Nov. 15, 1966 D. D. CAMPBELL ET AL 3,286,050

SNAP ACTION, DOUBLE THROW SWITCH

Filed Oct. 21, 1964 2 Sheets-Sheet 1

Fig. 1

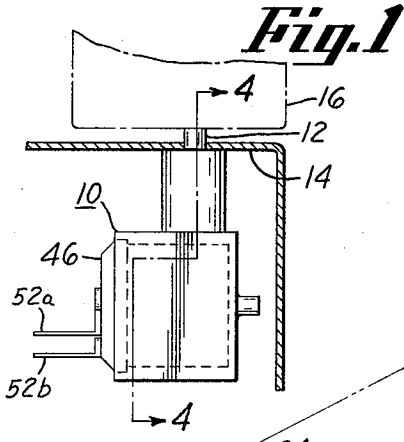
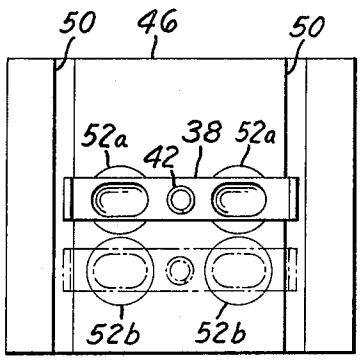


Fig. 2

Fig. 4

Fig. 3



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Fig. 5

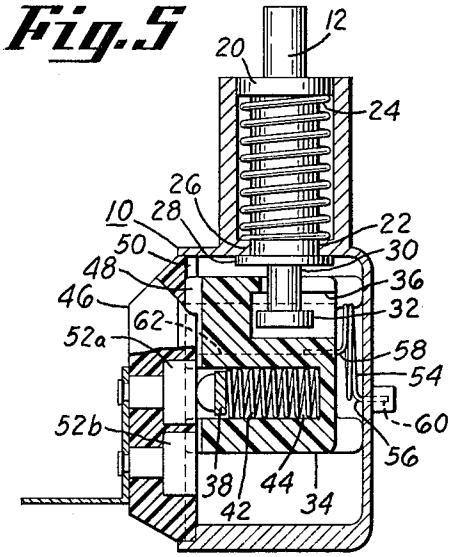


Fig. 6

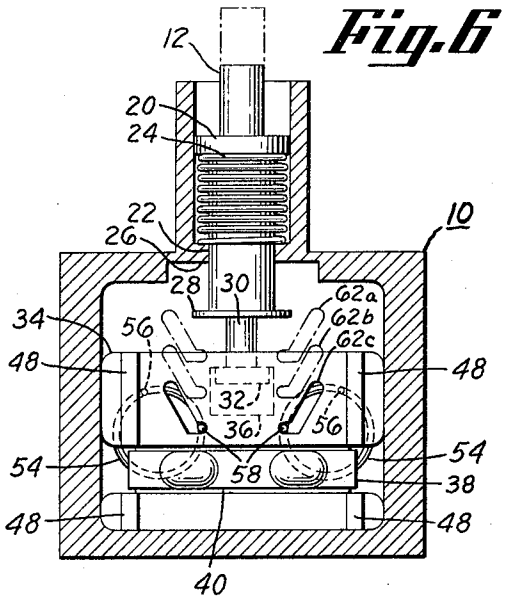


Fig. 7

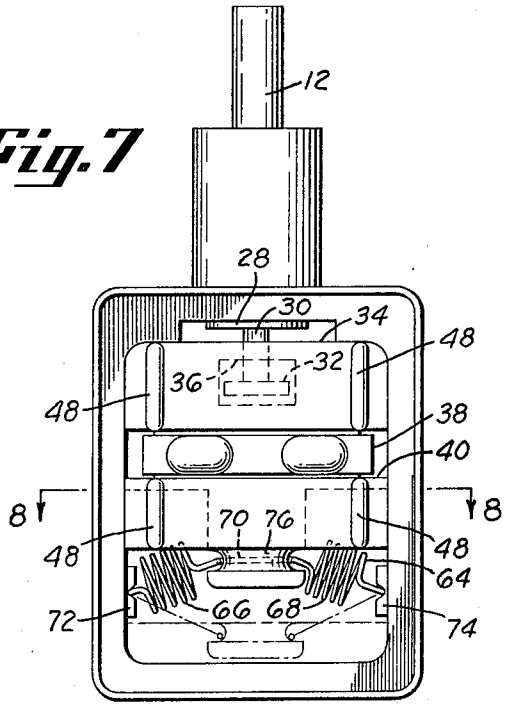
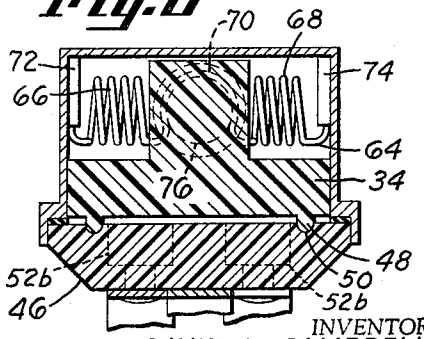


Fig. 8



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SNAP ACTION, DOUBLE THROW SWITCH

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7 Claims. (Cl. 200—47)

This invention relates to limit switches and more particularly to a type of electric switch responsive to movement of an object near an intended extreme of movement.

It is desirable in the use of limit switches that carry high amperage to have a very rapid switching action take place. Limit switches by their very nature require a very fast switching action to minimize the error allowed an object whose movement is being limited. The subject invention incorporates into a single switch, normally associated with high amperage electrical circuits, the desirable features of very quick switch contact movement and the feature of being adjustable after final mounting to accommodate a minor variance in the tolerance between the switch as mounted and an object whose movement is to be limited.

It is an object of the present invention to provide an improved electric switch adapted to very quickly switch high amperage circuits.

It is another object of the present invention to provide an improved electric switch used as a limit switch which is adapted to carry high amperage loads and which is automatically adjustable to a desired clearance between the switch as mounted and an object whose movement is to be limited.

It is still another object of the present invention to provide an improved electric switch which has a minimum number of moving parts and is adapted to be operated repeatedly without any disruption of internal tolerances.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a view of the subject invention illustrated in an operative environment;

FIGURE 2 is an exploded perspective view of the subject invention;

FIGURE 3 is an elevational view of the switching contacts of the subject invention shown in two operative positions;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 1;

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 4 ;

FIGURE 6 is a sectional view similar to FIGURE 4 wherein the switch sequence of movement is shown;

FIGURE 7 is a sectional view of another embodiment of the subject invention;

FIGURE 8 is a sectional view taken along line 8—8 of FIGURE 7.

Referring now to FIGURE 1, the subject switch, generally designated by the numeral **10**, is illustrated as being mounted with an actuator button **12** protruding through a panel **14** situated near an object **16** whose movement is to be limited. The clearance between the panel **14** and the object **16** is roughly established when the switch **10** is mounted to the panel **14** and is finally established in a manner to be hereinafter described.

Referring now to FIGURE 4, the actuator button **12** is frictionally disposed in a bore **18** of an actuator **20**. The actuator **20** is slidably disposed in an aperture **22** through one wall of the switch body **10**. A spring **24** biases the actuator **20** away from a flange **26** of the switch body **10**. It is understood that the frictional engagement of the actuator button **12** with the bore **18** is greater than the compressive force of the spring **24**. The actuator **20** carries a retaining ring **28** that limits the movement of the actuator **20** by coming into contact with an opposite portion of the switch body on which the flange **26** is formed. An extension **30** of the actuator **20** includes a disc-shaped end **32** adapted to engage a contact carrier **34**.

Referring now to FIGURE 2, contact carrier **34** is cast from any well-known insulating material and includes a key slot **36** arranged to engage the disc end **32** of the actuator **20**. Therefore, the contact carrier **34** is responsive to sliding movement of the actuator **20**. A bumper shaped contact element **38** is normally carried in a peripheral groove **40** formed in the contact carrier **34** and is biased away from the main body of the contact carrier **34** by means of a spring **42** engaging the contact element **38** and loosely disposed in an aperture **44** formed in the contact carrier **34**.

The switch body **10**, as illustrated in FIGURE 2, is substantially hollow and is closed on one end by a cover **46**. Cover **46** when positioned against switch body **10** forms a closed compartment within the switch body whose lateral dimension is substantially equal to the size of the contact carrier **34**. Key portions **48** formed integrally with the contact carrier **34** cooperate with key slots **50** formed in the cover **46**, best seen in FIGURE 5, guide the contact carrier **34** in its operative movement.

Referring now to FIGURE 5, a plurality of contact elements **52***a* and **52***b* are illustrated as passing through the cover **46** forming terminal portions on the outside thereof. Contact heads are exposed on the inside of the switch body when the cover **46** is appropriately mounted and are arranged to be contacted by the bumper shaped contact element **38** as the contact carrier is moved up and down, as viewed in FIGURE 5. FIGURE 3 illustrates the contact elements **52***a* and **52***b* as operatively positioned with the contact element **38** shown in the two positions it assumes relative to the contact elements **38** during operation of the subject switch.

Referring to FIGURE 5, a pair of torsion springs **54** are illustrated as having ends **56** and **58**. The ends **56** of the springs **54** engage cooperating apertures **60** formed in a wall of the switch body **10**. The ends **58** of the springs **54** engage cooperating slots **62** formed in the contact carrier **34**. These slots are more clearly seen in FIGURE 2.

Referring to FIGURE 6, the switch is shown in an actuated position with the slot **62** illustrated in progressive stages of movement. When the slot is positioned in the position as illustrated by the dotted line **62***a*, the switch is at the upper limit of its travel, in which position the bumper shaped contact element **38** engages the pair of fixed contact elements **52***a*. When the slot **62** is positioned as illustrated by the dotted line **62***b*, the switch is centered between complementary pairs of fixed contact elements and the spring **54** is entering its overcentering phase. When the slot **62** is positioned as shown by the solid line **62***c*, the switch has reached a lower limit of travel in which complementary contacts **52***b* are engaged. It is therefore seen that the springs **54** are contained on one end and pivot in the apertures **60** and are contained on another end by the slots **62**. In a preferred mounting, the ends **56** and **58** extend from the periphery of the spring **54** radially. An examination of FIGURE 6 illustrates that the ends **56** and **58** of the springs are positioned closer together when the slot **62** is positioned at **62***b* than when positioned at **62***a* or **62***c*. As the contact carrier **34** moves up and down between two extremes of

movement, as illustrated in FIGURE 6, the springs **54** are torsionally compressed and an overcentering action acting on the contact carrier **34** develops as the contact carrier **34** is moved past the point designated by the dotted line **62***b*.

It is obvious then that, as the contact carrier **34** moves from a position as illustrated in FIGURE 5 to a position as illustrated in FIGURE 6, springs **54** will resist the movement of the contact carrier **34** initially and then, after the slot **62** passes through the point designated by **62***b*, the springs **54** will assist the contact carrier in its downward movement and the contact carrier **34** will be accelerated. This acceleration will move the bumper shaped contact element **38** very quickly from an engagement with the contacts **52***a* into engagement with the contacts **52***b*.

It is noted that the key slot **36** formed in the contact carrier **34** is greater in dimension than the thickness of the end **32** of the actuator **20** thereby providing a lost motion connection between the actuator **20** and the contact carrier **34**. It is seen that the actuator will be moving at a given rate of speed due to the pressure of an object **16** whose movement is to be limited and, as the object reaches the desired clearance point, the contact carrier **34** very rapidly shifts and breaks an electrical circuit established through the fixed contacts **52***a*.

When the cycle described is the initial cycling of the switch as mounted, a mechanical force can be exerted on the object **16** after the contact carrier **34** has bottomed out against the switch body **10** to establish the desired clearance between the shifted contact carrier **34** and the movable object **16**. Thereafter, subsequent switch actuations will be brought about when the desired limit of movement of the object **16** is reached. The button **12**, as previously stated, frictionally engages the bore **18** with greater force than the combined force of the springs **24** and springs **54** so this adjusted position of the button **12** will not be later disturbed.

When it is desired to return the object **16** to a position of rest away from the panel **14**, a movement of the object **16** will allow the spring **24** to become dominant and the spring **24** will pull the contact carrier against the compression of the springs **54** back to the position as illustrated in FIGURE 5. It is understood that the compressive force of the spring **24** is greater than the force required to torsionally compress the springs **54**.

The embodiment illustrated in FIGURE 7 differs from the embodiment previously described only in the substitution of a single spring **64** for the pair of springs **54**. Referring to FIGURE 8, the resilient element **64** is seen to be comprised of coils **66** and **68** connected by an omega-shaped portion **70**. Opposite ends of the coils **66** and **68** are arranged to cooperaate with abutments **72** and **74**, respectively, formed as a portion of the inside wall of the switch body **10**. The omega-shaped loop **70** springs into contact with a groove **76** formed on the lower extremity of the contact carrier **34**. The groove and spring relationships are best seen in FIGURE 7.

The operation of the embodiment shown in FIGURE 7 is the same as that described in the previous embodiment in that an overcentering action is generated when the groove **76** passes a plane defined by the abutments **72** and **74**. Again, the resilient spring **24** creates more force when compressed during a switch actuation than the compressive force of the spring **64** and a return movement is thereby generated. It is understood that the coils **66** and **68** could be separate springs or formed as two coils on the same spring as illustrated in FIGURE 7. In a given installation, a different rate of travel for the contact carrier could be developed when desired by varying the number of loops of the coils, varying the size of the wire, or by the substitution of separate springs for the single spring illustrated. The exact combination chosen for a given installation would depend on the operating characteristics desired.

The utility of the present invention is particularly apparent in an environment where high amperage loads are carried in the switch and a rapid switching is desired while maintaining a contact cleaning, wiping action of the switch contacts. A typical operative environment for the subject switch could be as a limiter for the travel of an automobile convertible top. In this environment, oxidation on switch contacts is likely to occur and is easily dissipated by the wiping action previously described. In addition, high amperage carrying circuits are sometimes utilized for movement of a convertible top and the subject invention is easily adaptable for use in such circuits.

While the embodiments of the present invention, as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A limit switch comprising: a switch body having an aperture in one wall thereof; actuator means including a first portion slidably carried in the aperture of said switch body and a second portion disposed within said switch body, said first portion being biased away from said switch body; first means mounted for sliding movement in said switch body between two extremes of movement and having a portion engaging said second portion of said actuator means disposed within said switch body to make said first means responsive to movement of said actuator means, said first means resiliently carrying contact means; fixed contacts carried by one wall of said switch body including terminal portions extending from said switch body and contacting portions carried within said switch body in juxtaposition to the contacts carried by said first means; and second means engaging one wall of said switch body and said first means resisting movement of said first means during a portion of the distance between the two extremes of movement thereof and being adapted to later very quickly shift said first means toward an extreme of movement wherein said resiliently carried contact means engage a different series of fixed contacts as newly positioned than engaging as originally positioned.

2. A limit switch according to claim **1** wherein the first means is a non-conductive block having means for directionally controlling the sliding movement within the switch body and insulatedly carrying the resiliently mounted contact means.

3. A limit switch according to claim **1** wherein the second means is a plurality of coil springs, each having a plurality of terminating outwardly extending ends, one of said ends engaging an inside wall of said switch body and another end operatively engaging said first means.

4. The limit switch according to claim **1** wherein the first means is a single spring element having two coil portions and terminating end portions outwardly projecting from opposed ends of the coils, said ends engaging opposite walls of said switch body and the portion of the element between the coils formed in a manner allowing a resilient engagement of the first means.

5. A limit switch according to claim **4** wherein said single spring element is angularly preformed so that the terminating ends are disposed on a single plane while the spring is in a free position and the portion connecting the plurality of coils is disposed on a different plane than the terminating ends when the spring element is in a free position.

6. A limit switch comprising: a switch body having a substantially hollow interior and an aperture through one wall thereof; an actuator button including a portion arranged to slide in the aperture within the switch body and a portion disposed in the hollow portion of the switch body, said portion slidable in the aperture of the switch body having a telescoping interior portion frictionally engaging a sleeve formed in the button; a contact carrier keyed for directionally controlled movement in the hollow portion of the switch body and having a resiliently carried contact element thereon, said contact

carrier including a slot formed in a complementary manner with respect to the portion of the actuator button disposed in the hollow portion of the switch body and operatively engageable therewith; a plurality of fixed contact means carried by one wall of the switch body, said fixed contact means showing a first portion extending from the switch body and forming terminals and a second portion of said fixed contact means carried within the hollow portion of the switch body in juxtaposition to the resiliently carried contact element of the contact carrier; and resilient means engaging an inside wall of the hollow switch body and having a portion engaging said contact carrier biasing said contact carrier and said actuator button in a manner allowing a maximum extension of the actuator button from the switch body, said resilient means being drivable over center from a poised position in response to a sliding movement of the contact carrier induced by the actuator button to move said resiliently mounted contact element very rapidly between several

of the fixed contact means into engagement with several other of the fixed contact means.

7. A limit switch according to claim 6 wherein said resilient means comprises a plurality of coil springs adapted to be torsionally compressed as the contact carrier moves between two extremes of sliding movement within the hollow switch body.

References Cited by the Examiner

UNITED STATES PATENTS

1,103,020	7/1914	Austin.	
2,548,678	4/1951	Ohenour	200—76
2,627,006	1/1953	Lawson et al.	200—164 X
2,919,319	12/1959	Chapin et al.	200—67
3,037,099	5/1962	Aandewiel	200—67

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