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SNAP SWITCH OVERTRAVEL MECHANISM

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Fig. 4

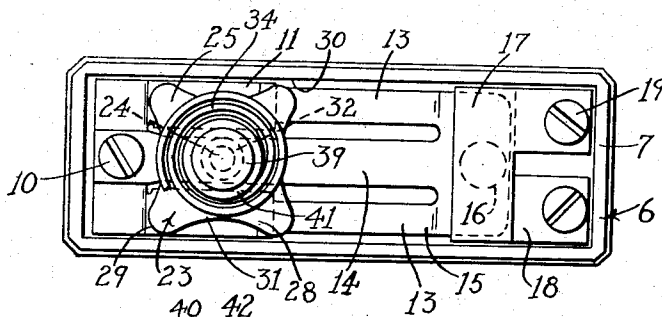


Fig. 1

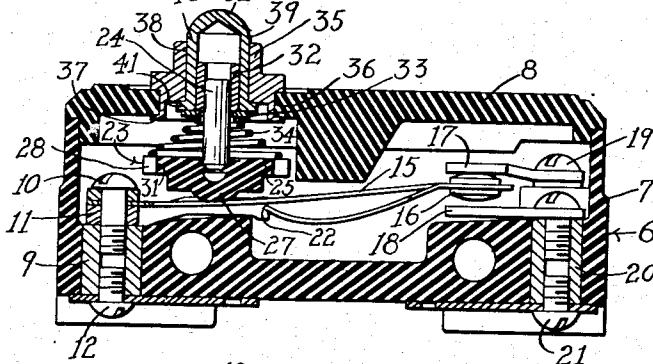


Fig. 2

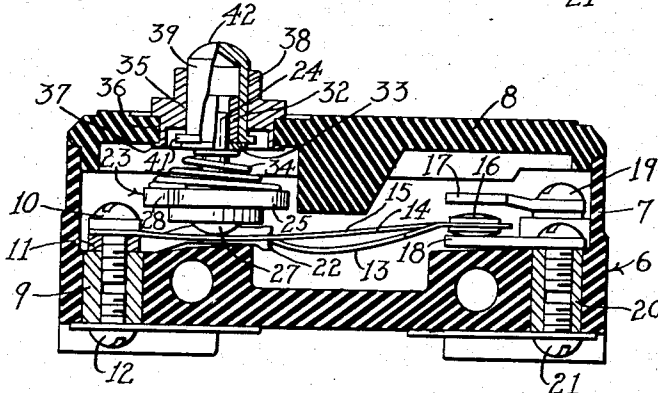
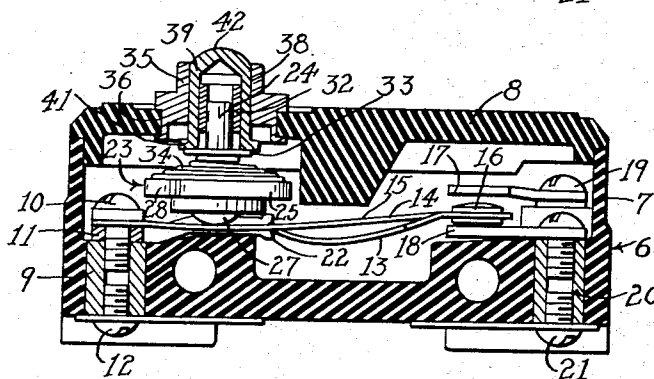


Fig. 3



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SNAP SWITCH OVERTRAVEL MECHANISM

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7 Claims. (Cl. 200—67)

This invention relates to electric snap switches of the small, compact, precision type shown in McGall Patent 1,960,020, issued May 22, 1934, and is more particularly concerned with an improved overtravel mechanism.

In referring to the switch of my invention as a "precision switch," it must be understood that this means one which operates in response to very slight movement of the operating plunger, and one which is intended to operate consistently at the same position of its plunger. One commercial construction of the switch, for example, has the switch mechanism in a molded housing of insulating material, occupying less than one and one-half ($1\frac{1}{2}$) cubic inches of space, and operating in response to a plunger movement of the order of one ten thousandth (0.0001) inch between "on" and "off" with only a few ounces of operating force, although controlling directly loads of the order of a thousand watts on alternating current.

Provision for overtravel is important in switches of this kind, because it permits greater tolerance in the location of the switch with respect to the device or member which must operate it in applications where precise operation is not of prime importance, and in all cases the provision for overtravel guards the switch mechanism against damage from accidental or other occasional excess movement of the device or member operating the switch. An outstanding objection to the overtravel mechanisms devised heretofore has been that the overall height of the switch is increased, all out of proportion, by the addition of the overtravel mechanism, the mechanism in many instances having an overall dimension almost equal to, if not even greater than, the overall height of the switch itself. As a result, switches so equipped could not be used in places where only limited space was available, as, for example, where switches are mounted in instruments. It is, therefore, the principal object of my invention to provide a switch in which the overtravel assembly is incorporated inside the switch between the internal operating plunger and the external actuated plunger, whereby the overall height of the switch is reduced appreciably and other important advantages are also realized, such as,

(1) The decreased weight of the assembly, which makes it more responsive to rapid actuation because of the lower inertia factor, and

(2) Reduced side thrust, which is due to the decreased length of the plunger and results in smoother and easier operation, because of the decreased frictional resistance to movement.

Another object is to provide a switch of the kind mentioned, in which the outer end of the external plunger, which is made of hardened steel for reduced wear, is rounded to provide smooth easy operation when actuated directly by sliding contact, the plunger being, moreover, freely rotatable with respect to the overtravel mechanism, so that wear is not apt to occur all at one point. The combination of the rounded contour and the stubbiness of the external plunger reduces the effect of side thrust to a minimum and makes the mechanism highly responsive.

The invention is illustrated in the accompanying drawing, in which—

Figure 1 is a longitudinal section through a switch made in accordance with my invention, on an enlarged scale;

Fig. 2 is another longitudinal section showing the parts in moved positions, at the operating point of the switch;

Fig. 3 is another longitudinal section with the parts moved farther so as to illustrate the overtravel, and

Fig. 4 is a top view of the switch with the cover removed so as to show the relationship of the internal and external plungers to the snap action spring.

The same reference numerals are applied to corresponding parts throughout the views.

The switch comprises a housing 6 of insulating material consisting of a base 7 and a cover 8 for enclosing the switch mechanism. 9 is a metal insert in the base carrying a screw 10, and 11 is an anchor held by the screw. The insert 9 provides an electrical connection between the anchor 11 and an external terminal screw 12. The anchor 11 supports a pair of compression spring members 13 and a tension spring member 14 of the snap mechanism of the switch. The two side compression members 13 and the central tension member 14 of the snap mechanism are stamped integrally from a single sheet of thin spring material, so that the several spring members together constitute a three-pronged piece 15. This piece carries a movable contact 16 which, when the switch operates, moves with snap action between the stationary contacts 17 and 18 on the base. The stationary contacts 17 and 18 each have a screw 19 mounting the same on another metal insert 20 in the base 7 which provides an electrical connection between the contact 17 or 18 and an external terminal screw 21.

The compression members 13 are pivotally supported in notches 22 in the ends of the legs of the U-shaped anchor 11. The tension member

14 is supported in cantilever fashion under the head of the screw 10 at the base of the U of the anchor 11 and passes near the pivotal axis of the two compression members 13 in the notches 22. If pressure is applied to the tension member 14 to deflect its tension center line across the pivotal axis of the two compression members 13, the spring members 13 and 14 will coact to snap the movable contact 16 from its one extreme position to the other. When the tension member 14 is forced down, the movable contact 16 is snapped out of engagement with the contact 17, the snap action member 15 coming into engagement with the contact 18, but when the pressure is released, the contact 16 snaps back to its normal position in engagement with the contact 17. As has already been pointed out, the switch will operate in response to a movement of the order of one ten thousandth (0.0001) inch and accordingly the actual distance through which the tension member need be deflected to operate the switch is exceedingly small. It should be understood, therefore, that Figs. 1-3 are intended only to show the general relationship of the parts mentioned.

The operating plunger 23 is similar to that forming the subject matter of a copending application of Arthur L. Riche and Ben J. Rush, Serial No. 448,598, filed June 26, 1942, and includes a highly polished stainless steel pin 24 onto which is molded a head 25 of insulating material. The switch, as will soon appear, is operated by depressing the head 25 so as to deflect the tension member 14 downwardly to operate the switch. The pressure is applied to the tension member 14 by a central spherical projection 27 on the bottom of the head 25 at a point between the point of support of the tension member under the head of the screw 10 and the point of support of the compression springs 13 in the notches 22. The head 25 overhangs the two legs of the anchor 11 so that the anchor serves as a stop to limit the downward movement of the plunger, the movement being limited to a little more than that necessary to deflect the tension member 14 to the point at which it moves with snap action to the opposite extreme position. The head 25 is of generally cylindrical form but has a star-shaped skirt portion 28 formed thereon intermediate the ends thereof in a plane substantially normal to the axis of the pin 24 of such dimensions that the light sliding contact of the rounded points 29 with the smooth inner side walls 30 of the housing will prevent rotation of the plunger with no perceptible increase in the resistance to the movement of the plunger.

The pin 24, in accordance with my invention, has a collar 32 suitably fixed on the upper end portion thereof, as by a press fit, and this collar serves both as a limiting abutment and retaining means for a washer 33 loosely mounted on the pin 24 and a conical or beehive spring 34 which encircles the pin 24 with its large end seated on top of the enlarged skirt portion 28 of the head 25 and its small end engaging the underside of the washer 33, as most clearly appears in Fig. 1. The spring is held caged between the head 25 and washer 33 under a certain preload compression. A one-piece metal ferrule 35 entered through a hole 36 in the cover 8 has its lower portion swedged outwardly, as indicated at 37, to fasten the ferrule permanently in place on the cover. The ferrule provides a guide 38 therein for an external plunger 39. The plunger 39 has a bore 40 in which the collar 32

has an easy working fit, so that the plunger 39 may be reciprocated freely with respect to the collar 32 and pin 24 in the overtravel movement. The inner end of the plunger 39 has an annular flange 41, which when the switch is at rest engages the bottom of the ferrule 35 to prevent upward displacement of the plunger 39. The outer end of the plunger 39 is substantially spherical, as indicated at 42, so that the plunger 39 may be operated smoothly directly by sliding engagement with a member or members movable with respect to the switch in a direction transversely with respect to the axis of the plungers 23 and 39. The plunger 39 is preferably of hardened steel to reduce wear and will turn with respect to the collar 32 to distribute what little wear is apt to occur. The collar 32 is preferably, although not necessarily, of cadmium plated brass, while the washer 33 may be of brass or any other suitable material.

In operation, when the plunger 39 is depressed, the operating plunger 23 moves with it as a unit, as shown in Fig. 2, so as to deflect the tension member 14 downwardly and operate the switch. The plunger 23 moves with the plunger 39 as a unit in the snap action of the switch because of the preloading of the spring 34, the preloading being great enough to insure that the spring will not be further compressed except in the overtravel movement after the snap operation of the switch. The movement of the plunger 23 is limited by engagement of the head 25 with the two legs of the anchor 11, as shown in Fig. 3, the movement being limited to a little more than that necessary to deflect the tension member 14 to the point at which it moves with snap action to the opposite extreme position. When the operating plunger 23 is stopped by engagement with the anchor 11, the spring 34 will yield so as to allow overtravel of the plunger 39, the washer 33 in the overtravel being forced downwardly away from the collar 32 by the plunger 39, thereby compressing the spring 34 between the washer 33 and the head 25, as clearly appears in Fig. 3.

It should be clear from the foregoing that the overtravel assembly of my invention is incorporated inside the switch between the internal operating plunger 23 and the external actuated plunger 39, and in that way the overall height of the switch is reduced appreciably. Furthermore with this improved construction, the weight of the assembly is decreased, which makes it more responsive to rapid actuation, because of the lower inertia factor. Then, too, there is reduced side thrust, which is due to the decreased length of the plunger 39, so that smoother and easier operation is obtained because of the decreased frictional resistance to movement. It should also be clear that the combination of the rounded contour 42 and the stubbiness to the external plunger 39 reduces the effect of side thrust to a minimum and makes the mechanism highly responsive.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. In a device of the character described, the combination of a housing, a switch element comprising a thin, leaf spring, snap action switch member operatively supported therein, one end being movable with snap action from one extreme position to another for switch operation when

pressure is applied to a portion of said element, an operating plunger in said housing guided for reciprocatory movement with respect to the housing and engaging said switch element to apply pressure thereon, an external actuating plunger also guided for reciprocatory movement with respect to the housing, a pin movable with one of said plungers and projecting therefrom into the other of said plungers and guided therein for reciprocatory movement with respect thereto, means in said housing for positively limiting movement of the internal plunger toward the switch element, and a coiled compression spring encircling said pin inside the housing for yieldably and resiliently transmitting pressure from the external plunger to the internal plunger, said spring being arranged to yield to permit overtravel of the external plunger when movement of the internal plunger is stopped.

2. A device as set forth in claim 1, wherein the coiled compression spring is substantially conical in form so as to permit compression thereof down to a small dimension, the large end of the spring being seated on the internal plunger and the small end thereof being operable by the external plunger.

3. In a device of the character described, the combination of a housing, a switch element comprising a thin, leaf spring, snap action switch member operatively supported therein, one end being movable with snap action from one extreme position to another for switch operation when pressure is applied to a portion of said element, an operating plunger in said housing guided for reciprocatory movement with respect to the housing and engaging said switch element to apply pressure thereon, an external actuating plunger also guided for reciprocatory movement with respect to the housing, a pin movable with one of said plungers and projecting therefrom into the other of said plungers and guided therein for reciprocatory movement with respect thereto, means providing an annular shoulder on the outer end portion of said pin, a washer reciprocable on the pin toward and away from said shoulder, and a coiled compression spring within said housing encircling the pin and held caged under a predetermined preload compression between the washer and the plunger movable with the pin, whereby to transmit pressure from the external plunger to the internal plunger yieldably and resiliently.

4. A device as set forth in claim 3, wherein the coiled compression spring is substantially conical in form so as to permit compression thereof down to a small dimension, the large end of the spring being seated on the internal plunger and the small end thereof having engagement with the washer.

5. In a device of the character described, the combination of a housing, a switch element comprising a thin, leaf spring, snap action switch member operatively supported therein, one end being movable with snap action from one extreme

position to another for switch operation when pressure is applied to a portion of said switch element, an operating plunger in said housing guided for reciprocatory movement with respect to the housing and engaging said switch element to apply pressure thereon, an external actuating plunger also guided for reciprocatory movement with respect to the housing, a pin movable with one of said plungers and projecting therefrom into the other of said plungers and guided therein for reciprocatory movement with respect thereto, means providing an annular shoulder on the outer end portion of said pin, a washer reciprocable on the pin toward and away from said shoulder, and a coiled compression spring within the housing encircling the pin and held caged under a predetermined preload compression between the washer and the plunger movable with the pin, whereby to transmit pressure from the external plunger to the internal plunger yieldably and resiliently, and means for positively limiting movement of the internal plunger toward the switch element, said spring due to its preload compression being arranged to yield only when movement of the internal plunger has been positively stopped, whereby to permit overtravel of the external plunger.

6. In a device of the character described, the combination of a housing, a switch element comprising a thin, leaf spring, snap action switch element operatively supported therein, one end thereof being movable with snap action from one extreme position to another for switch operation when pressure is applied to a portion of said element, an operating plunger in said housing guided for reciprocatory movement with respect to the housing and engaging said switch element to apply pressure thereon, a pin projecting from said plunger and reciprocable therewith, a coiled compression inside the housing spring surrounding said pin and seated on the plunger, a washer reciprocable on the pin and seated on the outer end of the spring, a collar adjustable on the outer end portion of the pin toward the washer serving to hold the spring caged under a predetermined preload compression, a removable cover for said housing, and an external plunger reciprocably mounted in said cover and having a bore therein, the collar on the outer end portion of said pin being guided therein for reciprocatory movement of the external plunger with respect to the internal plunger, said external plunger being arranged to engage the washer to transmit movement to the internal plunger yieldably and resiliently through the medium of the coiled compression spring.

7. A device as set forth in claim 6, including means in the housing for positively limiting movement of the internal plunger toward the switch element, said spring being arranged to yield when movement of the internal plunger is positively stopped, whereby to permit overtravel movement of the external plunger.

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