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(54) Electric switch

(57) A snap-action electric switch includes a housing (2) containing a snap-action mechanism (16) movable by a plunger (22) between a rest position and a displaced position, the snap-action mechanism (16) comprising a thin leaf spring with three parallel legs (28,30,32) the integral one ends of which constitute a contact member, at least one of said legs (28) being longitudinally stressed such that, on movement of the unstressed leg or legs (30,32) beyond an overcentre position by the plunger (22), the contact member snaps from its rest position to its displaced position. The other end of the or each unstressed leg (30,32) is mounted to be movable with the plunger (22) whereby, on guided linear movement of the plunger (22) within the housing (2), the other end of the or each unstressed leg (30,32) is moved bodily with the plunger (22) to achieve said overcentre position of said unstressed leg or legs (30,32).

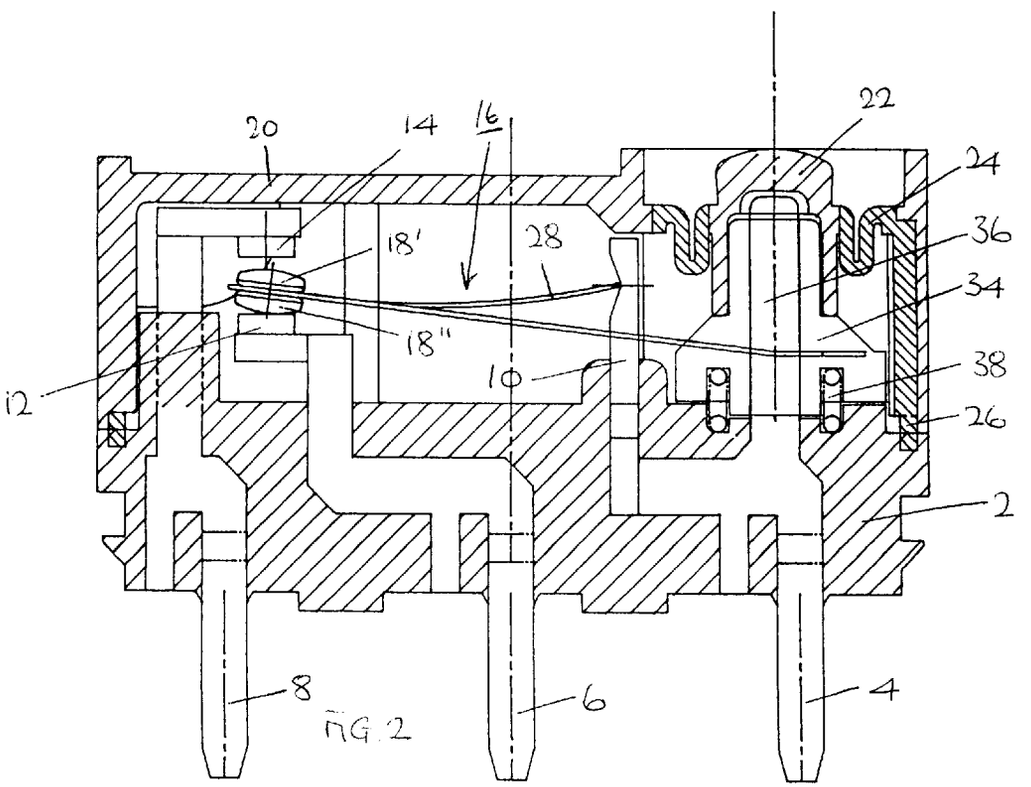

FIG. 2

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Description

This invention relates to electric switches, and more particularly to snap-action electric switches.

It is well-established practice, for example as disclosed in US-A-2533671, to provide electric switches incorporating overcentre or snap-action leaf spring mechanisms which, on depression of an associated plunger, are moved from a first stable position to a second stable position such that an electric contact member of the mechanism, on said movement, alters the electrical condition of an associated circuit.

The snap-action mechanism commonly comprises a thin leaf spring having three parallel legs. In one arrangement the centre leg is longitudinally stressed, the free rear end thereof being urged into pivotal engagement with a fixed anchor member. The rear ends of the two outer legs are fixed against upward and downward movement, while the fronts of the three legs are integral with one another and carry upper and lower contact members.

On depression of the plunger, said plunger engages the outer legs at points intermediate the fixed anchor member and the rear of the spring, continued depression of the plunger moving the outer legs downwardly below the line of action between the free end of the centre leg and the contact members whereby snap-action of the contact members from an upper position to a lower position occurs to alter the conditions of associated electric circuits.

On release of the plunger, the inherent resilience of the spring returns the spring and the plunger from their displaced positions back to their rest positions.

In a further arrangement, the outer two legs of the leaf spring are longitudinally stressed with the free rear ends thereof being urged into pivotal engagement with a fixed anchor member. The rear end of the centre leg is fixed against upward and downward movement, and again the front ends of the three legs are integral with one another and carry upper and lower contact members.

Actuation of the mechanism is achieved substantially as detailed above, except that the plunger engages the centre leg which is displaced downwardly relative to the two outer legs until snap-action occurs.

The plunger is conventionally guided by co-operation with the housing for axial sliding movement therein, for example by a co-operating tongue and groove arrangement, and actuation of the snap-action mechanism occurs when the plunger reaches a precise and predetermined axially displaced position within the housing.

It is established practice to incorporate a small degree of overtravel of the plunger within the housing beyond the point at which snap-action occurs, primarily to allow for tolerances in the mechanism operating the plunger. The absence of such overtravel could result in damage to or breakage of the snap-action mechanism if the plunger was depressed beyond the point at which snap-action occurred.

The invention is particularly concerned with the problem of overtravel in very small, so-called ultraminiature switches where space is at a premium.

Conventionally, such ultraminiature switches have overtravel of the order of 0.2 mm which is often not sufficient to accommodate the tolerances that can occur in the associated operating mechanisms.

Although there are designs available that provide longer overtravel, these rely upon internal magnification of the mechanism by means of various lever-type arrangements which invariably involve additional components within the housing. Additionally, the aforementioned leaf spring arrangements are only capable of producing very limited movement before overstressing occurs.

It would be desirable to be able to provide an electric switch, in particular an ultraminiature electric switch, including a snap-action mechanism of the aforementioned leaf spring type and capable of accommodating longer overtravel than heretofore in a relatively simple and economical manner without the necessity for substantial additional components to be incorporated in the switch.

According to the present invention there is provided a snap-action electric switch including a housing, an operating plunger linearly movable relative to said housing, and a snap-action mechanism movable by said plunger between a rest position and a displaced position, the mechanism comprising a thin leaf spring having three substantially parallel legs the integral one ends of which constitute a contact member, at least one of said legs being longitudinally stressed such that, on movement of the or each unstressed leg beyond an overcentre position by the plunger, the contact member snaps from its rest position to a displaced position, characterised in that the other end of the or each unstressed leg is mounted to be movable with the operating plunger such that said overcentre position of the or each unstressed leg is achieved by bodily movement of the other end of the or each unstressed leg from a rest position to a displaced position, the plunger co-operating with guide means within the housing to ensure linear movement of the plunger and the other end of the or each unstressed leg.

Thus it will be appreciated that such an arrangement enables substantially unrestricted linear movement of the complete rear end of the leaf spring whereby said spring can be moved beyond the point of snap-action without overstressing of the mechanism, and such as to provide increased overtravel - typically 1.3 mm in an overall travel of 2.0 mm.

Conveniently the switch further includes resilient means, for example a compression spring, reacting between the operating plunger and the housing to urge the operating plunger towards its rest position.

The mechanisms associated with depression of the

operating plunger of snap-action electric switches commonly comprise linear or rotary cams, levers and the like which apply substantial side loads to the plunger. The guide means within the housing must therefore be such as to be capable of withstanding these substantial side loads.

In one embodiment of the invention, the electric switch includes a hollow operating plunger and the guide means comprises a fixed pin member upstanding within the housing, the operating plunger being located on, for guided movement along, said pin member.

Conveniently the electric switch includes an anchor terminal fixedly mounted therein, said terminal having an anchor portion within the housing against which the free end of the or each stressed leg of the leaf spring is urged for pivotal engagement therewith, and a terminal portion projecting from the housing, the pin member being integrally formed with said anchor terminal.

In such an embodiment, the operating plunger may comprise a plunger portion one end extent of which projects from the housing and in the hollow other end extent of which is fixedly received a hollow sleeve portion, said sleeve portion being located on, for guided linear movement along, said pin member.

Preferably the sleeve portion is an interference fit within the hollow other end extent of the plunger portion.

In an alternative embodiment of the invention, the guide means may comprise one or more walls upstanding within the housing and integrally formed therewith to define a hollow interior to receive therein said plunger.

In such an embodiment, the operating plunger may comprise a plunger portion one end extent of which projects from the housing, the other end extent of which is fixedly located within a hollow sleeve portion, said sleeve portion being located in, for guided linear movement along, the hollow interior of the guide means.

Preferably the other end extent of the plunger portion is an interference fit within the sleeve portion.

By way of examples only, embodiments of the invention will now be described in greater detail with reference to the accompanying drawings of which:

Figs. 1 and 2 are vertical sections through a first electric switch according to the invention with the operating plunger and the snap-action mechanism in their rest positions and their displaced positions respectively;

Fig. 3 is a plan view of the switch of Fig. 1 with the lid portion of the housing removed;

Figs. 4 and 5 are vertical sections through a second electric switch according to the invention with the operating plunger and the snap-action mechanism in their rest positions and their displaced positions respectively, and

Fig. 6 is a plan view of the switch of Fig. 4 with the lid portion of the housing removed.

Referring to Figs 1 to 3 of the drawings, the illustrated switch is of relatively conventional construction in its lower and intermediate regions, comprising a moulded base portion 2, typically of glass-filled polyamide, in which are encapsulated an anchor terminal 4, a bottom contact terminal 6 and a top contact terminal 8, said terminals respectively including, above the base portion 2, an anchor portion 10, a bottom contact 12 and a top contact 14.

The anchor portion 10 has a notched face for the mounting thereto of a snap-action mechanism indicated generally at 16 and which will be described in more detail below but which includes contact members 18', 18" movable between a first position engaging the contact 14 and a second position engaging the contact 12 thereby to alter the electrical condition of the switch.

The body of the switch is completed by a lid portion 20 manufactured in accordance with the method detailed in our European patent application no. 93309160.5.

More particularly the lid portion 20 is injection moulded from a glass-filled polyamide and includes an aperture therethrough in which is located an operating plunger 22 of the same material. A flexible cowl 24, typically of a thermoplastic elastomer, surrounds the plunger 22 and is integrally bonded to both the plunger 22 and the defining edge of the aperture in the lid portion 20 to effect a seal between the plunger 22 and the lid portion 20 whilst permitting upward and downward movement of the plunger 22 relative to the lid portion 20 between the positions shown in Figs. 1 and 2.

A peripheral seal 26 extends around the bottom edge of the lid portion 20 to react between the lid portion 20 and the base portion 2, the seal 26 being of the same thermoplastic elastomer material as the cowl 24, being integrally moulded with said cowl 24 and being integrally bonded to the lower edge of the lid portion 20 to provide a sealed housing for the switch.

It will be appreciated that the lid portion 20, the plunger 22, the cowl 24 and the peripheral seal 26 constitute a single component, thus facilitating handling and assembly of the switch.

The snap-action mechanism 16 comprises a thin leaf spring including three parallel legs 28, 30, 32 the rear ends of the outer ones 30, 32 of which are interconnected as seen in dotted lines in Fig. 3.

The central leg 28 has a free rear end, while the front ends of all three legs are integral with each other and carry upper and lower contact members 18', 18".

The aforementioned plunger 22 includes a hollow inner member 34 which is an interference fit in the hollow interior of said plunger 22 to be movable therewith, while an upstanding guide pin 36 is integrally formed with the anchor terminal 4 within the housing to receive thereon the inner member 34, linear movement of the plunger 22 and the inner member 34 as a unit between their rest and displaced positions therefore being positively guided by said guide pin 36.

A compression spring 38 reacts between the base

portion 2 of the housing and the undersurface of the inner member 34 to bias the plunger 22 towards its rest position shown in Fig. 1.

The interconnected rear ends of the legs 30, 32 are fixedly secured to the inner member 34 by means of overmoulding the inner member 34 onto said rear ends of the legs 30,32, thereby combining these two components into a single component for ease of handling.

Alternatively the interconnected rear ends of the legs 30,32 may be received in a groove or the like formed in the inner member 34 to be pivotally mounted on side member 34.

The free end of the central leg 28 is urged into pivotal engagement with the notch in the face of the anchor portion 10 of the anchor terminal 4 whereby said central leg 28 is longitudinally stressed as shown in Fig. 1.

With the plunger 22 and the inner member 34 urged by the spring 38 into their rest positions shown in Fig. 1, the snap-action mechanism is such as to adopt the first stable position shown in Fig. 1 in which the contact member 18' engages the top contact 14 thereby completing the electric circuit between terminals 4 and 8.

On downward linear movement of the plunger 22 and the inner member 34 against the bias of the spring 38, and guided by the pin member 36, the interconnected rear ends of the legs 30, 32 are moved bodily downwards until the overcentre position of the mechanism is reached, at which point the contacts 18', 18" are moved under the influence of the stressed central leg 28 to the second stable position shown in Fig. 2 in which contact 18" engages bottom contact 12 to complete the electrical circuit between terminals 6 and 8.

It will be appreciated that, unlike conventional snap-action mechanisms in which the rear end/ends of the unstressed leg or legs are prevented from moving downwardly, the bodily linear movement of the complete rear end of the leaf spring as detailed above enables substantial movement to be effected without overstressing of the mechanism, and whereby significant overtravel beyond the point of snap-action can be accommodated without damage to or breakage of the mechanism. Fig. 2 illustrates the position of the plunger 22 after maximum overtravel - in the case of a sealed ultraminiature switch the plunger of which can move 2.0 mm, overtravel may be 1.3 mm.

It will also be appreciated that the provision of a metal guide pin 36 within the housing for guiding the downward linear movement of the plunger 22 enables the switch to withstand substantial side loads typically applied to the plunger 22 by actuating mechanisms in the form of linear or rotary cams and the like.

These actuating mechanisms can be such as to impose side loads on the plunger which are of sufficiently high values that guide pins such as 36 in Fig. 1 to 3 are unable to withstand the forces thereon.

Figs. 4 to 6 illustrate an alternative switch to that of Figs. 1 to 3 and incorporating a plunger guide arrangement capable of withstanding these higher forces.

The basic construction of the switch of Figs. 4 to 6 and the operation thereof are fundamentally the same as those of the switch of Figs. 1 to 3, and equivalent parts in the two embodiments are similarly referenced.

However, the plunger 22, inner member 34 and guide pin 36 are replaced by an alternative arrangement.

More particularly, the anchor terminal 4 does not include a guide pin integrally formed therewith. Instead, upstanding support walls 40,42 are integrally formed within the housing to define a substantially cylindrical interior thereto to guide the plunger arrangement as will be detailed below.

The wall 40 is of generally semi-circular transverse section, while the wall 42 is of arcuate cross-section as best seen in Fig. 6 whereby there are two slots between the walls 40 and 42 for passage therethrough of the legs 30,32 of the leaf spring.

The operating plunger 22 includes a downwardly depending pin portion 44 which is an interference fit in the hollow interior of a sleeve portion 46 which is shaped to be a close sliding fit in the hollow interior defined by the walls 40,42. The rear ends of the legs 30,32 are fixedly secured to the sleeve portion 46 by means of overmoulding, thereby integrating the leaf spring 16 and the sleeve portion 46 for ease of handling.

Alternatively the interconnected rear ends of the legs 30,32 may be received in a groove or the like formed in the sleeve portion 46 to be pivotally mounted on said sleeve portion 46.

Thus it will be appreciated that any non-axial forces applied to the plunger 22 by external actuating mechanisms are absorbed by the support walls 40,42, which further ensure that the plunger 22 and sleeve portion 46 undergo the desired sliding linear movement within the housing 2 to actuate the snap action mechanism 16. In this respect, it will be noted that the wall 42 is itself reinforced by the anchor portion 10 of the terminal 4.

Clearly the precise construction of the switch can vary from those described and illustrated without departing from the scope of the invention. For example the two outer legs of the leaf spring may be stressed with the rear end of the central leg attached to, to be moved by, the plunger 22/inner member 34, while, in the embodiment of Figs. 1 to 3, the guide pin 36 may be other than part of the anchor terminal 4, and may be of plastic or other suitable material. Other modifications and variations will be apparent to those skilled in the art.

Claims

1. A snap-action electric switch including a housing (2,20), an operating plunger (22)movable relative to said housing (2,20), and a snap-action mechanism (16) movable by said plunger (22) between a rest position and a displaced position, the mechanism comprising a thin leaf spring having three substan-

tially parallel legs (28,30,32) the integral one ends of which constitute a contact member, at least one of said legs (28) being longitudinally stressed such that, on movement of the or each unstressed leg (30,32) beyond an overcentre position by the plunger (22), the contact member snaps from its rest position to a displaced position, characterised in that the other end of the or each unstressed leg (30,32) is mounted to be movable with the operating plunger (22) such that said overcentre position of the or each unstressed leg (30,32) is achieved by bodily movement of the other end of the or each unstressed leg (30,32) leg from a rest position to a displaced position, the plunger (22) co-operating with guide means (36) within the housing (2,20) to ensure linear movement of the plunger (22) and the other end of the or each unstressed leg (30,32).

2. A switch as claimed in claim 1 and further including resilient means (38) reacting between the operating plunger (22) and the housing (2,20) to urge the operating plunger (22) towards its rest position.

3. A switch as claimed in claim 2 in which the resilient means comprises a compression spring (38).

4. A switch as claimed in any one of claims 1 to 3 and including a hollow operating plunger (22,34), the guide means comprising a fixed pin member (36) upstanding within the housing (2,20), the operating plunger (22,34) being located on, for guided movement along, said pin member (36).

5. A switch as claimed in claim 4 and including an anchor terminal (4) fixedly mounted therein, said terminal (4) having an anchor portion (10) within the housing (2,20) against which the free end of the or each stressed leg (28) of the leaf spring is urged for pivotal engagement therewith, and a terminal portion projecting from the housing, the pin member (36) being integrally formed with said anchor terminal.

6. A switch as claimed in claim 4 or claim 5 in which the operating plunger comprises a plunger portion (22) one end extent of which projects from the housing (2,20) and in the hollow other end extent of which is fixedly received a hollow sleeve portion (34), said sleeve portion (34) being located on, for guided linear movement along, said pin member (36).

7. A switch as claimed in claim 6 in which the sleeve portion (34) is an interference fit within the hollow other end extent of the plunger portion (22).

8. A switch as claimed in any one of claims 1 to 3 in which the guide means comprise one or more support walls (40,42) upstanding within the housing (2,20) and integrally formed therewith to define a hollow interior to receive therein and guide said plunger (22).

9. A switch as claimed in claim 8 in which the plunger comprises a plunger portion (22) one end extent of which projects from the housing (2,20), the other end extent (44) of which is fixedly located within a hollow sleeve portion (46), said sleeve portion (46) being located in, for guided linear movement along, the hollow interior of the support walls (40,42).

10. A switch as claimed in claim 9 in which the other end extent (44) of the plunger portion (22) is an interference fit within the sleeve portion (46.)

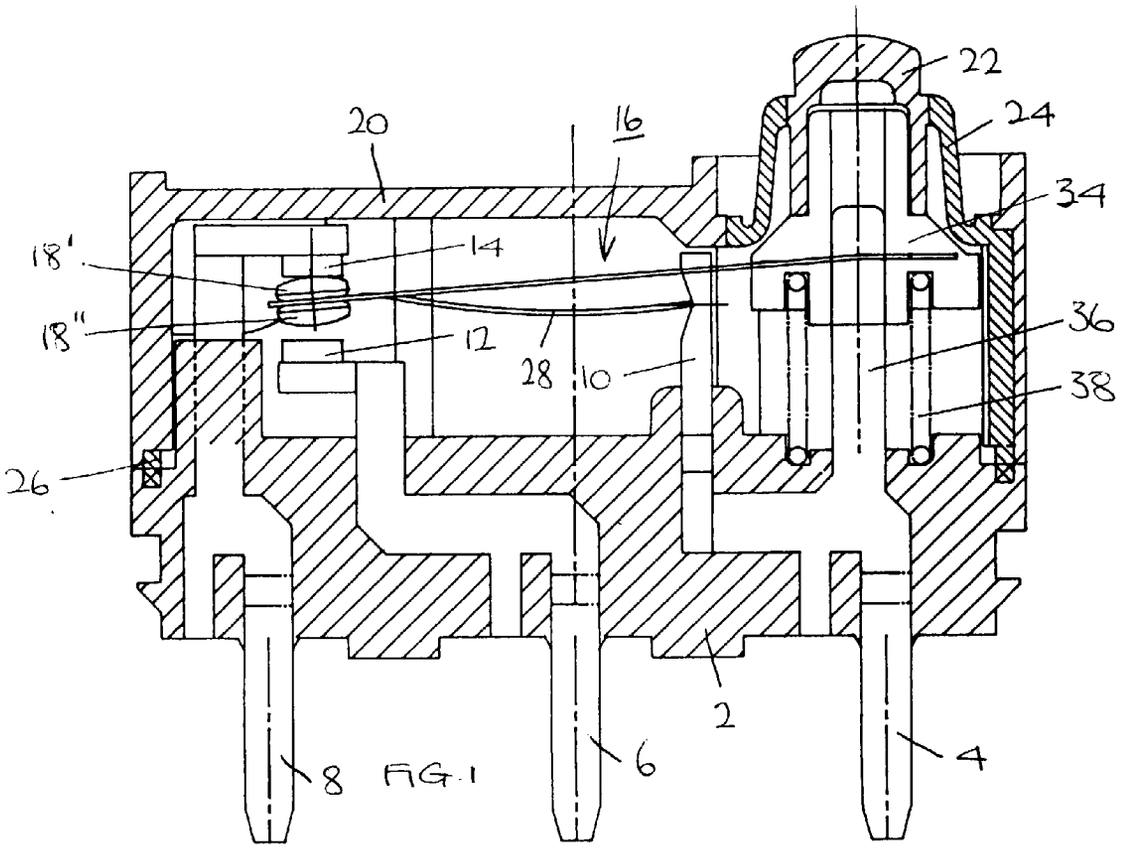
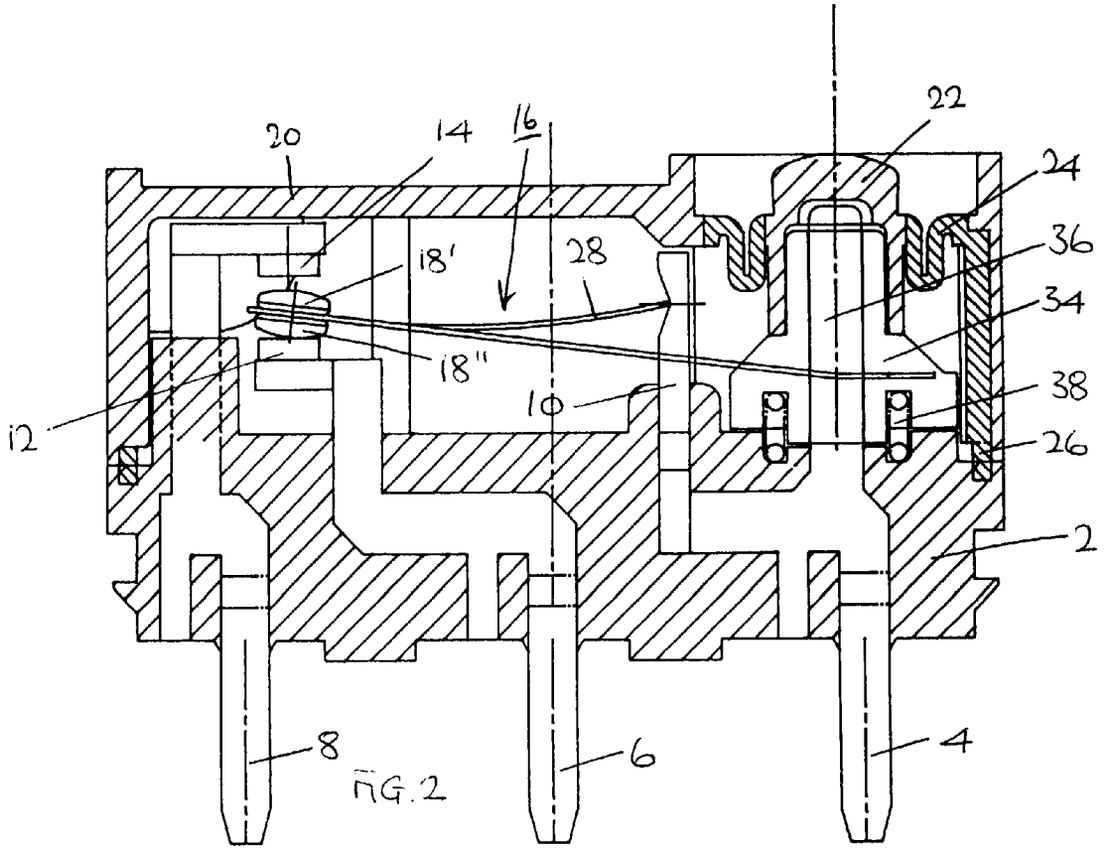

22
20
16
24
34
18'
14
18"
12
28
10
36
38
26
2
8
6
4

FIG.1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34
18"
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FIG.2

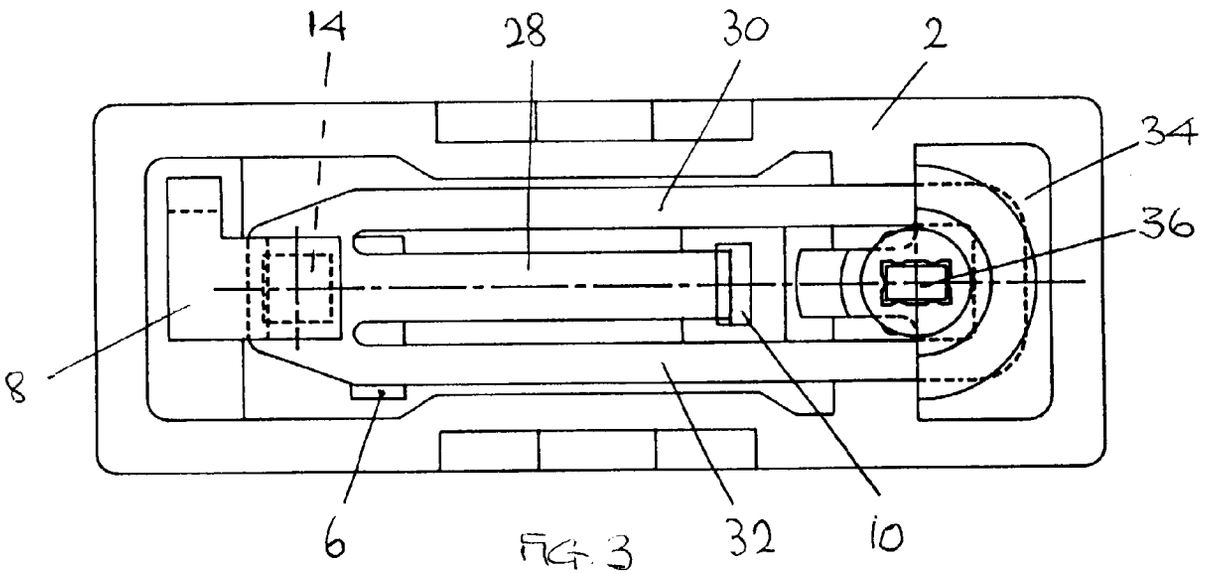
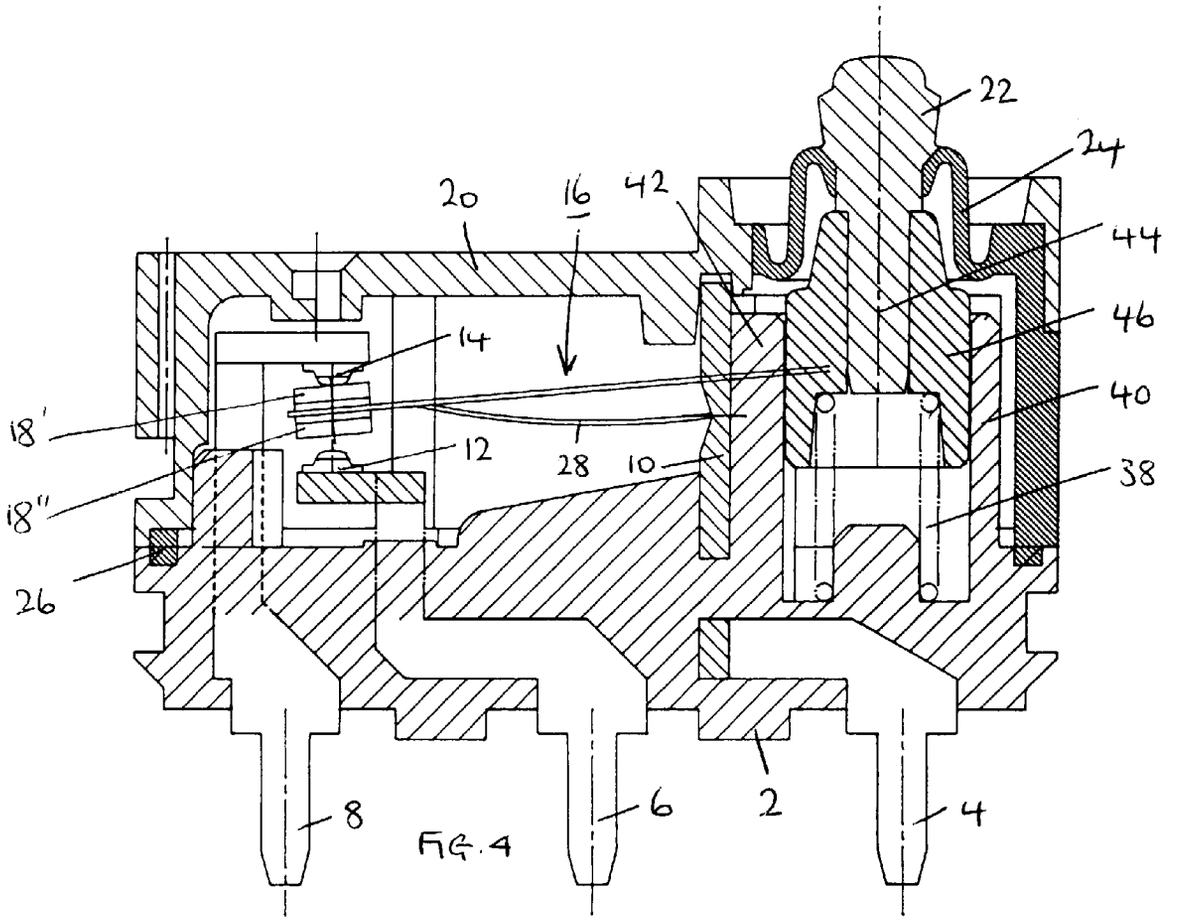


FIG. 3


22
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20
16
42
44
14
46
18'
40
12
28
10
38
18"
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2
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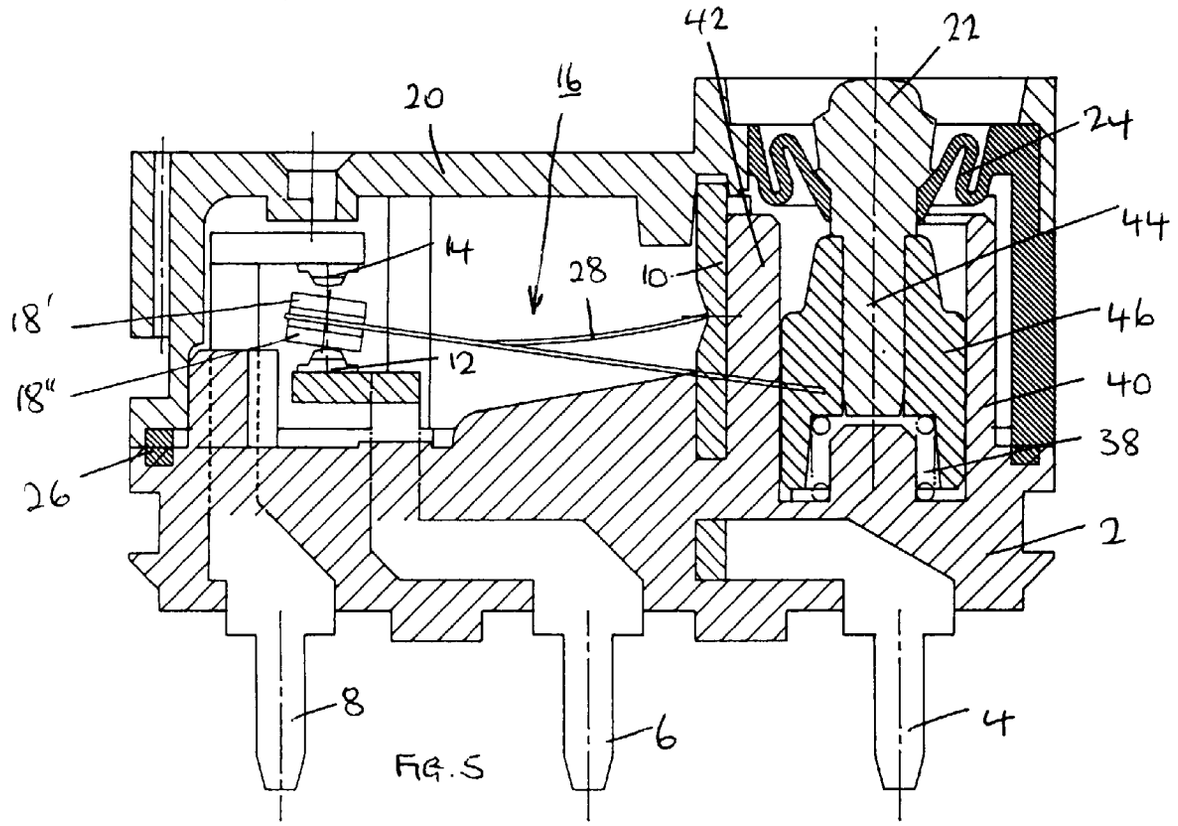
FIG.4


42
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16
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44
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18'
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18"
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FIG.5

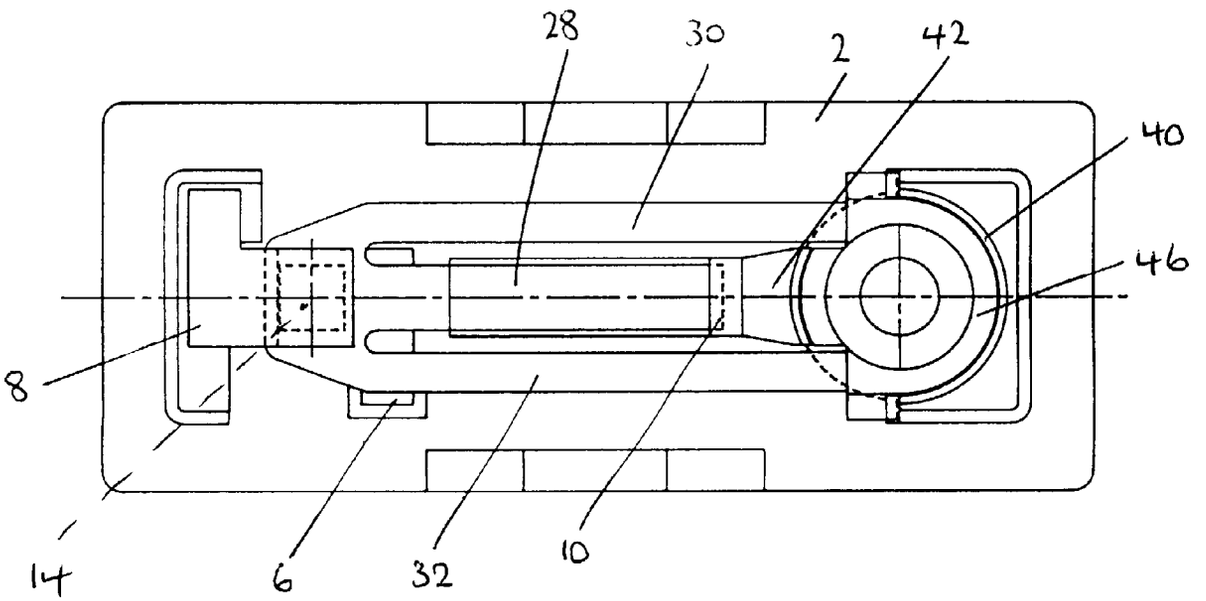

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 0686

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	US 2 533 671 A (THE ACRO MANUFACTURING CO.) 12 December 1950 * column 2, line 42 - column 3, line 16; figures 2,5 *	1	H01H13/36
A	CH 453 461 A (FIRMA GUSTAV SIERSIEPEN) 14 June 1968 * column 3, line 4 - line 18; figure 5 *	1,5	
A	US 2 479 313 A (GEC) 16 August 1949 * figure 1 *	2-4	
A	US 3 336 449 A (PLESSEY-UK LIMITED) 15 August 1967 * column 2, line 15 - column 3, line 47; figures *	1,5	
A	DE 18 79 992 U (GEBR. VEDDER GMBH) 23 October 1963 * figures *	1,2,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 April 1997	Janssens De Vroom, P

CATEGORY OF CITED DOCUMENTS

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