Dec. 10, 1968 A. W. KRIEGER 3,415,962

MINIATURE PRECISION SNAP ACTION SWITCH WITH ONE-PIECE STRESSED BLADE CONSTRUCTION

Filed Dec. 9, 1966 3 Sheets-Sheet 1

Fig. 1

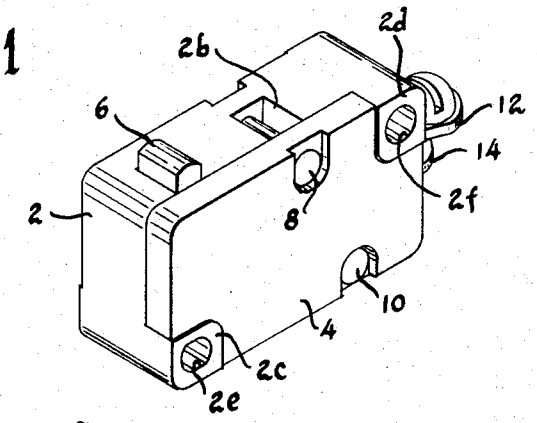


Fig. 2

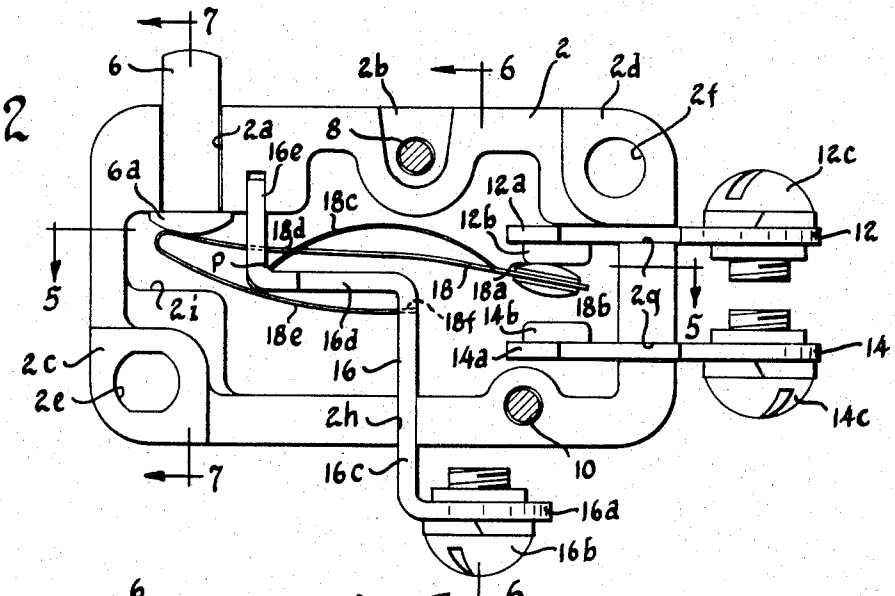
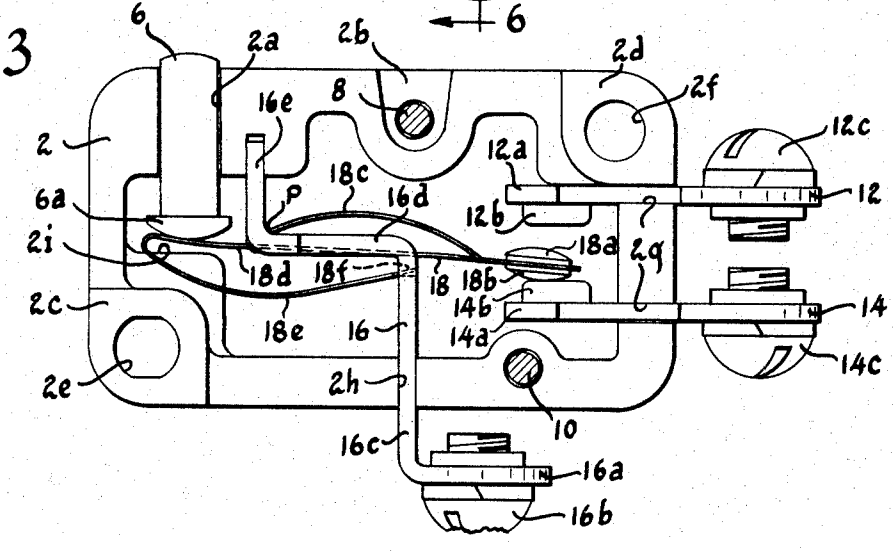


Fig. 3



Dec. 10, 1968 A. W. KRIEGER 3,415,962

MINIATURE PRECISION SNAP ACTION SWITCH WITH ONE-PIECE STRESSED BLADE CONSTRUCTION

Filed Dec. 9, 1966 3 Sheets-Sheet 2

Fig. 4

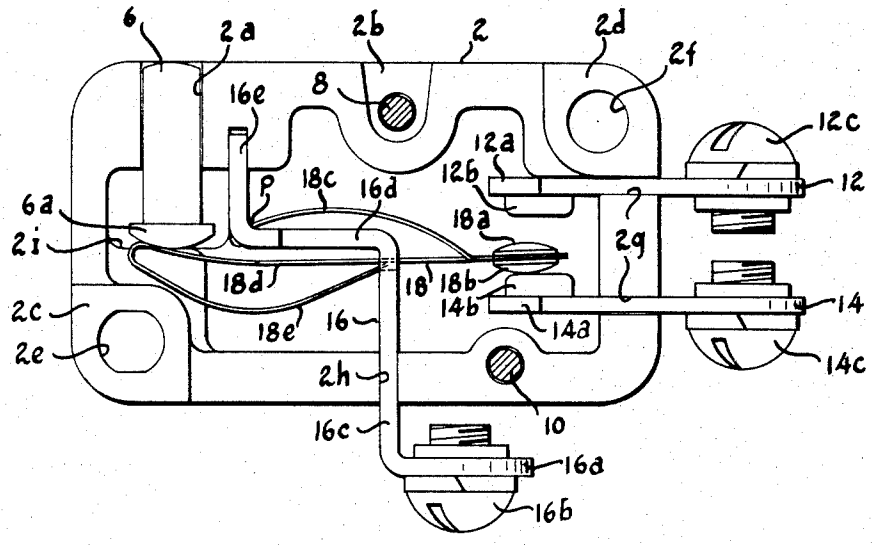


Fig. 5

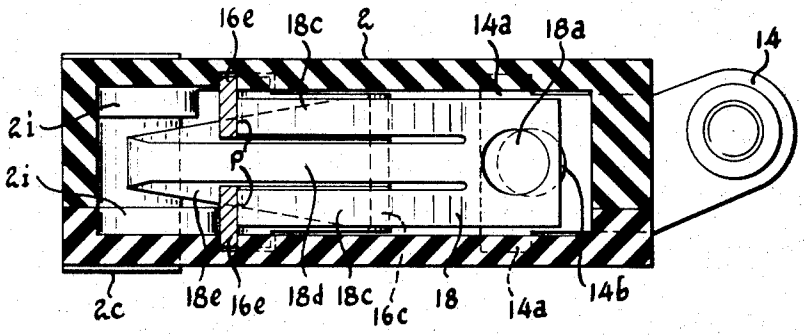
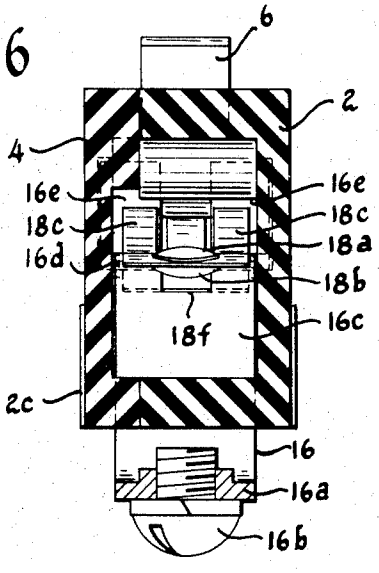


Fig. 6



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MINIATURE PRECISION SNAP ACTION SWITCH WITH ONE-PIECE STRESSED BLADE CONSTRUCTION

Filed Dec. 9, 1966 3 Sheets-Sheet 3

Fig. 7

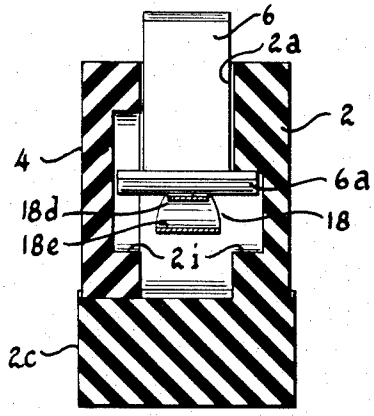


Fig. 8

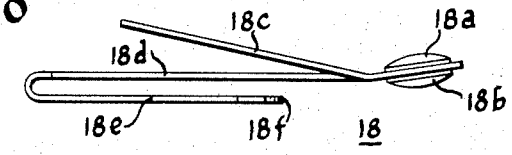
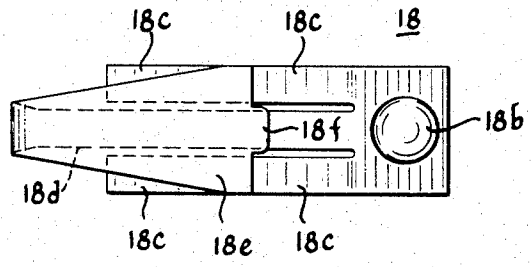


Fig. 9



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3,415,962

MINIATURE PRECISION SNAP ACTION SWITCH WITH ONE-PIECE STRESSED BLADE CONSTRUCTION

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Filed Dec. 9, 1966, Ser. No. 600,609
8 Claims. (Cl. 200—67)

ABSTRACT OF THE DISCLOSURE

A miniature precision snap-action switch having a one-piece snap-action contactor blade removably mounted on a terminal strip support within an insulating housing and including first and second compression force spring strips integral therewith, the first compression force spring strip extending from a point near the contact element which is at one end to a pivot point on said support to apply a force in one direction, and the other compression force spring strip extending with a reentrant bend from the extreme other end thereof to another pivot point on said support for free pivoting thereon, the bent end being movable by a plunger to cause switching action.

This invention relates to miniature precision snap action switches and more particularly to switches having a small size and being capable of detecting a small amount of motion and responding thereto to operate with a snap action.

While not limited thereto, the invention is especially applicable to miniature and sub-miniature snap action switches of the self-enclosed, plunger actuated type.

An object of the invention is to provide an improved miniature precision snap action switch.

A more specific object of the invention is to provide a switch of the aforementioned type with improved means affording improved operation and reduction in cost due to fewer parts.

Another specific object of the invention is to provide a snap action switch of the aformentioned type with improved means affording the contact actuator much more overtravel in a switch having smaller overall dimensions.

Another specific object of the invention is to provide a snap action switch of the aforementioned type with improved means affording less variation in operating characteristics between switches because the effect of dimensional tolerances is minimized.

Another specific object of the invention is to provide a snap action switch of the aforementioned type with means affording improved contact pressure operating force and mechanical life.

Other objects and advantages of the invention will hereinafter appear.

These and other objects and advantages of the invention and the manner of obtaining them will best be understood by reference to the following description of an embodiment of a miniature precision snap action switch taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is an isometric view of a miniature precision snap action switch constructed in accordance with the invention;

FIG. 2 is an enlarged front elevational view of the switch of FIG. 1 with the cover removed to show the switch mechanism mounted within the enclosing case, this switch mechanism being shown in its normal off position;

FIG. 3 is a front elevational view like FIG. 2 with

the plunger being shown depressed sufficiently to having actuated the switch to its operated or on position;

FIG. 4 is a front elevational view like FIG. 3 with the plunger being shown depressed further to show the amount of overtravel that is possible;

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 2;

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 2;

FIG. 7 is a cross-sectional view taken along line 7—7 of FIG. 2;

FIG. 8 is a front elevational view of the switch blade assembly showing how it would appear in unassembled and unstressed condition; and

FIG. 9 is a bottom view of the switch blade assembly of FIG. 8.

Referring to FIG. 1, there is shown the external appearance of a miniature precision snap action switch constructed in accordance with the invention. As shown therein, the switch is provided with an electrically insulating enclosure comprising a base **2** and a cover **4**. Base **2** provides the rear wall and integrally molded therewith most of the upper and lower and left and right walls of the enclosure. Cover **4** provides the front wall and a small part of the upper, lower, left and right walls of the enclosure.

Base **2** is provided with means for supporting a switch operating plunger **6**. This means comprises a rectangular aperture **2***a* extending down through the left-hand portion of the upper wall of the base. This aperture is in the form of a notch in that it communicates with the forward edge of such upper wall to enable the plunger to be dropped thereinto before the cover is riveted onto the base. In this manner, the cover is arranged to form one wall of the aperture and the base forms the other walls of this aperture whereby the plunger is slidably guided for longitudinal movement.

Base **2** is provided with means for pivotally supporting a so-called integral actuator for operating the plunger. This means comprises a cover rivet **8** and an external recess **2***b* in the upper wall of the base located slightly to the right of the midportion of the base and surrounding the rivet through a portion of its length. As more clearly shown in FIG. 2, this recess provides space around the rivet for an actuator which may be a metal strap bent to provide an offset hook on one end. This hook would retain the strap on rivet **8** allowing the limited pivotal movement and the straight end of such strap would rest on the end of the plunger **6** whereby depression of any portion of the strap would depress the plunger. As actuators of this type have been known heretofore, it has not been illustrated herein but has been described briefly to show the purpose of the recess in the base. As shown in FIG. 1, recess **2***b* extends from the forward edge of the upper wall of the base toward the rear a sufficient distance to center it on the enclosure when the cover is riveted in place. A second rivet **10** extends through the cover and the right-hand portion of the lower wall of the base to rigidly secure the cover.

The base and cover are provided with complementary interfitting portions to register the cover on the base. For this purpose, the lower left and upper right corners of the cover are notched away and the corresponding corners of the base have forward projections **2***c* and **2***d*, respectively, fitting into the notches in the cover. These projections have horizontal mounting holes **2***e* and **2***f* therethrough with one of these holes such as **2***e* being oblong to avoid close tolerance requirements in the locations of the bolts or rivets that are used to secure the switch in place.

As shown in FIG. 2, the switch is of the single pole

double throw type whereby a common external terminal may be connected to either one of two selected external terminals. For this purpose, base **2** is provided with a pair of spaced slots **2***g* in the right wall communicating with the forward edge thereof for receiving a pair of flat contacts **12** and **14**. These contacts are provided at their internal ends with lateral ears **12***a* and **14***a* which fit into complementary recesses in the rear wall of the base and in the cover rigidly to secure the contacts in place when the cover is assembled. Suitable contact elements **12***b* and **14***b* of low resistance metal are welded on the internal ends of the contacts on the surfaces facing one another. The external ends of these two contacts are provided with suitable terminal connectors such as screws **12***c* and **14***c* for connecting the switch to an external circuit.

A common terminal **16** is arranged to receive an improved snap action contactor **18**. This common terminal is bent at a right angle at three spaced apart points along its length to provide four functional portions including an external terminal portion **16***a* arranged horizontally beneath the base and having a suitable connector thereon such as a screw **16***b*. The adjacent portion **16***c* extends vertically through a slot **2***h* in the lower wall of the base. The next portion **16***d* extends in the left-hand direction within the base and the final portion **16***e* extends vertically from portion **16***d*. As shown in FIGS. 2 and 5, common terminal **16** is divided or has its center removed throughout portions **16***e* and **16***d* and into the upper part of vertical portion **16***c* to provide space for contactor **18**. Also, upper divided portion **16***e* has lateral extensions as shown in FIGS. 2 and 6 which continue into the left-hand part of divided portion **16***d*. These lateral extensions fit into complementary recesses in the rear wall of the base and the cover rigidly to secure the common terminal in the enclosure.

The switch is provided with a one-piece snap action contactor **18** for electrically connecting the common terminal to either one of the selected contacts **12** and **14**. This contactor comprises a leaf spring as shown in FIGS. 8 and 9 having contact elements **18***a* and **18***b* of low resistance metal secured to upper and lower surfaces at its relatively wide right-hand end for engaging the contact elements of the selected contacts. Contact elements **18***a* and **18***b* may form parts of a single rivet swaged in a hole in the leaf spring. For this purpose, this right-hand end of the contactor extends between the internal ends of the selected contacts **12** and **14**. A pair of leaf spring compression elements **18***c* extend in the left-hand direction at a small upward angle from this right-hand end of the contact and are separated by a center strip **18***d*. These compression elements and center strips are of substantially equal width and are spaced from one another by a pair of narrow gaps to allow freedom of relative movement. This center strip is longer than the compression elements and its left-hand end portion is bent back parallel underneath to underlap the compression elements through a substantial portion of their length. Also, this bent back portion **18***e* has diverging sides or widens from the bent back point which is some distance to the left of the compression elements **18***c* toward its end. As shown in FIG. 9, this portion **18***e* widens starting from or just before the bent back point so that it reaches the full width of the snap action contactor a short distance before its end. This full width is the width of the contactor at the contact elements and at the compression elements. The extreme end of the bent back, widened portion is provided with a short central tongue **18***f* for retaining this end in the bottom of the U-shaped slot which divides the upper end of the common terminal **16** and for preventing side movement of the contactor blade. The operating force of the contactor may be selected by making this U-shaped slot the desired depth down into portion **16***c*.

When the snap action contactor is assembled on the common terminal, elements **18***c* and bent back portion **18***e* become compression elements. The left ends of compression elements **18***c* are pivotally supported in the right angle corner pivot P between portions **16***d* and **16***e* of the common terminal and are bowed upwardly. Also, the right end of the bent back portion **18***e* is pivotally supported at the upper end of portion **16***c* with its tongue **18***f* confined in the bottom of the U-shaped cutout in such upper end. This causes bent back portion **18***e* to be bowed downwardly whereby the bent end of center strip **18***d* is biased upwardly against the enlarged and rounded lower end **6***a* of the plunger. Center strip **18***d* of the contactor is in tension.

In its normal position as shown in FIG. 2, the compression elements bias the bent left end of the contactor upwardly against the plunger. With the plunger in its upper position, the line of action of the contactor blade assembly **18** from the point engaging the plunger to the point of connection of compression elements **18***c* thereto is above the pivot point P of compression elements **18***c* at their left ends. Consequently, contact element **18***a* of the contactor blade assembly is biased against contact element **12***b* of the upper stationary contact with sufficient contact pressure to make a good electrical connection.

Now when the plunger is depressed to move the bent left end of the contactor blade assembly downward, the contactor will snap from the upper stationary contact to the lower stationary contact. To this end, a point will be reached in the downward movement of the plunger wherein the line of action of the movable contactor passes from above pivot P below such pivot. The line of action of the movable contactor may be defined as a straight line from the point where the left end thereof engages the plunger to the point where both of the compression elements **18***c* connect with the contactor blade assembly near contact elements **18***a* and **18***b*. As this line of action passes just below pivot P, the right end of the contactor will move with a snap action from the upper to the lower stationary contact as shown in FIG. 3.

A characteristic feature of the invention is that the improved structure therein provides much more overtravel for the plunger than is obtained in heretofore known switches of similar type. As will be apparent, after the switch has been operated as shown in FIG. 3, the plunger can be depressed further all of the way in to the position shown in FIG. 4 without affecting the switch position. When the plunger is pressed all the way in, the enlarged lower end thereof stops against ledges **2***i* shown in FIG. 7 so that bent back portion **18***e* of the contactor does not engage the base. The advantages of this large amount of overtravel are apparent in that it avoids the necessity of close manufacturing or operating tolerances in the operators which depress the plunger. This large amount of overtravel is obtained by the one-piece construction of contactor blade assembly wherein bent back portion **18***e* is also made as a compression element in addition to compression element **18***c*. When made as a compression element integral with and as a bent back continuation of the flat leaf spring, portion **18***e* will bow the proper amount when the plunger is depressed and this portion **18***e* is thin enough as constructed to clear the hump above hole **2***e* in the base molding. This is in sharp contrast to prior devices wherein a stiff member, helical compression spring or the like has been used at this point which bottoms on the base before the plunger has been fully depressed. Flexing of bent back portion **18***e* reduces wipe of the contacts and thus prevents excessive mechanical wear thereof.

Another characteristic feature of the invention is that the one-piece contactor blade construction minimizes the effect of dimensional tolerances thereby affording less variation in operating characteristics between a multiplicity of manufactured switches. To this end, it will be apparent that some of the compressive force is afforded by bent back compression element **18***e* so that so much

less compressive force is required of compression elements **18***c*. In effect, the compressive force is divided between two parts whereby variation in each has correspondingly less effect on operating characteristics.

A further characteristic feature of the invention is the provision of improved contact pressure operating force and longer mechanical life obtained from the one-piece contactor blade construction having the compressive force divided into two parts. It will readily be apparent that division of the compressive force into two parts reduces the flexing in each compression element **18***c* and **18***e* whereby to improve the mechanical life of the switch. This division also provides better control of stress in the upper arch **18***c* whereby to improve the contact pressure operating force and to make it more consistent.

When the plunger is released, the switch will automatically return to its normal position. Referring to FIG. 4, it will be seen that the left end of the contactor blade applies an upward force on the plunger. Therefore, when the plunger is released, the contactor blade will push it upwardly. This causes the line of action of the contactor blade to pass from below pivot P above this pivot, causing compression elements **18***c* to snap contact element **18***b* away from contact element **14***b* and to snap contact element **18***a* into engagement with contact element **12***b*.

While the apparatus hereinbefore described is effectively adapted to fulfill the objects stated, it is to be understood that I do not intend to confine my invention to the particular preferred embodiment of miniature precision snap action switch disclosed, inasmuch as it is susceptible of various modifications without departing from the scope of the appended claims.

I claim:

1. In a miniature precision snap-action switch having an insulating housing including an insulating plunger extending into the housing and at least two conductive members within the housing and extending to the exterior thereof, one of said members including a stationary contact and the other of said members including supporting means for a movable contactor;

a one-piece snap-action contactor device removably mounted on said supporting means and including a contact element in overlying relation to but separated a short distance from the stationary contact comprising:

an elongated unitary member extending past said supporting means and having said contact element secured thereto at one end and including;

first compression force means integral with said unitary member and extending from a point near said contact element to a pivot point on said supporting means for applying a force in one direction;

second compression force means which is an integral part of said unitary member and extending with a reentrant bend from the extreme other end thereof to another pivot point on said supporting means on which it is freely, articulately and separably pivoted for applying a force in the opposite direction;

the other end portion of said unitary member being movable by the plunger to cause switching action between said contact element and said stationary contact;

and said other pivot point being spaced from the first mentioned pivot point to cause said unitary member to apply a force also in the outward direction of the plunger in both the normal and operated positions of the contacts.

2. In a miniature precision snap-action switch having an insulating housing including an insulating plunger extending into the housing and at least two conductive members within the housing and extending to the exterior thereof, one of said members including a stationary contact and the other of said members including supporting means for a movable contactor;

a snap-action contactor device mounted on said supporting means and including a contact element in overlying relation to but separated a short distance from the stationary contact comprising;

an elongated unitary member extending past said supporting means and having said contact element secured thereto at one end and including;

first compression force means integral with said unitary member and extending from a point near said contact element to a pivot point on said supporting means for applying a force in one direction;

second compression force means integral with said unitary member and extending from the other end thereof to another pivot point on said supporting means for applying a force in the opposite direction;

said other end of said unitary member bearing against the plunger;

and said other pivot point being spaced from the first mentioned pivot point to cause said unitary member to apply a force also in the outward direction of the plunger in both the normal and operated positions of the contacts;

said first and second compression force means comprising, respectively;

a pair of leaf springs cut for the opposite sides of said elongated unitary member and bent at the connecting point to a small angle so that they are bowed upwardly when their free ends are inserted in the first mentioned pivot point on the supporting means;

and a single leaf spring bent back from the other end of said elongated unitary member so that it is bowed downwardly when its free end is inserted in said other pivot point on the supporting means.

3. The invention defined in claim **1** wherein:

the pivot point of said bent back second compression force means is offset vertically and horizontally on the supporting means from the pivot point of said first compression force means.

4. The invention defined in claim **5** wherein:

the horizontal offset of said pivot points affords overlapping of said bent back second compression force means and said first compression force means a substantial amount thereby to provide a large amount of overtravel for the plunger after it has been depressed enough to cause snap action closure of said contact element against said stationary contact.

5. In a miniature precision snap-action switch having an insulating housing including an insulating plunger extending into the housing and at least two conductive members within the housing and extending to the exterior thereof, one of said members including a stationary contact and the other of said members including supporting means for a movable contactor;

a snap-action contactor device mounted on said supporting means and including a contact element in overlying relation to but separated a short distance from the stationary contact comprising;

an elongated unitary member extending past said supporting means and having said contact element secured thereto at one end and including;

first compression force means integral with said unitary member and extending from a point near said contact element to a pivot point on said supporting means for applying a force in one direction;

second compression force means integral with said unitary member and extending from the other end thereof to another pivot point on said supporting means for applying a force in the opposite direction;

said other end of said unitary member bearing against the plunger;

and said other pivot point being spaced from the first mentioned pivot point to cause said unitary member to apply a force also in the outward direction of the plunger in both the normal and operated positions of the contacts;

said elongated unitary member and said first and second compression force means comprising;

a one piece leaf spring member including an elongated central leaf spring having a pair of lateral leaf springs extending from one end thereof therealong with an upward bow with their free ends in said first pivot point to form said first compression force means and the other end of said central leaf spring having been bent back therebelow and having a downward bow with its free end in said second pivot point and underlapping a substantial portion of said pair of lateral leaf springs thereby to afford a large amount of overtravel to the plunger engaging said central leaf spring at its bent end.

6. The invention defined in claim **1**, together with:

an enlarged end on the plunger within the housing;

and at least one ledge within the housing against which said enlarged end stops when said plunger is fully depressed to prevent any portion of said snap-action contactor device from being damaged against the housing.

7. The invention defined in claim **1**, wherein the supporting means comprises:

a metal strap having a center strip cut out for a predetermined distance from the end thereof within the housing to provide parallel strips with space therebetween through which said elongated unitary member extends;

said parallel strips having two spaced apart right angle bends in opposite directions to provide two portions parallel but offset from one another;

the acute angle formed by one of said bends forming a pivot for said first compression force means;

and the bottom of said cut out forming a pivot for said second compression force means and its position relative to said pivot of said first compression force means determining the contact operating force.

8. The invention defined in claim **7**, wherein said

bent back portion of said elongated unitary member widens toward its pivoted end and is provided with a narrow tongue whereby it is pivoted in the bottom of said cut out and prevented from lateral movement in said space.

References Cited

UNITED STATES PATENTS

2,740,857	4/1956	Porland.
2,980,774	4/1961	Millerwise.
3,142,741	7/1964	Bury.
3,248,959	5/1966	Angold.
1,960,020	5/1934	McGall.
2,486,033	10/1949	Kaminky.
2,565,790	8/1951	Van Ryan et al.
3,170,998	2/1965	Stahl.

FOREIGN PATENTS

609,680	10/1948	Great Britain.
1,358,588	3/1964	France.

OTHER REFERENCES

Wintzer, Ger., Appl. No. 1,118,310, pub. 11–61, 3 Shts., dwgs.

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