Dec. 5, 1967 H. SIMON 3,356,802

ELECTRIC SNAP-ACTION SWITCH

Filed July 7, 1965 5 Sheets-Sheet 1

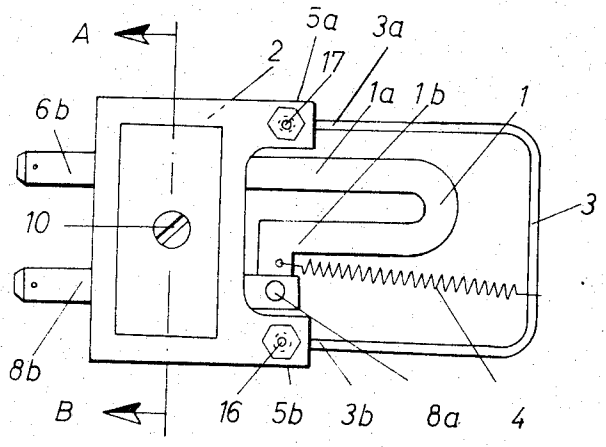


Fig. 1

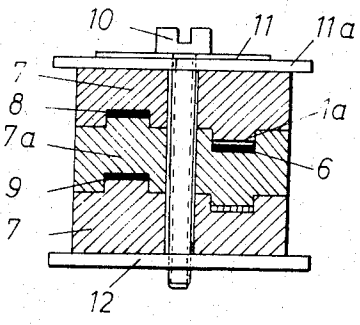


Fig. 5

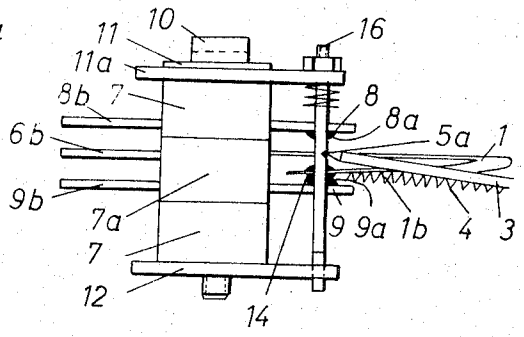


Fig. 2

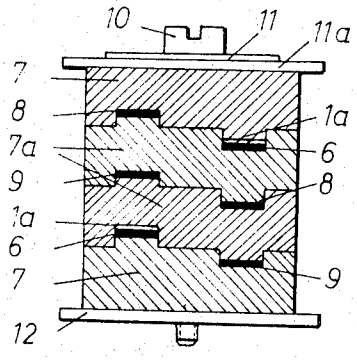


Fig. 4

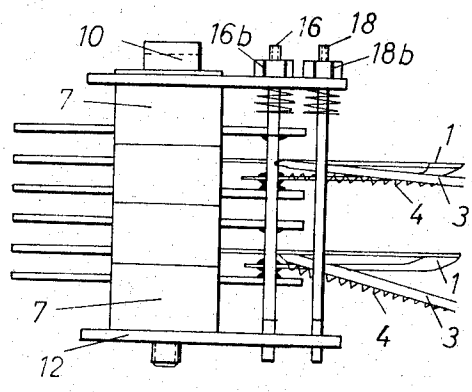


Fig. 3

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ELECTRIC SNAP-ACTION SWITCH

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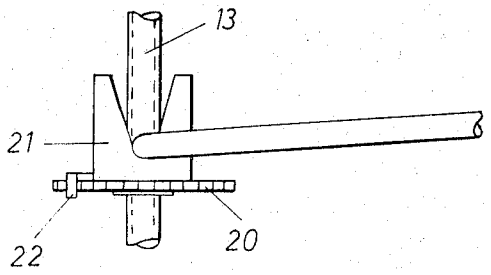


Fig. 6

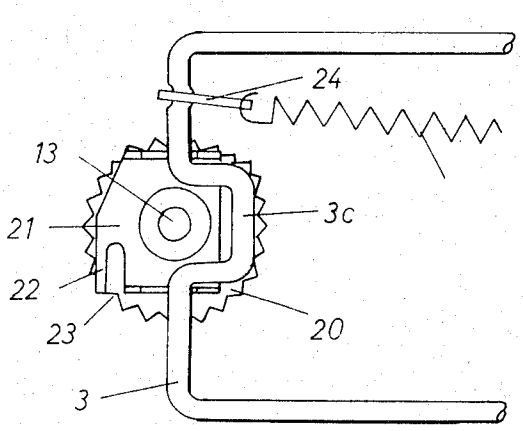


Fig. 7

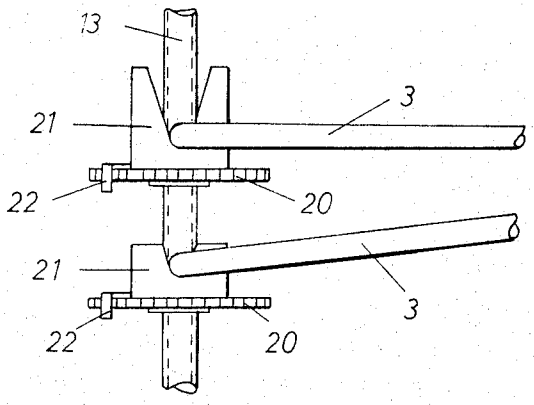


Fig. 8

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ELECTRIC SNAP-ACTION SWITCH

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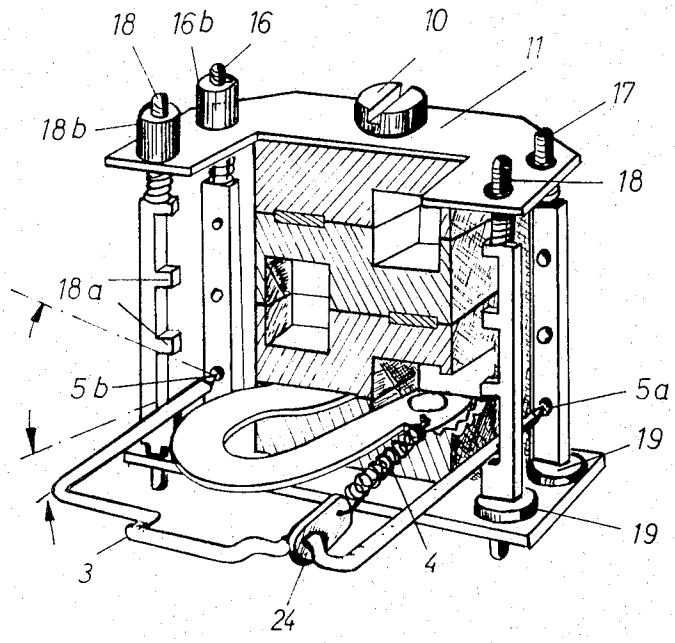


Fig. 9

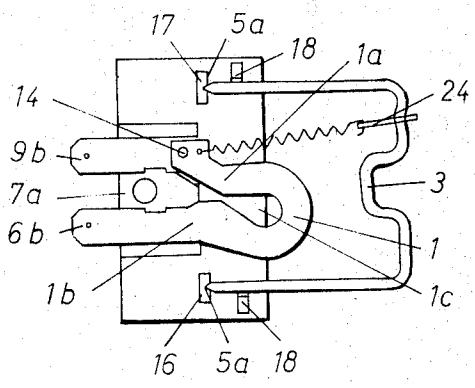


Fig. 10

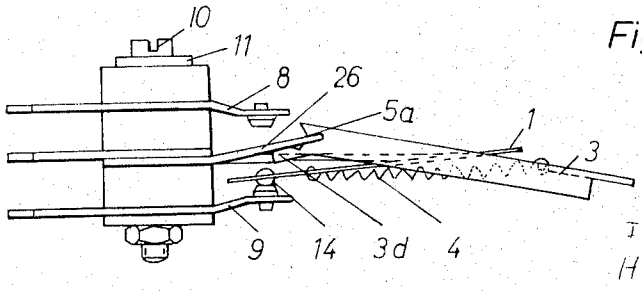


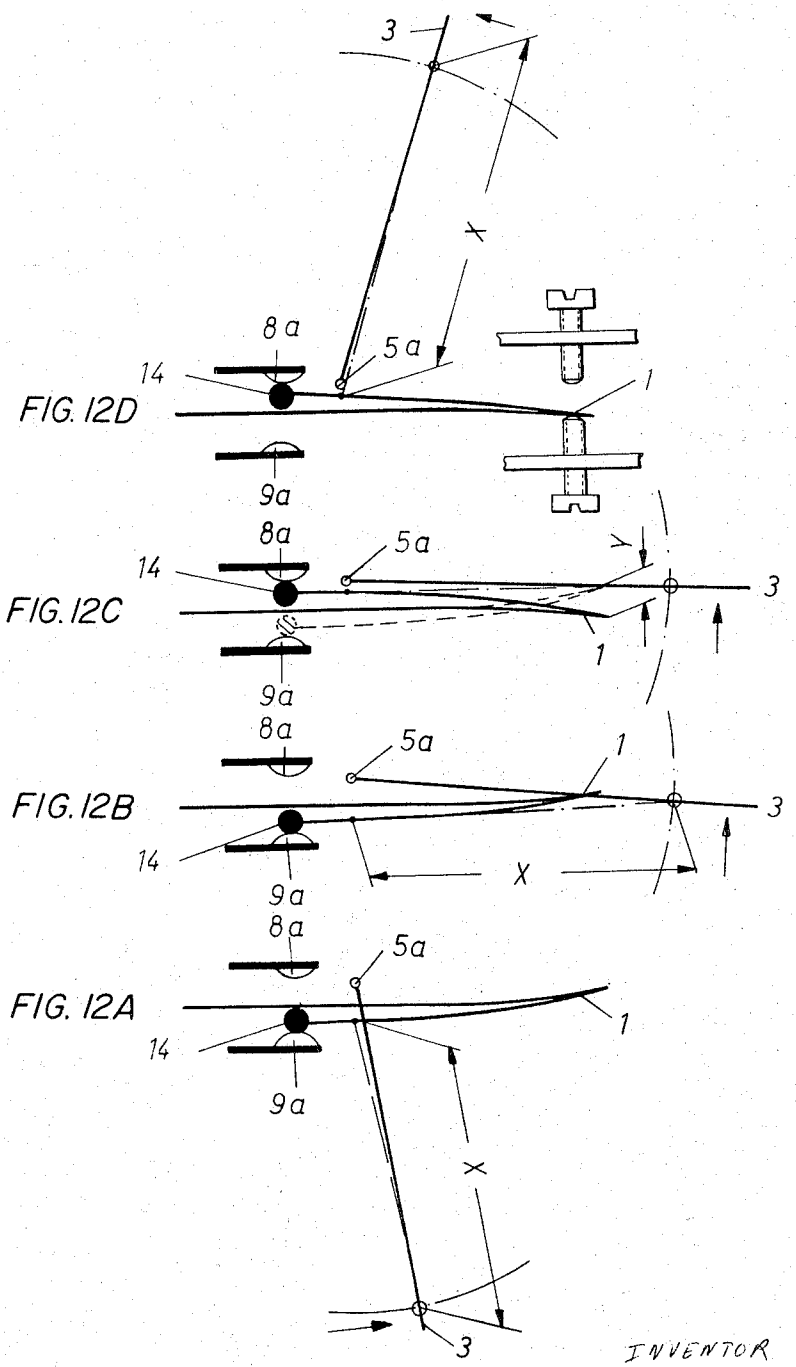
Fig. 11

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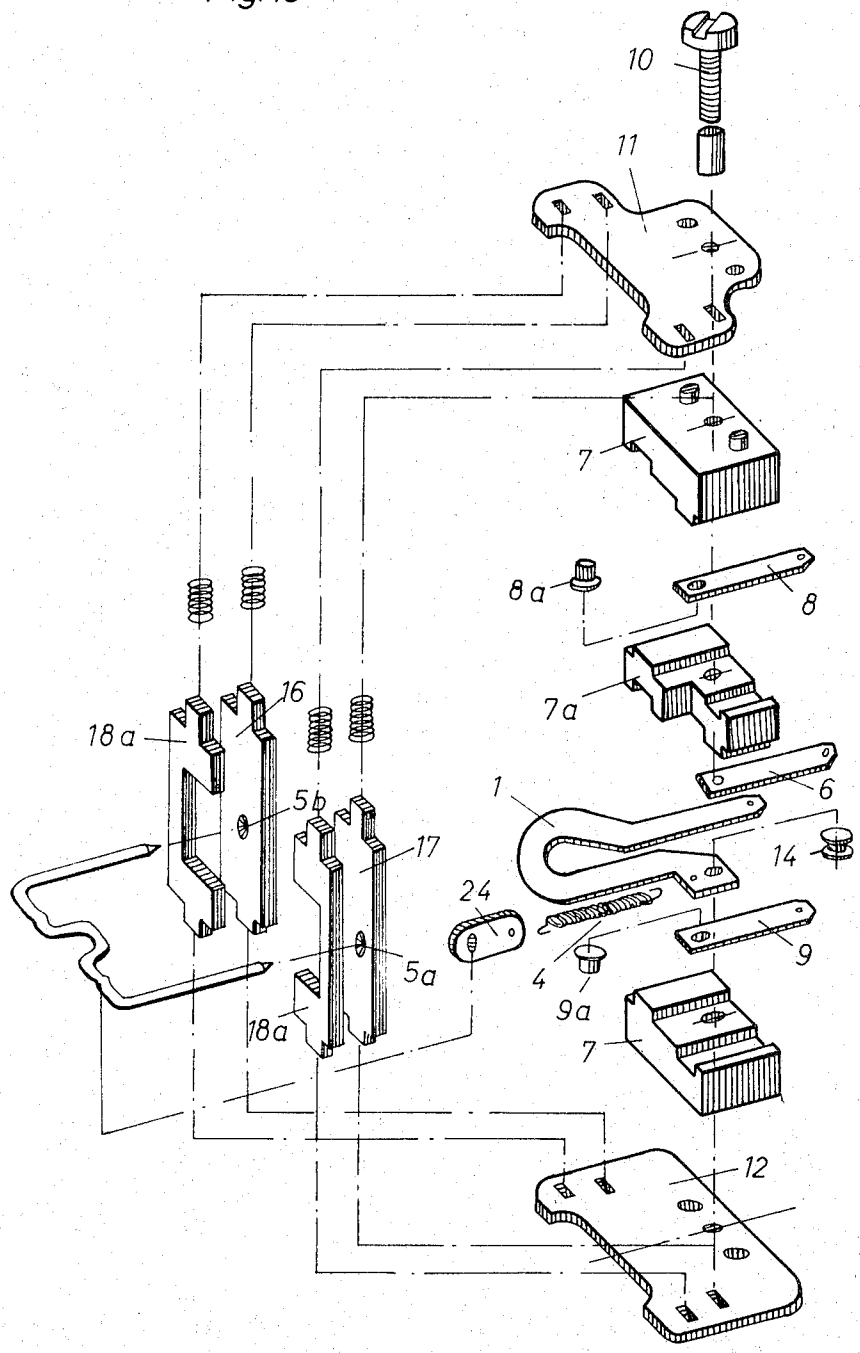
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Fig. 13



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United States Patent Office 3,356,802
Patented Dec. 5, 1967

3,356,802

ELECTRIC SNAP-ACTION SWITCH

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Filed July 7, 1965, Ser. No. 470,116
Claims priority, application Germany, Oct. 7, 1964, S 91,997
9 Claims. (Cl. 200—67)

The invention concerns an electrical snap action switch, and more particularly to a switch having a contact provided on a movable snap member formed in one piece.

The object of the present invention is to provide a switch which renders possible relatively high carrying capacity in a very small space, is simple and cheap to manufacture, requires only weak forces to actuate it and, independently of the slow or rapid movement of the trigger member, renders possible high speed switching operations without contact bounce.

In prior art snap switches have been frequently described which cannot be universally employed either because the entire construction is too complicated, too sensitive or too bulky, or the mechanism actuating the snap member becomes sluggish with time. A further disadvantage of these known constructions resides in the feature that the forces necessary for the switching operation are rather large and are not appreciably reduced even after a switching operation has been carried out, so that the combination of several components in a switch and the graduated actuation of the individual components, is not possible.

In a previous German patent application, S 82,256, the applicant has already proposed an electrical snap switch with displaceable contacts provided on a W-shaped snap member having an actuating member engaging by means of a tension spring on the connecting bridge of the inner shanks of the W member, which actuating member avoids some of the above described disadvantages by the fact that the W member is formed in one piece from spring material and that the contact or contacts are located on the connecting bridge of the W member itself. Such a switch however, is still very bulky on account of the sign of the W-shaped member and therefore for this reason it is not suitable for very many uses.

In a development of this already proposed switch, the described disadvantages are avoided in accordance with the present invention by a switch having contacts on the displaceable snap member and having an actuating member operating by a tension spring, by the feature that the snap member is formed in one piece of a U-shaped or Ω-shaped spring material one shank of which is clamped, while the other carries a contact or contacts, and is secured to the tension spring. Compared with the already proposed switch having a W-shaped snap member, such an embodiment permits a much more compact construction and, in addition, in the case of the Ω-shaped snap member, the spring force can be simply varied by perforations of different size.

In a modification of the invention, the point of attachment of the tension spring to the free shank of the snap member is situated near the pivotal axis of an actuating stirrup. By such an arrangement the power necessary for the further movement of the actuating stirrup is reduced after the switching operation is completed, a feature which is to be attributed to the almost identical pivotal radius of the tension spring and actuating stirrup. As will be seen from the accompanying drawings, the switching phases are shown schematically and described in greater detail in the description. Whereas, in the previously known embodiments the pivotal radii of tension spring and actuating stirrup are widely separated and thus, after switching

over makes additional forces necessary for further movement of the actuating stirrup, on account of the further compression of the tension spring, the embodiment of the present invention enables several switch units to be combined and renders possible complete actuation even with relatively low switching powers.

According to a further embodiment of the invention, the pivotal axis of an actuating stirrup is adjustable in the direction of movement of the free end of the snap member, which is achieved by a displacement of the usual double mounting of the actuating lever. In this manner, the force necessary for the triggering of the switching operation can be varied.

Since small displacement of the pivotal axis produce a relatively large change in the force necessary for the switching operation, it is obviously advantageous to vary the two mountings of the actuating stirrup independently of each other, especially if only one bearing is moved since in this manner very accurate adjustment of the switching force is possible. The mounting of the actuating stirrup can be made in the usual manner and preferably consists of a simple plugin seating since the cohesion of the parts obtained by the tension spring is sufficiently ensured. The displaceability of the individual bearings can be easily achieved if the bearings are provided with one or two bores and are arranged on one, or preferably two, round bars and are held by a stop screw.

In accordance with a further exemplary embodiment, one of the two bores is provided with a thread, and a round bar is replaced by a long screw fitting in this threaded bore. By turning the screw, the height of the bearing can be easily adjusted.

According to a further embodiment of the invention, the actuating stirrup is provided at least on one of its two bearings, and preferably on both, with one or two extensions which, after the switchover point is passed, rest on the bearing support and thereby prevent further movement of the actuating stirrup in one or in both directions. In this manner, no additional device is necessary for limiting the movement of the actuating stirrup and a much simpler switch construction is achieved.

The mounting of the snap member and the fixed contacts is effected, in accordance with a further embodiment of the invention, in a block of insulating material which, in the manner of a building block, consists of superimposed staircase-like small insulating blocks provided with inter-engaging recesses and projections, which blocks are preferably held together by one or more screws, rivets or the like. In this manner, it is possible to build up any desired number of switch components with the use of similar small insulating blocks and furthermore, simple interchanging of the contacts is made possible. For a very compact arrangement of the switch, particularly for the combination of two and more components in one switch, it has proved adviseable to assemble each insulating block of smaller insulating pieces which are provided on their contact surfaces with interengaging staggered recesses and projections for receiving parts to be clamped, the recess on one side being opposite to the elevation on the other side. By means of such insulating blocks any desired number of switch elements can be combined to form a switch in a comparatively small space. The depth of the recesses and the height of the projections should be designed so that the parts to be held firmly in the recesses are adequately clamped by the projections pressed thereon. With this embodiment a second insulating block is used for the upper and lower cover of a large insulating block and is provided only on one side with corresponding graduated recesses and projections for receiving the parts to be clamped. The opposing surfaces of the small blocks are completely flat or pro-

vided with contours which facilitate the joining of two such small blocks. These small blocks may be imagined to have been produced by the fact that one of the blocks contoured on both sides and described in the previous paragraph has been cut-up in parallel to the contact surfaces. By using such small blocks alone it is possible to combine any desired number of switch components without a specially shaped block being required as a covering.

The insulating blocks may be provided in another embodiment with additional recesses in which the fixed contacts are arranged, these recesses serving simultaneously as spark chambers.

More particularly, in a combination of several switch components to form one switch, it has proved to be a great advantage to connect the tension spring to the actuating stirrup by means of an insulating member. An insulating plate provided with two holes may be used. By this means insulation of the individual switch components is obtained.

A trigger member for operating the switch may be provided in accordance with available paths and forces either at the free end or on a cross piece of the actuating lever.

According to a preferred embodiment of the invention, the actuating stirrup is provided with a U-shaped or semicircular rounded portion and is mounted in support adjustable by means of a knurled screw, on the feeler member. This support may consist of a U-shaped plate provided with notches in its side. The actuating stirrup is located in these notches and by adjusting the knurled screw, the switching time can be accurately set. Such an arrangement is very advantageous particularly in the case of a combination of several switch components in a single switch, since the exact switching moment of each component can be adjusted independently of the other switch components by mounting each individual actuating stirrup in each a holder.

For locking the knurled screws it has proved to be an advantage in accordance with another embodiment of the invention to provide the holder, consisting of U-shaped sheet metal, with a projection which can be bent into the notches of the knurled screw after adjusting the precise switch time.

The invention will be described hereinafter with reference to the embodiments illustrated in the accompanying drawings, but without limitating the scope of the invention.

FIG. 1 is a plan view of a switch according to the present invention.

FIG. 2 is a side view of a switch according to the present invention, comprising one switch component with the mounting of the actuating stirrup adjustable in a vertical direction; the actuating stirrup is only partly shown.

FIG. 3 is a side elevation of a switch according to the present invention, having two components and a vertically adjustable mounting for the actuating stirrup, the latter being only partly shown.

FIG. 4 is a block insulating material for supporting the snap member and fixed contacts of a switch comprising two components, in a rear elevation.

FIG. 5 is an insulating block for supporting the snap member and fixed contacts of a switch comprising one switch component, sectioned on the line A–B of FIG. 1.

FIG. 6 is a side elevation of the support of the actuating stirrup on the operating member, said support being adjustable in height.

FIG. 7 is a plan view of this support and the actuating stirrup.

FIG. 8 is a side view of the support of two actuating stirrups on one operating member, said support being adjustable in height.

FIG. 9 is a perspective view of a switch provided with an insulating block for three switch components, the small

insulating blocks of which have additional recesses forming spark chambers.

FIG. 10 is a section of the embodiment shown in FIG. 9 in the plane of the snap member.

FIG. 11 is a side elevation of a simplified embodiment.

FIGS. 12(*a–d*) are views of the individual phases of a switch.

FIG. 13 is an exploded view of an embodiment of a switch of the present invention provided with one switch component.

The snap member **1** which is illustrated in FIG. 1 is provided on its free shank **1***b* with a moveable contact, and is clamped by its shank **1***a* in the insulating block **2**. A bifurcated actuating stirrup **3** surrounds the snap member **1** by the shanks **3***a* and **3***b* and is connected by the spring **4** to the free shank **1***b* of the snap member **1** carrying the contact, near the pivotal axis of the actuating stirrup. The actuating stirrup **3** is pivotably journalled in the bearings **5***a* and **5***b* by the shanks **3***a* and **3***b*. The insulating block **2** is provided with contact plates **8** and **9** for the fixed contact **8***a* and **9***a* between small insulating blocks **7** and **7***a*, which contacts terminate on the opposite side on contact tags **8***b* and **9***b*. The contact tags may be formed for example as sockets to receive leads provided with plugs.

The shank **1***a* of the snap member **1** is clamped, together with a contact plate **6** which also terminates in a similar tag **6***b*, between small insulating blocks **7** and **7***a*. The entire construction of the insulating block is clamped by the screw **10**, if desired with the inter-position of a cover spring **11** and on cover plate **11***a*, to the base plate **12**.

The switch is actuated by a stem or feeler member which is arranged on the bifurcated actuating stirrup **3** being adjustable in height and holdable against displacement. The moveable contact **14** on the free shank **1***b* is formed as a two-sided contact which in dependence on the position of the actuating stirrup, engages either the upper contact **8***a* or the lower contact **9***a*. The actuating stirrup **3** can be mounted in bearings firmly connected to the base plate **12**. In FIGS. 2 and 3 an adjustable bearing of the actuating stirrup is shown. The bearings **5***a*, **5***b* are formed as a slot provided on two displaceable round bars **16** and **17** connected to the base plate **12** and the cover plate **11***a*, which bars in turn are secured in a predetermined position by a stop screw. An adjustable support **18** limits the movement of the securing stirrup.

The arrangement of the fixed contacts and the fixed shank of the snap member is illustrated together with the use of small insulating blocks **7** and **7***a* in FIG. 4. This figure also shows the reciprocal arrangement of the two switch components permitting a very compact construction.

The small insulating blocks are provided on both sides with recesses and projections in which the parts to be clamped are arranged, and are secured by the projections of the adjacent block. Individually shaped small insulating blocks **7** are required for the upper and lower closure of the block.

In FIGS. 6, 7 and 8, the adjustment in height of the actuating stirrups on the feeler member is shown. The support **21** which is adjustatble in height by a knurled screw **20** on the feeling member **13** comprises a U-shaped metal plate in the two raised sides of which gaps are made for the mounting of the actuating stirrup. The actuating stirrup itself is provided with a U-shaped bend **3***c* to enable it to clear the actuating member. The knurled screw **20** has notches **23** on its outer periphery in which the tab **22** of the U-shaped plate **21** can be bent for locking purposes.

The tension spring **4** is connected to the actuating stirrup **3** by means of the insulating member **24**.

FIG. 9 is a perspective view of a switch the insulating block of which is provided for three switch components; greater clarity, only one switch component with snap

member and actuating stirrup is shown. The small insulating blocks are provided with recesses which form spark chambers. The purpose of the support **18** is provided with limit stops **18***a*, is clearly apparent from the figure. The support is shown in two embodiments in the same manner as the mounting of the actuating stirrup, which are adjustable either by the knurled screw **18***b*, **16***b* or alternatively, the adjustment in height is effected by means of washers **19**.

FIG. 10 is a section through the switch of FIG. 9 in the plane of the snap member. The recess **1***c* of the snap member or its diameter can be varied, whereby the snap member becomes more or less sensitive and is easier or harder to actuate.

FIG. 11 is a side elevation of a simple form of a switch which is fitted with only one snap member the actuating switch **3** of which has an extension **3***d* under the pivot bearing **5***a*. The object of this extension is to secure the actuating stirrup **3** in a position just below the switching-on or switching-back point, without impeding its movement in the switching direction. For this purpose the extension **3***d* of the actuating stirrup is disposed below or above the bearing supports **26** which are rigid, and can be constructed in one piece with the snap member.

The mode of operation of the switch is apparent from FIGS. 1 and 2. If no forces are acting on the feeler member and actuating stirrup **3**, the free end of the snap member **1**, provided with contact **14**, is drawn by the tension spring **4** downwardly against the fixed contact **9***a*. When the feeler member and the actuating stirrup **3** connected therewith are raised beyond dead centre, the tension spring **4** pulls the free end of the snap member **1** with the contact **14** suddenly i.e. with a snap-like movement, upwardly against the contact **8***a*.

The switch therefore acts as a changeover. However, it can of course be constructed and used for simple switching on and off operations.

In FIG. 12 the individual switch phases are shown schematically. The actuating stirrup **3** may move through an angle of almost 180°. Its rotary bearing **5***a* is located just above the point of engagement of the tension spring **4** (shown by X) and may be adjustable in height. By means of the height adjustment any desired change of the force required for actuation is achieved.

The phase A shows the almost entirely lowered actuating stirrup **3** which draws the moveable contact **14** by way of the spring X against the lower fixed contact **9***a*. The U-shaped part of snap contact spring **1** points in the opposite direction.

Phase B shows the actuating stirrup **3** lifted close to the switching point. On account of the bent U-shaped part of the snap contact spring **1** the displaceable contacts **14** have an increased contact pressure up to the changeover point, which pressure results from the angle of incidence of the line of action of the spring X to the contact **14** of the snap contact spring **1**.

Phase C shows the snapped-over displaceable contact **14**, now is in engagement with the fixed contact **8***a*. The U-shaped part of the snap contact spring **1** now points downwardly. The above mentioned advantage is also demonstrated by this position.

Phase D shows the nearly complete follow-up of the actuating stirrup **3** which is able to describe a total angle of almost 180°.

All the phases show that the spring **4** is in no way subjected to excessive stretching a feature resulting from the close location of the centres of rotation of the spring **4** and the actuating stirrup **3**, and the equal pivotal radii involved; this makes for long life of the switch.

Finally, FIG. 13 shows an exploded view of a switch of the present invention. The individual parts are provided with reference numerals as mentioned above.

What I claim is:

1. In an electrical snap-action switch, support means, an elongated snap member of substantially U-shaped configuration having a pair of elongated shanks one of which is fixed to said support means and the other of which is freely moveable with respect to said fixed shank, a stationary contact, a movable contact carried by said freely movable shank for movement with the latter into and out of engagement with said stationary contact, and spring means operatively connected to said freely movable shank for yieldably maintaining the latter either in a position where said movable contact engages said stationary contact or in a position where said movable contact is displaced from said stationary contact, said spring means moving through a dead-center position during displacement of said freely movable shank between said positions thereof for acting on said freely movable shank to snap the latter between said positions as said spring means passes through said dead-center position, lever means pivotally connected to said support means and operatively connected with said spring means for displacing the latter in either direction through said dead-center position to change said freely movable shank between said positions thereof, said lever means being turnable about a predetermined axis and said spring means being connected to said freely movable shank at a location adjacent to said axis, and adjusting means carried by said support means for adjusting said axis in the direction of movement of said freely movable shank, said lever means having the configuration of a stirrup provided with a pair of substantially parallel legs pivotally engaging said support means, said legs of said stirrup being situated substantially in a plane which includes said fixed shank when said spring means is in said dead-center position thereof, and said adjusting means including a pair of elongated members to which said legs of said stirrup are pivotally connected, said elongated members extending substantially perpendicularly through said plane and each being longitudinally adjustable independenetly of the other, so that the legs of said stirrup can have their pivotal connections independently adjusted.

2. In a switch as recited in claim **1**, limiting means carried by said support means and situated in the path of movement of said stirrup for limiting the extent of turning thereof.

3. In an electrical snap-action switch, support means, an elongated snap member of substantially U-shaped configuration having a pair of elongated shanks one of which is fixed to said support means and the other of which is freely movable with respect to said fixed shank, a stationary contact, a movable contact carried by said freely movable shank for movement with the latter into and out of engagement with said stationary contact, and spring means operatively connected to said freely movable shank for yieldably maintaining the latter either in a position where said movable contact engages said stationary contact or in a position where said movable contact is displaced from said stationary contact, said spring means moving through a dead-center position during displacement of said freely movable shank between said positions thereof for acting on said freely movable shank to snap the latter between said positions as said spring means passes through said dead-center position, said support means including at least two electrically non-conductive blocks one of which is formed with a recess and projection and the other of which is formed with a projection nesting into said recess and a recess into which said projection of said one block nests, said fixed shank and said stationary contact being clamping between said blocks.

4. In a switch as recited in claim **3**, means engaging said blocks for pressing them against each other.

5. In a snap-action switch assembly, a plurality of electrically non-conductive blocks superimposed one upon the other and nested one into the next, said blocks each having a stepped configuration providing each block with at least one projection and one recess respectively projecting into and receiving the recess and projection of an adjoining block, and a plurality of switch units clamped

between said blocks, each unit including a snap member of substantially U-shaped configuration having a pair of shanks one of which is clamped between a pair of said blocks and the other of which is freely movable and carries a movable contact, each unit including a stationary contact clamped between a pair of said blocks and situated in the path of movement of said movable contact, said freely movable shank being displaceable between a position where said movable contact engages said stationary contact of each unit and a position where said movable contact is displaced from said stationary contact of each unit, and each unit further comprising a spring means for yieldably maintaining said freely movable shank in one or the other of said positions thereof, said spring means moving through a dead-center position during displacement of said freely movable shank between said positions thereof, and adjoining units being oppositely oriented with the fixed shank of the snap member of one unit aligned with the stationary contact of an adjoining unit.

6. In an electrical snap-action switch, support means, an elongated snap member of substantially U-shaped configuration having a pair of elongated shanks one of which is fixed to said support means and the other of which is freely movable with respect to said fixed shank, a stationary contact, a movable contact carried by said freely movable shank for movement with the latter into and out of engagement with said stationary contact, spring means operatively connected to said freely movable shank for yieldably maintaining the latter either in a position where said movable contact engages said stationary contact or in a position where said movable contact is displaced from said stationary contact, said spring means moving through a dead-center position during displacement of said freely movable shank between said positions thereof for acting on said freely movable shank to snap the latter between said positions as said spring means passes through said dead-center position, lever means turnably connected to said support means, and an electrically non-conductive member connecting said spring means to said lever means for displacement through said dead-center position during turning of said lever means.

7. In an electrical snap-action switch, support means, an elongated snap member of substantially U-shaped configuration having a pair of shanks one of which is fixed to said support means and the other of which is freely movable with respect to said fixed shank, a stationary contact carried by said support means, a movable contact carried by said freely movable shank and engaging said stationary contact in one position of said movable shank and displaced from said stationary contact in another position of said movable shank, spring means for displacing said movable shank between said positions thereof, said spring means moving through a dead-center position during displacement of said movable shank between said positions thereof, an actuating stirrup having a pair of substantially parallel legs pivotally connected to said support means and a transverse leg connected to said spring means for displacing the latter through said dead-center position thereof during turning of said stirrup with respect to said support means, said stirrup having intermediate the ends of said transverse leg thereof a portion of substantially U-shaped configuration, an elongated threaded feeler member extending in the general direction of movement of said freely movable shank and around which said U-shaped portion of said transverse leg of said stirrup extends, a nut turnable on said threaded member, and a support resting on said nut, through which said threaded member extends, and engaging said transverse leg of said stirrup for supporting the latter.

8. In a switch as recited in claim 7, said support being in the form of a plate having a pair of side walls respectively formed with notches which receive said transverse leg of said stirrup.

9. In a switch as recited in claim 8, said nut having a serrated periphery providing the periphery of said nut with gaps distributed along said periphery and said plate having a projection received in one of said gaps.

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ROBERT K. SCHAEFER, *Primary Examiner.*

D. SMITH, JR., *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,356,802 December 5, 1967

Hans Simon

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 6, for "Oct. 7, 1964" read -- July 10, 1964 --.

Signed and sealed this 4th day of February 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents