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Hoshioka

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[54] **LIGHT LOAD TYPE PUSH BUTTON SWITCH**

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[73] Assignee: **Matsushita Electric Works, Ltd.**, Osaka, Japan

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June 22, 1972 Japan 47-74213

[52] **U.S. Cl.** ..... **200/67 DA**, 200/67 D
[51] **Int. Cl.** **H01h 13/36**
[58] **Field of Search** ..... 200/67 R, 67 D, 67 DA, 200/67 DB; 74/100 P

[56] **References Cited**

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Attorney, Agent, or Firm—Wolfe, Hubbard, Leydig, Voit & Osann, Ltd.

[57] **ABSTRACT**

A light load type push-button switch comprises an actuator inserted at one end of movable-contact fixing section between fixed contacts opposing each other as secured to a housing and engaged at the other end of push-button contacting section to a push-button, said push-button contacting section having a spring section extending therefrom toward the movable contact fixing section, a supporting metal member as a common terminal and fixed to the housing so as to substantially transverse the actuator at a substantially intermediate position thereof, said spring section of the actuator being fixed to the supporting metal member at the free end of the movable-contact fixing section side, and a turning spring member, or toggle spring, engaged to the actuator for biasing the push-button contacting section thereof toward the push button.

5 Claims, 9 Drawing Figures

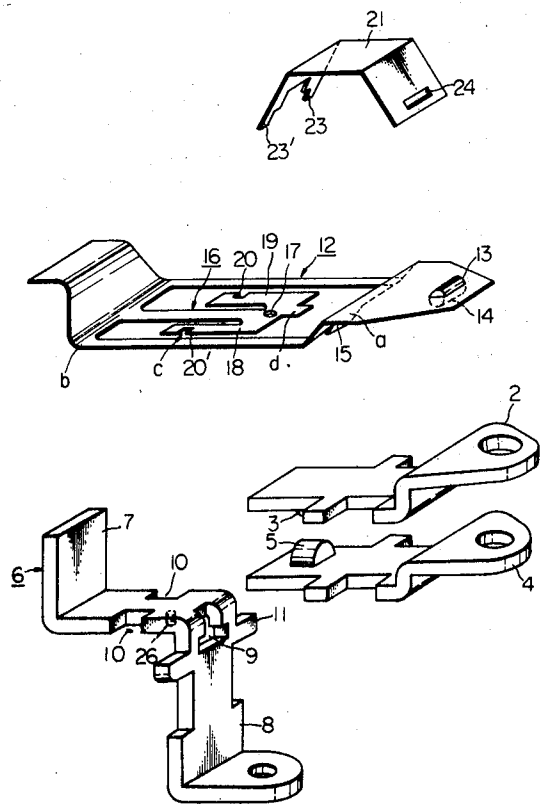


Fig. 1 (PRIOR ART)

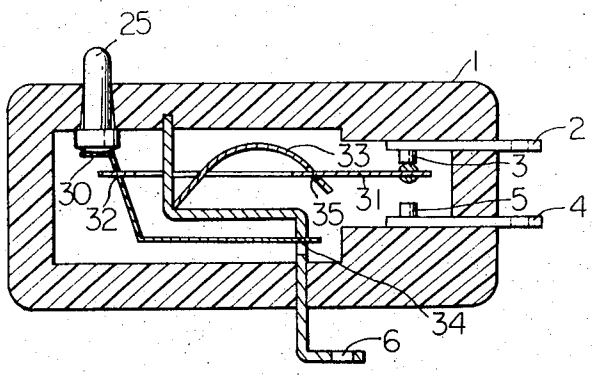


Fig. 2

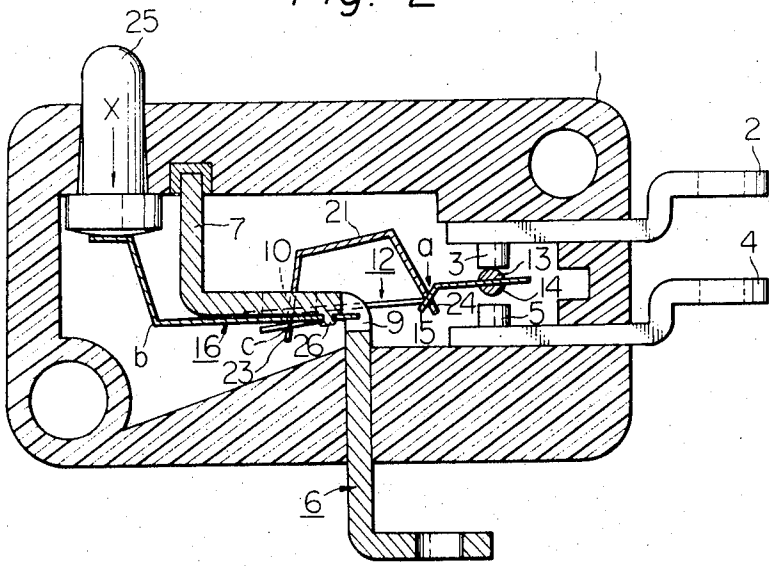


Fig. 3

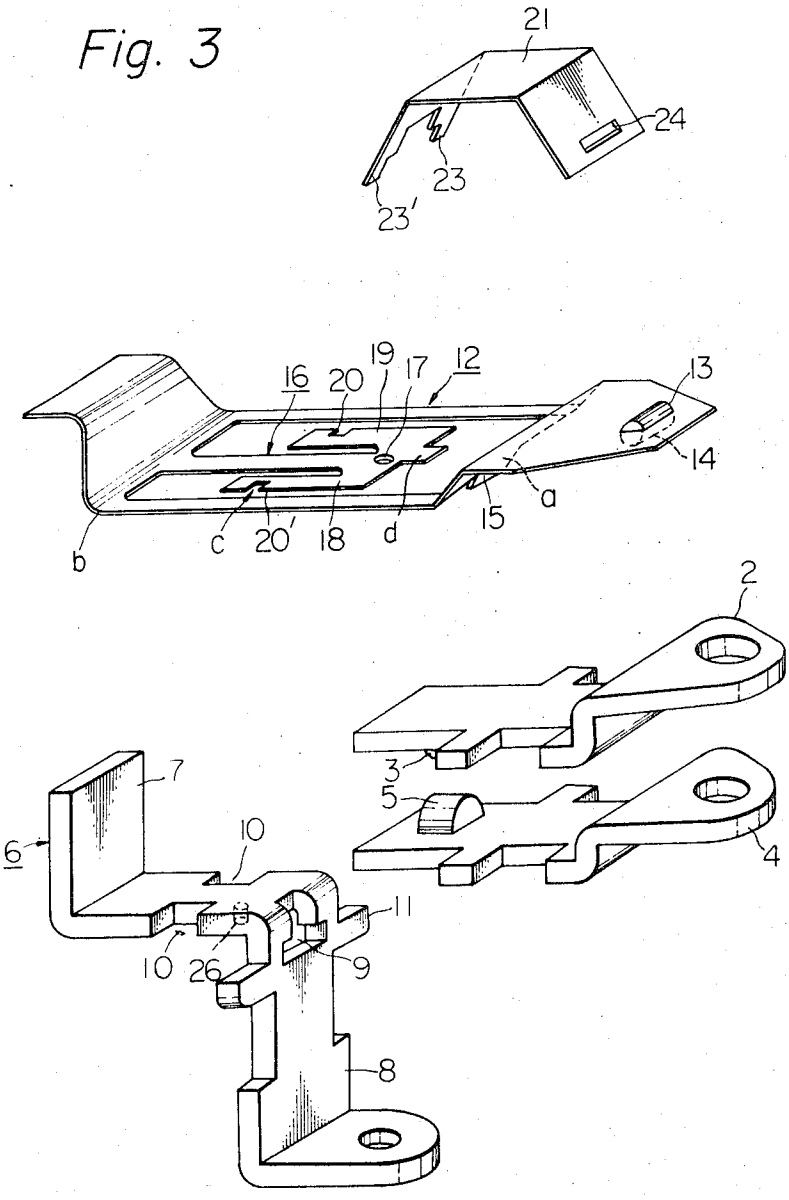


Fig. 4A

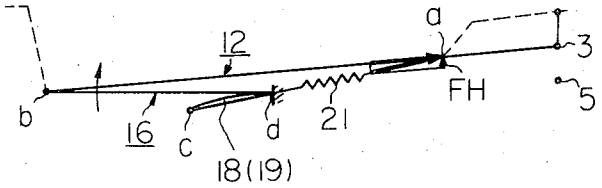


Fig. 4B

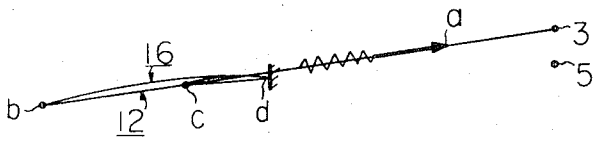


Fig. 4C

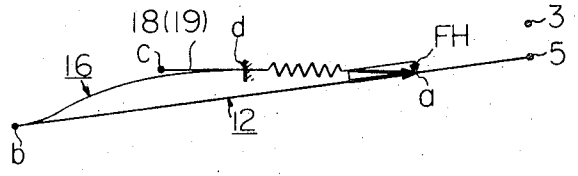


Fig. 5A

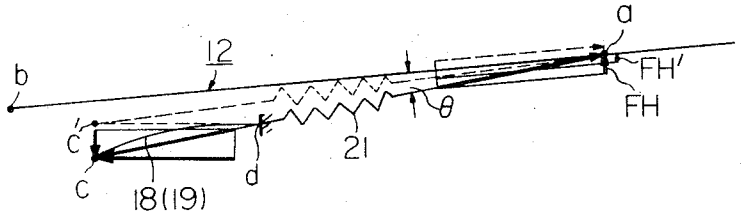


Fig. 5B

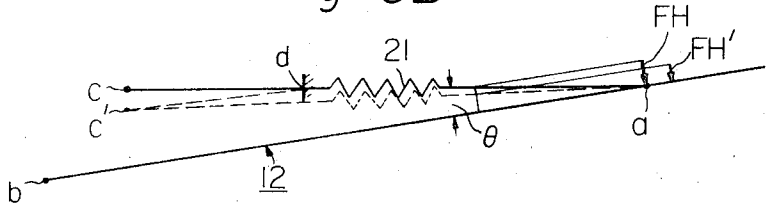
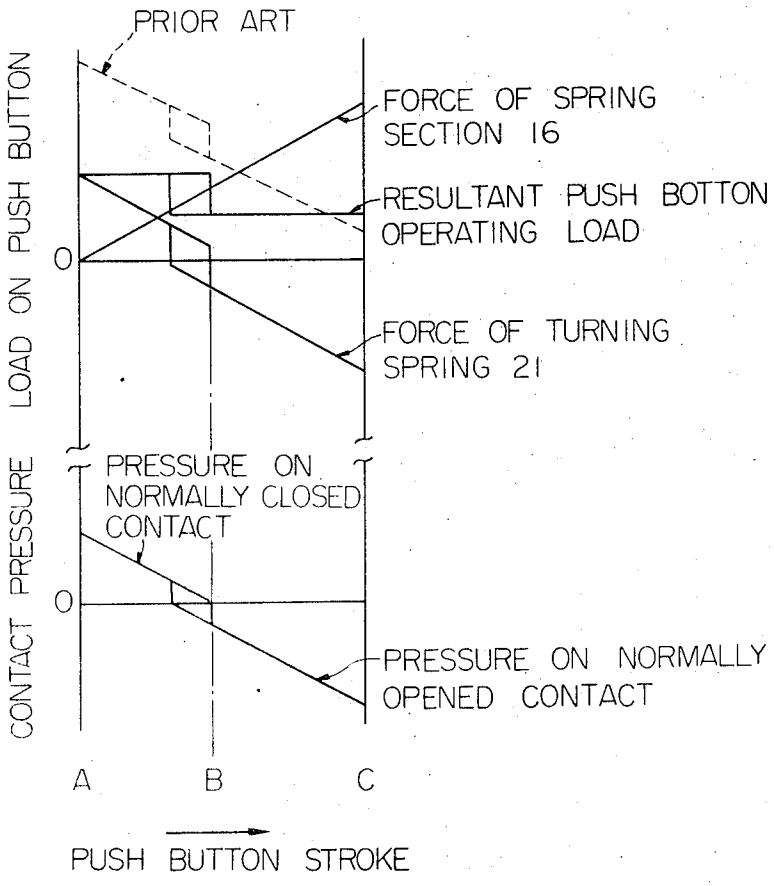


Fig. 6


PRIOR ART
FORCE OF SPRING SECTION 16
RESULTANT PUSH BOTTON OPERATING LOAD
FORCE OF TURNING SPRING 21
CONTACT PRESSURE LOAD ON PUSH BUTTON
0
PRESSURE ON NORMALLY CLOSED CONTACT
0
PRESSURE ON NORMALLY OPENED CONTACT
A
B
C
PUSH BUTTON STROKE

LIGHT LOAD TYPE PUSH BUTTON SWITCH

This invention relates to small switches and, more particularly, to a microswitch in which a high contact pressure can be obtained with a light load.

In conventional microswitches of this kind, as exemplified in FIG. 1 showing an example schematically, a handle supporting member **30** and an actuator **31** are made respectively of separate parts and, therefore, the contact at hinging points **32** and **34** has been unstable. Further, as the return motion of the actuator **31** has been performed with the force of only a turning spring **33** engaged to the actuator, no high contact pressure has been able to be obtained.

The present invention has been suggested to solve the above mentioned problems by using an actuator having a handle section and return spring section in one spring plate.

A main object of the present invention is, therefore, to provide a microswitch of a high contact pressure with a low load by using a smaller number of component parts.

Another object of the present invention is to provide a microswitch wherein the actuator is provided with a spring section so that the instability of the contact at conventional hinging points are eliminated.

A further object of the present invention is to provide a microswitch in which the mass around the contact part is small and the shock-proofness is excellent.

Now the present invention shall be explained with reference to the accompanying drawings, in which:

FIG. 1 is a schematic sectioned view of an exemplary one of conventional microswitches;

FIG. 2 is a sectioned view of a microswitch of the present invention;

FIG. 3 is a perspective view of essential parts of the microswitch of FIG. 2 as disassembled;

FIGS. 4A to 4C are diagrams showing operating states of the microswitch according to the present invention;

FIGS. 5A and 5B are diagrams for explaining the operations of the same; and

FIG. 6 shows pressing load and contact pressure curves with respect to push button stroke.

In FIGS. 2 and 3, a case or housing **1** forms a substantial body of the microswitch, to which a terminal plate **2** provided at an end with a normally closed contact **3** and another terminal plate **4** provided at an end with a normally opened contact **5** are fixed so as to extend at the respective other ends out of the housing **1** and to have the respective contacts **3** and **5** opposed to each other above and below. As a common terminal, a supporting metal member **6** bent substantially in Z-shape is fixed to the housing **1** in such that an upper part **7** is embedded in an inside wall of the housing and the other lower part **8** is extended out of the housing downward. The supporting metal member **6** is formed to have an inverted T-shaped engaging hole **9** in the bent section located substantially in the middle, a notch **10** on each side of horizontal section adjacent the bent section and a locking arm **11** projecting laterally at each side of vertical section adjacent the bent section. Inside the housing **1**, there is disposed an actuator **12**, an end of which is adapted to be a movable contact fixing section having a normally closed movable contact **13** and normally opened movable contact **14** fixed respectively to upper and lower surfaces thereof and the other L-shaped end

of which is adapted to be a push button contacting section. From this push button contacting section, as the base, a spring section **16** extends toward the movable contact fixing section. These push button contacting section and spring section **16** are forming a handle section of the actuator **12.** Further, a hole **17** is provided adjacent free end of the spring **16** at the side directed to the movable contact fixing section and extensions, or side springs, **18** and **19** are provided at both sides of the free end as branches therefrom and reverse directed to the push button contacting section side. At the respective outer sides of these extensions **18** and **19,** there are provided notches **20** and **20'**. A projection **15** is provided downward in the base part of the movable contact fixing section side. A turning spring member, or toggle spring, **21** formed in "C" shape for compressive action is separately prepared, so as to be provided with a locking extensions **23** and **23'** at one end and with an engaging slot **24** at the other end. For manually operating the actuator **12,** a push button **25** made of an insulative material is provided.

Now the assembly of the microswitch of the present invention shall be explained. The actuator **12** is fixed to the supporting metal member **6** preliminarily fixed to the housing **1,** in such manner that the hole **17** will be fitted to a stubby projection **26** provided at lower surface of the horizontal section of the supporting metal member **6,** and the projection **26** is calked to tightly secure the free end of the spring section **16.** Then, the turning spring member **21** is fitted to the actuator **12** from above in such that the engaging slot **24** of the turning spring **21** is engaged to the downward projection **15** of the actuator **12** and then the locking extensions **23** and **23'** of the turning spring **21** are respectively inserted into the notches **10** of the supporting metal member **6** and further into the notches **20** and **20'** of the extensions **18** and **19** in the spring section of the actuator **12,** so that the locking extensions **23** and **23'** of the turning spring **21** will engage in the notches **20** and **20'**, respectively. The push button **25** is slidably disposed so as to be in contact with the other end of the actuator **12,** that is, the push button contacting section.

The operation shall be explained in the following with reference to FIGS. 4A to 4C. In the drawings, notations *a*, *b*, *c*, and *d* are used for representations of the following points. That is, the point *a* represents a point of engagement of the projection **15** of the actuator **12** with the turning spring **21** at the engaging slot **24.** The point *b* represents a point on the actuator **12** at which the operating load from the push button **25** is received at the other end of the actuator. The point *c* represents a point of engagement of the locking extensions **23** and **23'** of the turning spring **21** with the extensions **18** and **19** at their notches **20** and **20'** in the spring section **16** of the actuator **12.** The point *d* represents the fixing point at which the spring section **16** of the actuator **12** is fixed by means of the projection **26** of the supporting metal member **6** through the hole **17** in th spring section **16** of the actuator **12.**

In the actuator arrangement as above, the respective points *a*, *b*, *c* and *d* are positioned under normal or non-actuated condition, substantially in the same plane, and the points c and *d* will keep their relative positions which are shifted slightly up and down with respect to the part $\overline{ab}$ of the actuator **12** which is moved up and down depending on a stroke of the point *b* given by the

actuated push button **25.** Further, the spring section **16** between the points *b* and *d* acts as a return spring for the actuator **12** since the point *d* is a fixed point.

In the state where the push button is not pushed (FIG. 4A), the point *b* is at the uppermost position and the point *c* remains in its position below $\overline{ab}$. Therefore, an upward component force FH due to the turning spring **21** will be added to the contact pressure directed to the normally closed fixed contact **3,** whereby the normally closed movable contact **13** will be additionally urged into contact with the fixed contact **3.**

Further in this state, the point *d* is positioned below $\overline{ab}$ and, therefore, the handle section of the actuator **12** is subjected to an upward moment caused by a component force in the direction of $\overline{ab}$ due to the turning spring **21** (the state corresponds the push button stroke point A in FIG. **6**). At this time, the returning force of the spring section **16** itself will be zero.

When the push button is gradually pushed until $\overline{ab}$ reached the point *c*, as shown in FIG. **4B**, the component force relating to the contact pressure due to the turning spring **21** will vanish, the contact pressure of the normally closed movable contact **13** against the normally closed fixed contact **3** will become zero and thus the actuator **12** enters into the state immediately before the turning or switching movement.

On the other hand, in this state, the point *d* is still positioned below $\overline{ab}$ and the moment to which the handle or spring section **16** is subjected due to the turning spring **21** will remain but with a reduced amount.

At this time, however, the returning force of the spring section **16** itself will increase and the resultant force (the curve of which is represented in FIG. **6** as the resultant push button operating load) of both the moment to which the handle or spring section **16** is subjected due to the turning spring **21** and the returning force of the spring section **16** itself substantially will not vary (the state corresponds to the stroke point B in FIG. **6**).

Next, when the push button is further pushed downward from the above mentioned state and $\overline{ab}$ passes through the point *c* so as to be shifted below it, as shown in FIG. **4C**, the component force FH in the direction relating to the contact pressure due to the turning spring **21** will be directed downward in this state, so that the normally opened movable contact **14** will be brought into resilient contact with the normally opened fixed contact **5.**

In this state, further, the point *d* will be positioned above $\overline{ab}$. In such case, the spring section **16** will be subjected to a downward moment by the turning spring **21** but the returning force of the spring section **16** itself will further increase and, therefore, the resultant push button operating load due to the return spring moment and the spring section returning force will be maintained at a value larger than zero (the state corresponds to the stroke point C in FIG. **6**).

On the other hand, in the conventional switches as exemplified in FIG. **1,** the returning force of the actuator depends solely on the turning spring **33** and, therefore, the required returning force becomes excessive as shown by a broken lines in FIG. **6** in order to provide a self-returning type switch and, on the other hand, the contact pressure becomes a smaller value comparing with the required push button operating load.

Now, the action of the extensions **18** and **19** of the spring section **16** in the actuator **12,** that is, the spring force caused by the part $\overline{cd}$ shall be explained with reference to FIG. **5A** and **5B.**

In the drawings, the arrangement in general conventional switch is represented by broken lines and with dashed notations, and the arrangement according to the present invention is represented by solid lines and with non-dashed notations.

In the switch according to the present invention, the engaging point *c* of the turning spring **21** and actuator **12** is disposed in the free end part of the extensions **18** and **19** extending from the fixed point *d* and the extensions **18** and **19** will flex to move the engaging point *c* in the direction of enlarging the angle θ defined by the actuator **12** and the force line direction of the turning spring **21,** due to the spring force of the turning spring **21.** Therefore, the component force FH relating to the contact pressure will be increased to be larger than FH′ in the case of the prior art, that is, the contact pressure will be increase by FH–FH′.

This action is performed in both states of the actuator in which the same is in the normally closed contact side (FIG. **5A**) and in the normally opened contact side (FIG. **5B**), so that the contact pressures on both the normally closed side and normally opened side will be increased in the same manner.

The operation of the switch described above may be summarized as follows: The point of support **26** is intentionally non-symmetrical with respect to the two contacts and the handle portion b is similarly offset with respect to the contacts so that the "toggle angle" is inclined upwardly to cause the contact section to bear against the upper one of the contacts as shown in FIG. **2.**

However, when the push button is depressed, flexure takes place in the central spring and the two side members of the actuator spring move bodily downward thereby reversing the toggle angle so it has a downward slant, or component, thereby bringing the contact section into engagement with the lower contact. Because of the support provided at **17** and the presence of the auxiliary spring member **18, 19** the actuating force, as stated above, is much less than that usually required in a switch of comparable current carrying capacity. Releasing the push button enables the mechanism to restore itself to the condition shown in FIG. **2.**

While the invention has been described in connection with a single-pole, double-throw switching function, it will be apparent that one of the main purposes of the elements **3, 5** is to serve as limit stops, and only one of such elements need be an electrical contact.

What is claimed is:

1. A small switch comprising a housing, a push button mounted therein, an actuator in the form of a leaf spring having a push button contacting section and a movable contact section at respective ends, said push button contacting section being provided with a spring section branched from the contacting section as a base and having a free end extending toward said movable contact section, a supporting metal member fixed within said housing, said actuator being fixed at said free end of the spring section to said supporting member, a turning spring member engaged with the actuator, movable contacts fixed to the contact section of the actuator, a normally closed fixed contact and normally open fixed contact mounted in the housing and opposed respectively to said movable contacts, the turning spring being interposed between the contact

section of the actuator and a receiving part on the spring section of the actuator, the turning spring receiving part comprising an extension of the spring section of the actuator, said extension being branched from the free end of said spring section and directed toward the push button contacting section of the actuator.

2. A small switch of the micro type comprising. in combination, an actuator in the form of a generally flat leaf spring having a handle section at one end and a contact section at the other, the sections being interconnected by spaced integral side members defining a central space, the actuator having an integral central spring in the central space extending from the handle section, a housing, a supporting member centrally positioned in the housing, the end of the central spring being secured to the supporting member, the housing providing closely spaced stops for limiting movement of the contact section in both directions, at least one of the stops being in the form of an electrical contact, a toggle spring member of C shape having one end engaged with the central spring and the other end engaged with the contact section so that force applied to the handle section moves the toggle spring over center for snapping of the contact section between its alternate positions.

3. The combination as claimed in claim **2** in which the supporting member is located at a level which is non-symmetrical with respect to the stops to establish a normal toggle angle causing the contact section to noramlly contact one of the stops and in which a push button is provided for pressing on the handle section to reverse the toggle angle for throwing of the contact section to its alternate stopped position.

4. The combination as claimed in claim **2** in which the central spring includes auxiliary leaf springs extending toward the handle section from adjacent the region of support, one end of the toggle spring engaging the ends of the auxiliary springs.

5. A small switch of the micro type comprising, in combination, an actuator in the form of a generally flat leaf spring having a handle section at one end and a contact section at the other, the sections being interconnected by spaced integral side members defining a central space, the actuator having a central leaf spring in the central space which extends from, and forms a continuation of, the handle section, a housing, a supporting member centrally positioned in the housing, the supporting member being secured to the end of the central spring, the housing providing closely spaced stops for limiting movement of the contact section in both directions, at least one of the stops being in the form of an electrical contact, the central spring having an integral extension extending reversely toward the handle section, a toggle spring member of C shape having one end engaged with the extension on the central spring and the other end engaged with the contact section, the support and the handle portions both being located non-symmetrically with respect to the stops so that the contact section normally bears against one of the stops to establish a normal toggle angle, and means for operating the handle member to reverse the toggle angle to throw the contact section to the alternate stop.

* * * * *