guide 30, being held in place by the cross portion 31 of the guide 30 and reacting against the mid-portion of middle leg 18 of bridging contact 14.

The moving contact assembly described above may be mounted in casing 2 by merely inserting it through the open side thereof with the inner stop flange 46 on operating plunger 36 being engaged with the inner surface of the top wall 3 of casing 2, and the projecting operating part 48 extending through an opening 5 in the top wall 3 of casing 2. Return spring 44 is compressed slightly to engage a shoulder 49 provided in the bottom wall 7 of casing 2, and normally maintains the middle leg 18 of projecting contact 14 bowed upwardly as shown in Fig. 1. At this position there is some stress in spring portions 24 of outer legs 16 of the bridging contact to thus maintain its lower contacts 22 in engagement with the lower stationary contacts 12 under pressure.

When operating plunger 36 is depressed it will move the middle leg 18 of the bridging contact downwardly while stressing the spring portions 24 of the outer legs 16 until middle leg 18 moves past the center line connecting the outer ends of bridging contact member 14, whereupon it will rapidly, and with a snap action, assume the position shown in Fig. 2. Once the bridging contact 14 starts to change its position, this movement occurs rapidly and uninterruptedly until stopped by engagement of the upper contacts 22 on bridging contact 14 with the upper stationary contacts 12 in casing 2. This snap action prevents the contacts from opening slowly and being damaged by arcing. Recess 51 is provided in the casing 2 to receive guide 30 when plunger 36 is depressed. When operating plunger 36 is released, the return spring 44 will return the plunger and bridging contact 14 to its original position shown in Fig. 1, due to the fact that it acts on the bowed middle leg 18 of the bridging contact and will move it back upwardly across the center line connecting the outer ends of bridging contact 14, to effect this return movement to the position shown in Fig. 1 with a snap action.

The modified form of bridging contact 52 shown in Fig. 4 is adapted to be assembled in the same manner as bridging contact 14 described above, with a plunger operating member and return spring, and then mounted in a casing like the casing 2 described above in substantially the same way as bridging contact 14. However, due to the modified construction of bridging contact 52 it functions in a different manner than bridging contact 14, and has certain advantages. Bridging contact 52 is also formed from a single piece of resilient conducting material 54 which may be of a material similar to that comprising the bridging contact 14, previously described. The blank shown in Fig. 7 is preferably stamped out of a strip of such material to the form shown in Fig. 7, with a

pair of longitudinally extending laterally spaced openings 58 terminating short of the ends of the blank to form side legs 57 and a middle leg 59. There is also provided end openings 56 for receiving the contacts 70 (Fig. 4), and a central rectangular opening 60 in middle leg 59 for receiving the stem of a plunger guide, such as guide 30, previously described. There are also provided a plurality of longitudinally aligned and spaced, substantially oval shaped openings 62 in each of the outer legs 57, for a purpose to be described.

After formation of the blank form shown in Fig. 7, a lateral bending operation is performed to arrive at the intermediate form of the bridging contact shown in Figs. 5 and 6. It will be observed that at this stage in the manufacture of bridging contact 52 the outer legs 57 thereof have been given a plurality of transverse, longitudinally spaced, relatively shallow, laterally deflected portions, for the purpose of shortening these outer legs sufficiently to cause the middle leg 59 to assume a slightly bowed position as shown in Fig. 6. The deflected portions 64 maintain middle leg 59 in bowed condition even though the middle leg 59 has relatively deep U-shaped spring portions 66 formed therein by transversely deflecting the material of middle leg 59 at spaced intermediate parts. The final operation comprises bending each of the outer legs 57 of the bridging contact along a longitudinal line extending through the small openings 62 which facilitate this bending operation.

It will now be observed that bridging contact 52 differs from the bridging contact 14 previously described because the spring action is restricted to the middle leg 59 due to the U-shaped spring portions 66 formed in the middle leg, and spring action is substantially entirely eliminated from the outer legs 57 by the formation of flanges 68 which operate to stiffen the outer legs against longitudinal bending. Accordingly, when middle leg 59 is moved across the center line joining the outer ends of bridging contact 52 substantially all of the spring action and flexing takes place in the material of the middle leg 59, particularly in the spring portions 66 thereof, and in passing across this center line the bridging contact 52 will be moved with a snap action substantially in the same manner previously described in connection with bridging contact 14. However, since the outer legs 57 do not bend, there will be no sliding or wiping action between the movable contacts 70 and stationary contacts, such as the contacts 12 shown in Figs. 1 and 2, which is of importance particularly where silver or silver alloy contact materials are employed because such sliding and wiping action is detrimental to the life of such contact materials. It will be further noted that the crimping 64 in the outer legs 57 of bridging contact 52 is kept small to prevent these legs from having any spring action.

Both forms of the invention are characterized by their extreme flexibility and low stress required for operation. However, both operate with a snap action to reduce arcing on the contacts, and contact operation is obtained in both cases at the same point in the travel of the contact operating member. The bridging contacts in both forms of this invention are made from a single piece of resilient electrical conducting material, and may be relatively simply and economically formed by pressing or stamping operations.

Having described preferred embodiments of the invention in accordance with the patent statutes, it is desired that this invention be given a broad construction because it is apparent that many changes may be made in the particular form thereof without departing from the broad spirit and scope of the invention. Thus, it has been previously pointed out that either form of bridging contact disclosed herein may be employed in either a double or single throw type of switch, and while they are both adapted for mounting in the particular form of switch casing 2 described herein, it will be apparent that many of the

advantages obtainable with the bridging contact constructions will be retained even though they are mounted in other forms of switch casing. Similarly, only two specific forms of bridging contacts are disclosed, but it will be apparent that this invention may be practiced even though the bridging contact construction is not identical in form with either of the modifications disclosed herein. Accordingly, the following claims are not in all cases limited to the specific details of construction described and illustrated herein.

We claim as our invention:

1. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, an intermediate part of said bridging member being deformed to produce an intermediate longitudinally bowed portion, said bowed portion having spaced generally U-shaped portions therein, and operating means engageable with said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

2. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, an intermediate part of said bridging member being deformed to produce an intermediate longitudinally bowed portion, said bowed portion having spaced generally U-shaped portions therein, and operating means engageable with opposite sides of said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said briding member carrying said contact means.

3. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, an intermediate part of said bridging member being deformed to produce an intermediate longitudinally bowed portion, said bowed portion having spaced generally U-shaped portions therein, a slidably mounted operating plunger engageable with one side of said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means, and return spring means engageable with the opposite side of said bowed portion for returning said bowed portion to its original condition following operation thereof by said plunger.

4. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least one longitudinal opening intermediate the ends of said bridging member with the material at one side of said opening being deformed to produce a longitudinally bowed portion in the material at the opposite side of said opening, said bowed portion having spaced generally U-shaped portions therein, and operating means engageable with said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

5. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least one longitudinal opening intermediate the ends of said bridging member with the material at one side of said opening being deformed to produce a longitudinally bowed portion in the material at the opposite side of said opening, said bowed portion having spaced generally U-shaped portions therein, means for stiffening the material at said one side of the opening against longitudinal bending, and operating means engageable with said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

6. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least one longitudinal opening intermediate the ends of said bridging member with the material at one side of said opening being deformed to produce a longitudinally bowed portion in the material at the opposite side of said opening, said bowed portion having spaced generally U-shaped portions therein, means for stiffening the material at said one side of the opening against longitudinal bending, comprising a longitudinally extending integral flange on said bridging member at said one side of the opening, and operating means engageable with said bowed portions between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

7. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least one longitudinal opening intermediate the ends of said bridging member with the material at one side of said opening being bent laterally to a substantial extent to form a substantially U-shaped spring portion to produce a longitudinally bowed portion in the material at the opposite side of said opening, said bowed portion also having spaced generally U-shaped portions therein, and operating means engageable with said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

8. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least two longitudinal openings intermediate the ends of said bridging member with the material at the outside of said openings being bent laterally to a substantial extent to form substantially U-shaped spring portions to produce a longitudinally bowed portion in the material between said openings, said bowed portion also having spaced generally U-shaped portions therein, and operating means engageable with said bowed portion between said spaced portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

9. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, at least one longitudinal opening intermediate the ends of said bridging member with the material at one side of said opening being bent laterally to a substantial extent to form a substantially U-shaped spring portion to produce a longitudinally bowed portion in the material at the opposite side of said opening, said bowed portion also having at least two spaced laterally bent portions therein, means for stiffening the material at said one side of the opening against longitudinal bending, comprising a longitudinally extending integral flange on said bridging member at said one side of the opening, and operating means engageable with said bowed portion between said bent portions for exerting a transverse force thereon in a direction to cause said bowed portion to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

10. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs with the outer legs being deformed to cause longitudinal bowing of the middle leg, each of said outer legs having a laterally bent substantially U-shaped spring portion, said middle leg having spaced generally U-shaped portions therein, and operating means engageable with said middle leg between said spaced portions for exerting a transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

11. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs with the outer legs being deformed to cause longitudinal bowing of the middle leg, said middle leg having spaced laterally bent substantially U-shaped spring portions and operating means engageable with said middle leg between said spaced spring portions for exerting a transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

12. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs with the outer legs being deformed to cause longitudinal bowing of the middle leg, each of said outer legs having a laterally bent substantially U-shaped spring portion, said middle leg having spaced generally U-shaped portions therein, and operating means engageable with said middle leg between said spaced portions for exerting a transverse force thereon in a direction to cause the bowed portion of said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

13. A switch comprising, spaced contacs, a bridging member mounted for movement into and out of bridging

engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs with the outer legs being deformed at a plurality of points to cause longitudinal bowing of the middle leg, said middle leg having a laterally bent substantially U-shaped spring portion, the outer legs having stiffening means to prevent longitudinal bending thereof, said outer legs having openings therein at the deformation points to facilitate forming said stiffening means, and operating means engageable with said middle leg for exerting a transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

14. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs with the outer legs being deformed at a plurality of points to cause longitudinal bowing of the middle leg, said middle leg portion having a laterally bent substantially U-shaped spring portion, and the outer legs having stiffening means to prevent longitudinal bending thereof comprising an integral flange extending along the outer side of each of said outer legs, the outer legs having openings therein at the deformation points to facilitate forming said flanges, and operating means engageable with said middle leg for exerting a transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

15. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs, each of the outer legs having a plurality of relatively shallow laterally deflected portions to foreshorten the same and cause the middle leg to assume a longitudinally bowed form, said middle leg having a relatively deep laterally deflected portion forming a substantially U-shaped spring section, and operating means engageable with said middle leg for exerting a transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

16. A switch comprising, spaced contacts, a bridging member mounted for movement into and out of bridging engagement with said spaced contacts, said bridging member being of a resilient electrical conducting material having contact means at opposite ends thereof for engaging said spaced contacts, a pair of spaced longitudinal openings intermediate the ends of said bridging member to form three legs, each of the outer legs having a plurality of relatively shallow laterally deflected portions to foreshorten the same and cause the middle leg to assume a longitudinally bowed form, flanged means for stiffening said outer legs against longitudinal bending, the outer legs having openings therein at the deflected portions to facilitate forming the flanged means, said middle leg having a relatively deep laterally deflected portion forming a substantially U-shaped spring section, and operating means engageable with said middle leg for exerting a

transverse force thereon in a direction to cause said middle leg to reverse its curvature to thus cause snap acting movement of the ends of said bridging member carrying said contact means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,668,974	Mottlau	May 8, 1928
2,476,056	Martin	July 12, 1949
2,511,526	Bugge	June 13, 1950
2,513,804	Kaminsky	July 4, 1950
2,518,255	Roeser	Aug. 8, 1950
2,616,996	Beeman	Nov. 4, 1952

FOREIGN PATENTS

288,315	Great Britain	Nov. 29, 1928
546,135	Great Britain	June 29, 1942
594,114	Great Britain	Nov. 3, 1947