April 17, 1962 H. C. KRYDER 3,030,466

SNAP SWITCH

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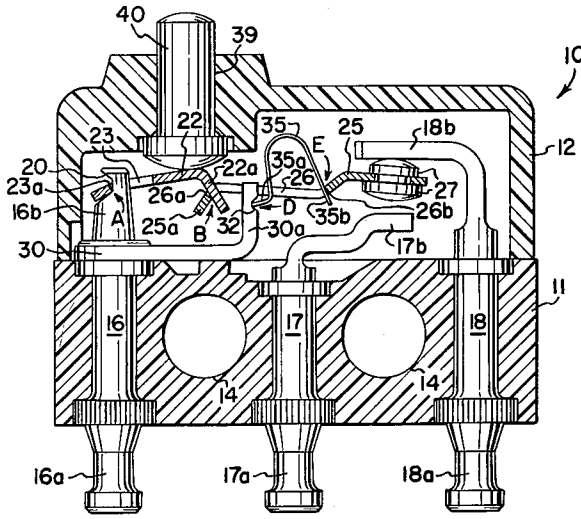


Fig. 1

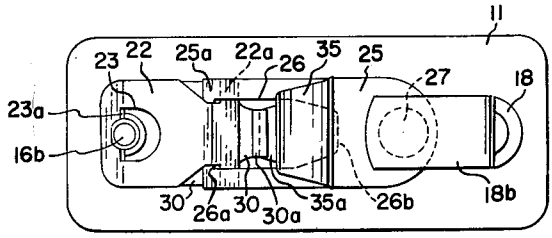


Fig. 2

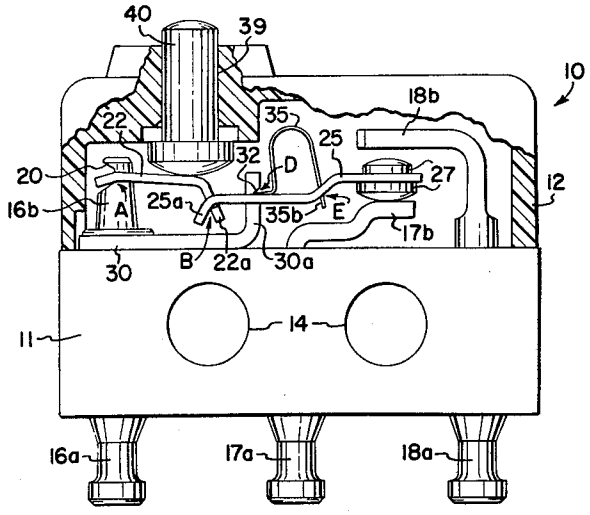


Fig. 3

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SNAP SWITCH

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The present invention is directed to an improved precision snap action switch, and more particularly to a switch of this type which is capable of being miniaturized to a very high degree without detrimental effects being realized insofar as contact pressure, contact wiping, and "dead break," electric load conveying and operating characteristics, and ease of assembly are concerned.

The snap switch disclosed herein includes a snap mechanism essentially comprised of three interconnected elements: a first tension member having a first extremity pivotally associated with the switch base; a second tension member having a first extremity pivotally associated with the second extremity of the first lever and having contact means disposed at the second extremity for cooperation with a pair of fixed terminal members; and a compression spring having a first extremity pivotally associated with the switch base and having a second extremity operatively associated with a portion of the second lever near the contact means thereof.

The snap mechanism and the pivotal connections are so arranged that adequate contact wiping is provided and the tendency of "dead break" is minimized. Further, the compression spring serves to act both as a snap action means and a return means upon actuation and deactuation of the mechanism, respectively. The compression spring also serves to provide positive contact force between the contact means and the terminal members in either condition of the mechanism.

As indicated above, the teaching disclosed herein is particularly adapted to be highly miniaturized. In fact, switches have been constructed in accordance with the present disclosure which occupy approximately $\frac{1}{25}$ cubic inch and weigh approximately $\frac{1}{28}$ ounce, and which are operable by 6 ounces of force and capable of switching 5 amperes at 250 v. A.C. or 30 v. D.C.

Therefore, it is an object of this invention to provide a novel three element snap switch mechanism.

Another object of the present invention is to provide a snap switch mechanism as set forth above which can be highly miniaturized without detrimental effects being realized insofar as general switch characteristics and ease of assembly of the snap switch mechanism are concerned.

These and other objects will become more apparent from a reading of the following specification and appended claims in which:

FIGURE 1 is a sectional view of a switch including the novel snap switch mechanism shown in the deactuated condition;

FIGURE 2 is a top plan view of the structure of FIGURE 1 taken with the cover removed; and

FIGURE 3 is a partial sectional view of the switch shown in the actuated condition.

In FIGURES 1, 2, and 3, a switch case **10**, comprising a molded switch base **11** and a molded switch cover **12** both formed of insulating material, is shown. The base **11** and the cover **12** are secured together by an appropriate adhesive applied at the joint therebetween. A pair of mounting holes **14** are provided in the base **11**. Terminals **16**, **17** and **18** are molded in the base **11** and include lower portions **16***a*, **17***a*, and **18***a* for the connection thereto of appropriate conductors, not shown. Near the upper extremity of upper portion **16***b* of the terminal **16**, a notch **20** is provided. A first conducting rigid tension member **22** includes an opening **23**, the leftward extremity **23***a* of which cooperates with the notch **20** to form a first pivotal connection A. The right end portion **22***a* of the lever **22** is depending and is **T** shaped. A second conducting rigid tension member **25** includes an opening **26** and a left end depending portion **25***a*. The **T** shaped depending portion **22***a* of lever **22** is disposed through opening **26** and engages the leftward extremity **26***a* thereof so as to be interconnected with the depending portion **25***a* of the lever **25** to thereby provide a pivotal connection B with line contact therebetween. At the right end portion of lever **25**, a contact **27** is provided.

To the upper portion **16***b* of terminal member **16**, at the upper extremity of the base **11**, an angle member **30** is secured thereto. A notch **32** is provided near the extremity of upstanding leg **30***a* of the angle member **30**. A preformed conducting **C** spring member **35** includes a first extremity **35***a* associated with the notch **32** of the upstanding leg **30***a* of the angle support **30** to form a pivotal connection D and further includes a second **T** shaped extremity **35***b* associated with the rightward extremity **26***b* of the opening **26** of the lever **25** to form a pivotal connection E. As is of course obvious, the opening **26** in the lever **25** accommodates the **C** spring **35** and also the upstanding leg **30***a* of the angle support **30**.

Terminal members **17** and **18** include upper portions **17***b* and **18***b* which serve as upper and lower stops for the contact **27** upon deactuation and actuation of the snap switch **10**, respectively.

The cover **12** includes an opening **39** in which a molded plunger **40**, formed of insulating material, is slidably disposed. The lower extremity of the plunger **40** acts on the lever **22** so that upon downward movement of the plunger **40**, actuation of the snap switch **10** takes place and upon subsequent upward movement, deactuation takes place.

The arrangement of the levers **22** and **25**, the **C** spring **35** and the pivotal connections A, B, D, and E allows for the **C** spring to act both as a snap over spring and a return spring, as will become more apparent from a description of the operation of the snap switch. Further, the particular arrangement of the elements allows the **C** spring to provide adequate contact pressure between the contact **27** and the upper stop portion **18***b* and lower stop portion **17***b* of the terminal members **18** and **17**, respectively. Also, because of the contact pressure provided by the **C** spring and the arrangement of the elements, "dead break" between the contact **27** and the upper stop portion **18***b* and lower stop portion **17***b* of terminal members **18** and **17** respectively, is inhibited. Again, due to the association of the elements, upon actuation and deactuation thereof, the lever **25** exhibits a certain amount of longitudinal movement which results in contact wiping, thus insuring clean contact and terminal surfaces thereby reducing the possibility of welding therebetween.

In the condition shown in FIGURE 1, the snap switch **10** is in a deactuated condition. Upon downward movement of the plunger **40**, the lever **22** rotates clockwise about the pivotal connection A, thereby causing clockwise rotation of the pivotal connection B about the pivotal connection A and leftward longitudinal movement of the lever **25** with the contact wiping discussed above arising. At rest and during the initial actuating movement, the **C** spring **35** provides an upward force on the contact **27** resulting in contact pressure arising between the contact **27** and the upper stop portion **18***b* of the terminal member **18**. Continued downward movement of the plunger **40** finally results in the toggle point between the pivotal connections B, D, and E being attained. As this toggle point is passed, a snap action of the lever **25** and the contact **27** associated therewith results whereby the contact **27** is driven from engagement with the upper stop portion **18***b*

of terminal member 18 into engagement with the lower stop portion 17*b* of the terminal member 17. In this condition, the arrangement assumes the position shown in FIGURE 3. The C spring 35 now provides a downward force so that the contact 27 engages the lower stop portion 17*b* of the terminal member 17 to provide an adequate contact force therebetween. The C spring 35 also provides an upward force on the left end portion of the lever 25 tending to return the arrangement to the position shown in FIGURE 1. Upon the removal of the input force from the plunger 40, the force provided by the C spring 35 on the left end portion of the lever 25 results in the pivotal connection B rotating counter clockwise about the pivotal connection A until the toggle point between the pivotal connections B, D, and E is again attained. Upon this toggle point being passed, the lever 25 returns with a snap action to its original position as shown in FIGURE 1. Again, during the upward movement of the pivotal connection B, leftward longitudinal movement of the lever 25 is encountered, so that wiping between the contact and the lower stop portion 17*b* of the terminal member 17 arises. It should be noted that the toggle point between the pivotal connections A, D, and E is never encountered so that the force provided by the C spring 35 with the arrangement in the condition shown in FIGURE 3 is sufficient to return the arrangement to the condition shown in FIGURE 1 upon removal of the input force. Of course, if the toggle point between the pivotal connections A, D, and E was passed, the arrangement would not be self returning and either a reset mechanism or a return spring would be required.

While the drawing shows the snap switch to be relatively large, it should be appreciated that switches incorporating the teaching of the present invention have been successfully produced which are ½ inch in length, ⅛ inch in width, and ½ inch in overall height. Even with such very high miniaturization, the structure disclosed herein provides excellent load carrying capacity, as set forth in the beginning of the specification, good repeatability and low operating force. Further, switches of this size exhibit the contact wiping, the absence of "dead break" and high contact pressure attributes discussed above.

Due to the simplicity of the elements of the snap switch, assembly of such highly miniaturized switches proves little problem. Further, due to the relative small cross section of the upper portion 16*b* of the terminal member 16 and the thinness of the upstanding leg 30*a* of the angle member 30, these can be easily bent to calibrate the switch. Further, the C spring 35 can be deformed to provide the necessary calibration.

Thus, an improved snap action mechanism has been disclosed which incorporates two tension elements and a compression element, simple in nature, which are so arranged as to allow the compression element to provide the force for snap over and return of the mechanism upon actuation and deactuation, respectively. Further, a snap action mechanism has been disclosed which provides good contact pressure, contact wiping and limits "dead break" and which is easily assembled and capable of being calibrated by simple expedients. Still further, the present invention is so devised as to be capable of being miniaturized to a very high degree with none of the foremention attributes being adversely effected.

While a C spring has been disclosed in the single embodiment, other types of compressive springs could be utilized. Similarly, where rigid tension members have been called for these could be merely tension springs. Other modifications could be made to the present invention, and therefore, the scope of the invention should be determined from the following claims.

I claim:

1. A snap switch arrangement comprising: a switch case including a base and a cover; a first terminal member affixed to said base near a first extremity; a second terminal member and a third terminal member affixed to said base so as to provide spaced stop portions near a second extremity of said base; a first rigid tension member extending toward said spaced stop portion and having a first end portion associated with said first terminal member so as to form a first pivotal connection; a second rigid tension member having a first end portion associated with the second end portion of said first tension member, the first end portion of said second tension member and the second end portion of said first tension member depending toward each other and interconnected to form a second pivotal connection having line contact therebetween; said second tension member having a second end portion including contact means for selective engagement with the stop portions of said second and third terminal members; a compression C spring partially disposed and movable in an opening provided in said second tension member and having a first end portion associated with a portion of a support member operatively fastened to said first terminal member so as to form a third pivotal connection and having a second end portion associated with an extremity of the opening in said second tension member so as to form a fourth pivotal connection, said third pivotal connection being located between said second and fourth pivotal connections; and a plunger slidably disposed in said cover for actuating said first tension member to cause snap movement of said contact means from one stop portion to the other stop portion of said second and third terminal members upon the toggle point of said second, third and fourth pivotal connections being attained; the elements being arranged so the toggle point of said first, third and fourth pivotal connections is never attained thereby effecting self-return of the arrangement upon deactuation of the plunger.

2. A snap switch arrangement comprising: a base; a first terminal member affixed to said base near a first extremity; a second terminal member and a third terminal member affixed to said base so as to provide spaced stop portions near a second extremity of said base; a first rigid tension member extending toward said spaced stop portion and having a first end portion associated with said first terminal member so as to form a first pivotal connection; a second rigid tension member having a first end portion associated with the second end portion of said first tension member so as to form a second pivotal connection and having a second end portion including contact means for selective engagement with the stop portions of said second and third terminal members; and a compression spring having a first end portion associated with a portion of a support member operatively fastened to said base so as to form a third pivotal connection and having a second end portion associated with said second tension member near the second end portion so as to form a fourth pivotal connection, said third pivotal connection being located between said second and fourth pivotal connections; an input force applied to said first tension member arranged to cause snap movement of said contact means from one stop portion to the other stop portion of said second and third terminal members upon the toggle point of said second, third and fourth pivotal connections being attained; the elements being arranged so the toggle point of said first, third and fourth pivotal connections is never attained thereby effecting self-return of the arrangement upon removal of the input force.

3. A snap switch arrangement comprising: a base; a first terminal member affixed to said base near a first extremity; a second terminal member and a third terminal member affixed to said base so as to provide spaced stop portions near a second extremity of said base; a first tension member extending toward said spaced stop portions and having a first end portion associated with said first terminal member so as to form a first pivotal connection; a second tension member having a first end portion associated with the second end portion of said first tension member so as to form a second pivotal connection and

having a second end portion including contact means for selective engagement with the stop portions of said second and third terminal members; and compression spring means operatively connected to said second tension member and having an end portion associated with a portion of a support member operatively fastened to said base so as to form a third pivotal connection, said third pivotal connection being located between said second pivotal connection and said operative connection; an input force applied to said first tension member between said first and second pivotal connections arranged to cause snap movement of said contact means from one stop portion to the other stop portion of said second and third terminal members upon the toggle point of said second and third pivotal connections and said operative connection being attained; the elements arranged so the toggle point of said first and third pivotal connections and said operative connection is never attained thereby effecting self-return of the arrangement upon removal of the input force.

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