July 25, 1967 H. W. HULTS 3,333,074

POSITIVE ACTION SWITCHES

Filed March 16, 1966 2 Sheets-Sheet 1

Fig. 1

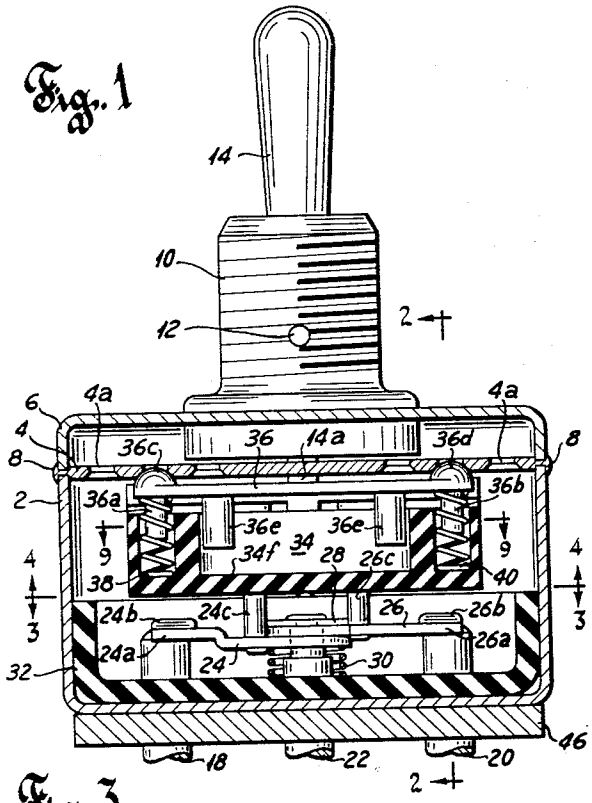

Fig. 2

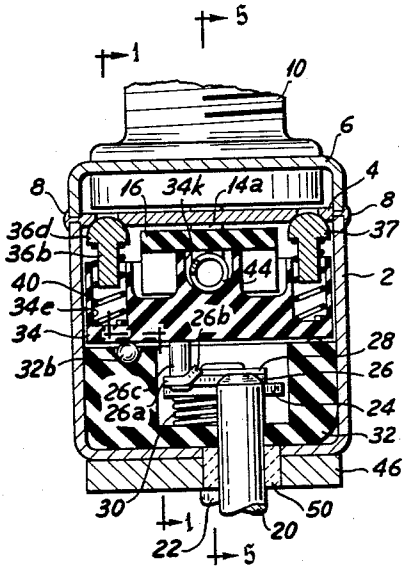

Fig. 3

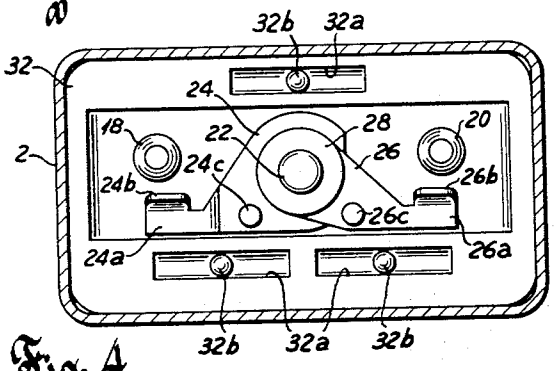

Fig. 10

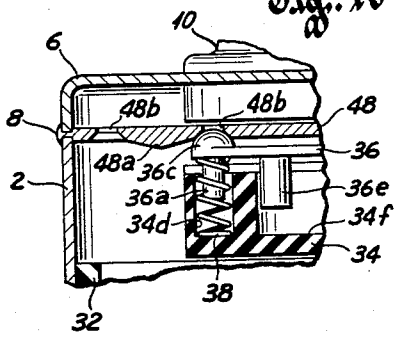

Fig. 4

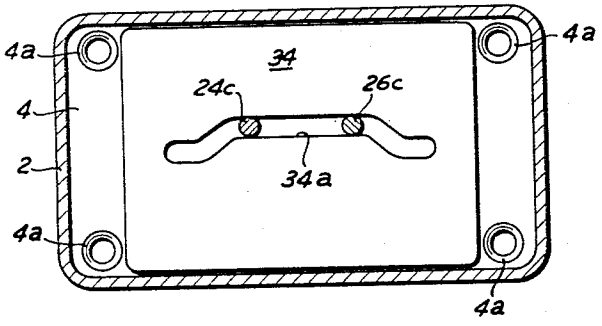

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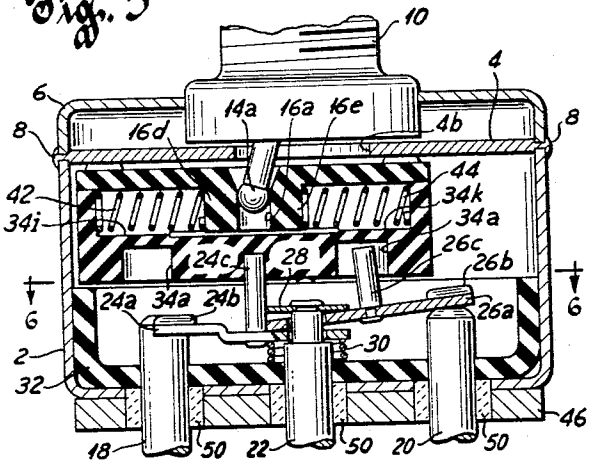
Fig. 5



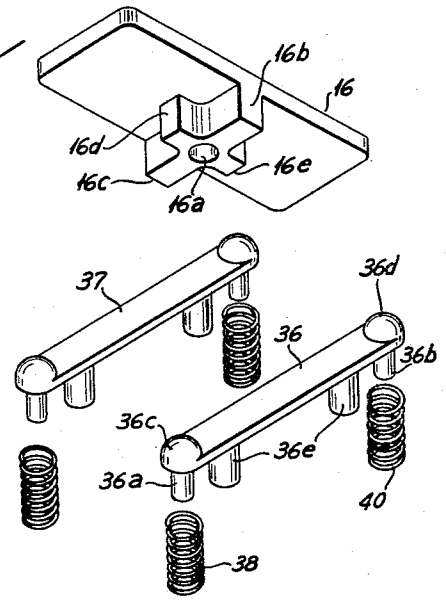


Fig. 6

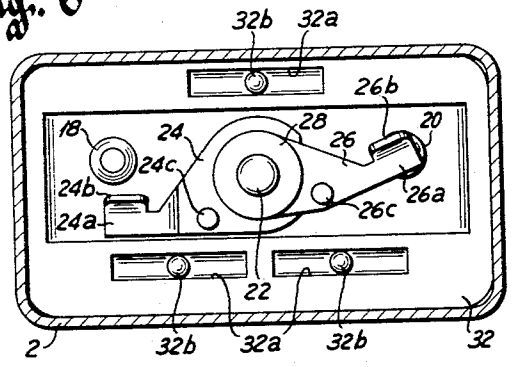


Fig. 7

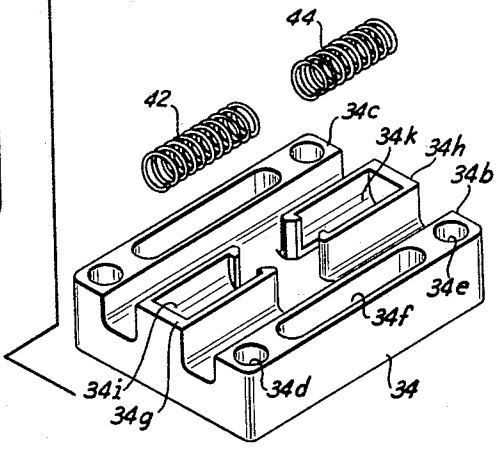


Fig. 8

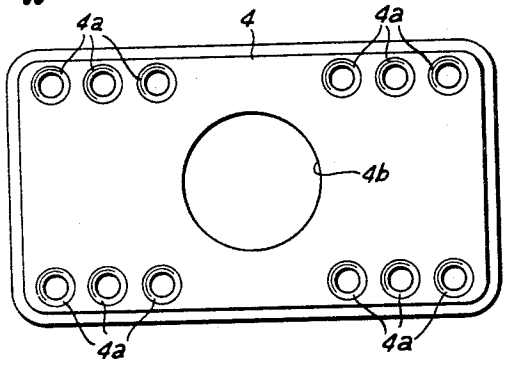
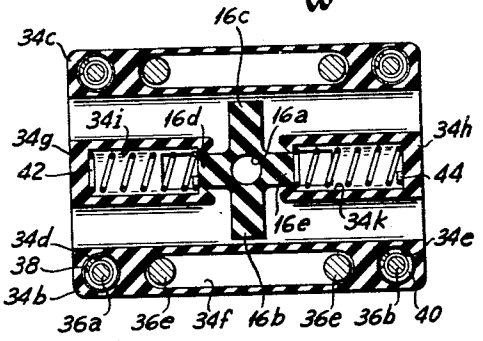


Fig. 9



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POSITIVE ACTION SWITCHES

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Filed Mar. 16, 1966, Ser. No. 534,719
10 Claims. (Cl. 200—68)

This invention relates to positive action switches and more particularly to manually operable switches having a positive and unyielding connection between the operating member and the movable contact for at least a portion of the operating member movement whereby positive force may be applied to open and close the contacts.

While not limited thereto, the invention is especially applicable to toggle switches of the self-enclosed type.

An object of the invention is to provide improved positive action switches.

Another object of the invention is to provide an improved switch structure which enables opening of a circuit under faulty conditions.

A more specific object of the invention is to provide improved switch structures which insure opening of the switch contacts under sticking or welding conditions.

Another specific object of the invention is to provide improved means affording positive break followed by snap-action opening of an electric switch.

Another specific object of the invention is to provide improved switch operating means combining positive force with snap-action and detent holding means.

Another specific object of the invention is to provide improved switch apparatus combining positive action and snap-action operation of wiping contacts.

Another specific object of the invention is to provide an improved switch structure which particularly lends itself to hermetic sealing.

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 exemplary embodiments of positive break switches taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a front elevational view partly in section taken along line 1—1 of FIG. 2 showing a single-pole, double-throw toggle switch with both contacts open;

FIG. 2 is a cross-sectional view taken through the right-hand portion of the switch along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view showing a top view of the contacts taken line along line 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view showing a bottom view of the actuator block taken along line 4—4 of FIG. 1;

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 2 but modified to show one contact closed;

FIG. 6 is a cross-sectional view showing a top view of the contacts taken along line 6—6 of FIG. 5;

FIG. 7 is an exploded isometric view of the combined positive break and snap-action indexing mechanism of the switch of FIGS. 1 to 6;

FIG. 8 is a bottom view of the indexing plate of the switch of FIGS. 1 to 7 affording three-position operation;

FIG. 9 is a cross-sectional view showing the snap-action mechanism taken along line 9—9 of FIG. 1; and

FIG. 10 is a fragmentary cross-sectional view like the left-hand portion of FIG. 1 showing a modified indexing plate affording two-position operation.

Referring to FIG. 1, there is shown a toggle switch constructed in accordance with the inventon. This switch is provided with a substantially rectangular metal housing comprising a cup-shaped base portion 2 open at the top on the rim of which rests the reduced edge portion of

an indexing plate 4 and a relatively shallow cup-shaped cover portion 6 inverted over the base portion so that its rim rests on the reduced edge portion of indexing plate 4. The adjacent rims of the base and cover portions are secured to one another as by welding over the reduced edge portion of the indexing plate, this weld being depicted by 8 in FIG. 1.

Cover portion 6 is provided with a large hole at its center into which is rigidly secured a bushing 10 having a cross pin 12 therethrough for pivoting therein an operating member such as a toggle lever 14. The toggle lever has a handle portion extending upwardly from the bushing so that it can be grasped by the hand to operate the switch. The toggle lever has a lower end projecting into the housing as shown in FIG. 5 and terminating in a spherical end portion 14a extending into a hole 16a in a laterally reciprocal driving plate 16. Hole 16a is round except for approximately its upper half which is frusto-conical in form to provide clearance as the toggle lever is rocked from the middle position to either the left or right side. Bushing 10 is threaded externally so that it can be inserted in a hole in a mounting panel and a nut threaded thereon to secure the switch to the panel.

The switch is provided with sliding contacts so that normal operation maintains them clean to afford a good electrical connection. As shown in FIGS. 2 and 5, base portion 2 of the switch housing is provided with holes through which stationary contacts 18 and 20 and a movable contact connector 22 extend from the interior to external terminals whereby the switch is adapted to be connected to the circuit in which it is used. Each stationary contact 18 and 20 is in the form of a round rod having a partially rounded upper end to afford camming of the associated movable contact thereon.

Connector 22 is also in the form of a round rod and is provided with a reduced upper end portion on which movable contacts 24 and 26 are rotatably mounted. Each movable contact has the form of a flat plate provided with a hole whereby it is inserted on the reduced end portion of connector 22, one on top of the other. A washer 28 shown in FIG. 3 is seated against the shoulder of a still further reduced portion and bears against upper contact 26 and said still further reduced end of connector 22 is riveted over the washer to secure it rigidly in place and to retain the contacts and permit rotation thereof. A helical compression spring 30 surrounds connector 22 and is compressed between lower contact 24 and an insulating base 32 lining the lower part of base portion 2 of the housing. As shown in FIG. 5, this helical spring affords contact pressure by forcing the movable contacts against the retaining washer whereby the reduced contacting portion 26a of the movable contact is pressed against the stationary contact.

Each narrow contacting portion 24a and 26a has an upwardly inclined extension 24b and 26b shown in FIGS. 2 and 6 to facilitate camming thereof on top of the associated stationary contact.

Each movable contact is also provided with a cam follower pin 24c and 26c riveted in a hole at an intermediate portion thereof and extending upwardly therefrom into a cam slot 34a in the lower surface of an insulating actuator block 34 as shown in FIGS. 1, 4 and 5.

The switch is provided with combined positive break and snap-action means for coupling the toggle lever to the movable contact. As shown in FIGS. 1, 2 and 5, this means is mounted above insulating base 32. This means comprises an actuator block 34, a pair of indexing plungers 36 and 37 cooperating with indexing plate 4, driving plate 16 and a number of helical springs hereinafter described.

As shown in FIGS. 7 and 9, in addition to the cam slot 34a in its lower surface, actuator block 34 is provided

on its upper surface with a front ridge **34***b* and a similar rear ridge **34***c* for supporting indexing detent plunger **36** and **37**, respectively. Front ridge **34***b* extends all the way from the left side to the right side of the actuator block and is provided with round pockets **34***d* and **34***e* at the left and right ends extending downwardly thereinto as shown in FIG. 1 for receiving helical compression springs **38** and **40**, respectively. As will be apparent, downwardly projecting pins **36***a* and **36***b* at the opposite ends of indexing plunger **36** extend into springs **38** and **40** and these springs bias the hemispherical upper end portions **36***c* and **36***d* against indexing plate **4**. Front ridge **34***b* of the actuator block is also provided with an elongated central recess **34***f* for receiving a pair of positioning pins **36***e* of the indexing plunger. These positioning pins will bear against the ends of recess **34***f* to keep the indexing plunger in proper registration on the actuator block and to prevent springs **38** and **40** from catching on the edges of their associated pockets. Indexing plunger **38** is similar to plunger **36** and is similarly mounted on rear ridge **34***c* and biased against the indexing plate.

The actuator block is provided with means at the center between the front and rear ridges for mounting the snap-action mechanism comprising driving plate **16** and compression springs **42** and **44**. This means comprises a pair of center ridges **34***g* and **34***h* extending from the left and right ends, respectively, toward the center and providing a space therebetween. These center ridges are provided with elongated pockets **34***i* and **34***k* open at the top and toward the center space for receiving helical compression springs **42** and **44**, respectively. As will be apparent, these compression springs cooperate with the driving plate to provide the snap-action to the actuator block. For this purpose, driving plate **16** which is substantially rectangular in form is provided with a downwardly projecting cross molded integrally on the lower surface around hole **16***a* as shown in FIG. 7. The front and rear arms **16***b* and **16***c* of this cross lie in the center space between ridges **34***g* and **34***h* and in the channels between the front and center and rear ridges as shown in FIG. 9 so that they will abut the opposed inner ends of center ridges **34***g* and **34***h* after the energy storing motion is taken up. The left and right arms **16***d* and **16***e* of this cross extend slightly into pockets **34***i* and **34***k* when the toggle lever is in its center position as shown in FIG. 9 and abut the ends of compression springs **42** and **44** whereby the latter tend to maintain driving plate **16** centered on the actuator block.

As shown in FIGS. 2, 3 and 6, the upper surfaces of base **32** are provided with grooves **32***a*, each having a steel ball bearing **32***b* extending slightly above these surfaces on which actuator block **34** rolls when the switch is operated.

From the foregoing, it will be recalled that indexing plungers **36** and **37** have hemispherical portions at their ends which are resiliently pressed against indexing plate **4**. For cooperation therewith, indexing plate **4** is provided with four sets of downwardly beveled holes **4***a* as shown in FIGS. 1, 2 and 8 into which the rounded end portions of the indexing plungers stop when the toggle lever is reciprocated and into which they are accelerated by the beveled edges of the holes. This plate is provided with a large hole **4***b* at the center to afford clearance for the toggle lever.

As shown in FIG. 8, for a three-position switch each set has three holes **4***a*. For the switch illustrated in FIGS. 1 to 9, which is a single-pole, double-throw switch, these three holes in each set afford a center off or switch open position and left and right closed positions.

As shown in FIGS. 1, 2 and 5, a steel plate **46** is rigidly secured as by welding to the bottom of the switch base portion **2** of the housing to thicken the bottom. This plate has holes coextensive with and in registration with the holes in the base portion which are substantially larger than the stationary contact connectors extending therethrough to accommodate insulation. These holes are filled with vitreous or ceramic material **50** or the like which has the qualities of strength, sealing and electrically insulating. As will be apparent, this material rigidly secures stationary contacts **18** and **20** and connector **22** to the base portion of the housing and electrically insulates them from the latter. This securing and sealing is accomplished by different coefficients of expansion of the materials whereby the metal shrinks around the glass seal and grips it.

A modified indexing plate **48** is shown in FIG. 10 which affords a two-position switch having no center stopping position for the toggle lever. As shown in FIG. 10, the center hole of each set of three holes in FIG. 8 has been eliminated and replaced by a bidirectional cam **48***a* sloping from the center in opposite directions to both of the remaining holes **48***b*. It will be apparent that when the hemisphere of the indexing plunger has been moved across the high point of cam **48***a*, this cam involuntarily snaps the indexing plunger and the actuator block assembly to the position toward which it was being moved.

It will be apparent that in FIG. 1, the switch is shown in the off or open contact position. If the toggle lever is pivoted clockwise, the lower ball end of the lever initially moves driving plate **16** in the left-hand direction against the force of spring **42** until arms **16***b* and **16***c* of the driving plate abut the inner end of ridge **34***g* of the actuator block. This movement has stored potential energy in spring **42**. Further movement of the toggle lever in the same direction causes positive movement of the actuator block in the left-hand direction. As a result, slot **34***a* in FIG. 4 positively cams pin **26***c* and movable contact **26** rigidly secured thereto rearwardly to cause end **26***a* of the movable contact to be cammed or slid up on the end of stationary contact **20** as shown in FIG. 5.

It will be apparent that the latter part of this contact movement occurs with a snap action. When the toggle lever has been moved to cause the hemisphere of the indexing plungers to cam out of the center holes in the hole groups in the indexing plate, the aforementioned potential energy comes into play. That is, spring **42** now snaps the actuator block in the left-hand direction all the way until these hemispheres stop in the left holes in the indexing plate. During this snap action, the movable contact is slid onto the stationary contact. During this closure of contact **26**, the other movable contact remains open since the linear part of slot **34***a* traverses pin **24***c*.

When the toggle lever is moved in the counterclockwise direction from the position shown in FIG. 5, spring **44** is first compressed until there occurs an unyielding connection between the toggle lever and movable contact **26** through driving plate **16**, actuator block **34** and pin **26***c*. This unyielding connection affords positive break of any weld between contacts **20** and **26** and then the movable contact snaps open to reduce arcing which would occur if the contacts were open slowly particularly when alternating current is interrupted.

While the apparatus hereinbefore described is effectively adopted to fulfill the objects stated, it is to be understood that I do not intend to confine my invention to the particular preferred embodiments of positive break switches disclosed, inasmuch as they are susceptible of various modifications without departing from the scope of the appended claims.

I claim:

1. In an electric switch, the combination comprising:

an insulating base;

a stationary contact mounted in said base;

a movable contact and means mounted in said base for mounting said movable contact for rotary movement into and out of engagement with said stationary contact;

an actuator block mounted for sliding movement along said base and having a camming slot provided with

at least a portion extending away from the path of said sliding movement;

a manually operable lever and means providing an unyielding connection between said lever and said actuator block for at least a portion of the lever movement to transmit positive force for closing or opening the contacts;

and a cam follower rigidly secured to said movable contact and extending into engagement with said portion of said camming slot for rotatably actuating said movable contact into and out of engagement with said stationary contact when said manually operable lever is reciprocated.

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

potential energy storing means effective in response to initial movement of said manually operable lever for storing energy without moving said actuator block;

said unyielding connection means being responsive to further movement of said manually operable lever for moving said actuator block;

and means responsive during said further movement for rendering said potential energy storing means effective to cause snap-action movement of said actuator block.

3. The invention defined in claim **1**, wherein said means mounting said movable contact for rotary movement comprises:

a connector rod extending through the bottom of said base and having an enlarged end portion within said base;

a hole in said movable contact through which said connector rod extends;

and a spring biasing said movable contact against said enlarged end portion wherein said movable contact is normally offset from the plane of the contacted portion of said stationary contact to provide contact pressure when said movable contact is deflected from the plane it occupies in its open condition onto said stationary contact.

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

indexing means for holding said actuator block in any one of a number of different operating positions comprising:

a spring biased indexing plunger mounted on said actuator block and having hemispherical portions;

and a stationary indexing plate against which said hemispherical portions are resiliently pressed and having holes for retaining the latter in any one of a number of different operating positions.

5. The invention defined in claim **4**, wherein said indexing plate comprises:

a bidirectional cam between the holes for enhancing movement of said hemispherical portions toward the holes under the influence of the spring biased force on said indexing plunger.

6. The invention defined in claim **1**, wherein said means mounting said movable contact for rotary movement comprises:

a connector member extending through the bottom of the base and having a washer secured to the end thereof;

said movable contact being flat and having a hole through which said connector member extends;

a spring between said base and said movable contact biasing the latter against said washer;

and said connector member normally holding said movable contact in a position offset relative to the stationary contact so that said movable contact must

be deflected from its normal place when it is cammed onto said stationary contact whereby said spring provides contact pressure.

7. In an electric switch, the combination comprising:

an insulating base;

a stationary contact mounted in said base;

a movable contact and means mounting said movable contact for movement into and out of engagement with said stationary contact;

a switch operating member;

and combined positive break and snap-action means mounted between said switch operating member and said movable contact comprising:

an actuator block mounted for reciprocal sliding movement on said base and engaging said movable contact;

a driving plate engageable by said switch operating member for movement thereby;

spring means between said driving plate and said actuator block permitting limited movement of said driving plate relative to said actuator block against the force of said spring means to store potential energy;

means on said driving plate and said actuator block causing positive engagement therebetween beyond said limited movement thereby providing an unyielding connection from said switch operating means to said movable contact to afford positive breaking of the contacts and thereafter said compressed spring means causing snap action of said actuator block;

a spring-biased detent member having rounded portions mounted on top of said actuator block beside said driving plate;

and a stationary indexing plate above said detent member and having recesses for receiving said rounded portions to cause said detent member to hold said actuator block during said limited movement of said driving plate.

8. The invention defined in claim **7**, wherein said means on said driving plate and said actuator block comprise:

a pair of tandem ridges with a space therebetween on said actuator block;

pockets in said ridges for receiving said spring means and communicating with said space;

and a depending cross molded integrally on said driving plate and having tandem arms bearing against said spring means and lateral arms in said space for engaging said ridges after said limited movement.

9. The invention defined in claim **7**, wherein said switch is provided with:

a housing comprising two parts clamping the edge of said indexing plate therebetween and welded together over the edge of said indexing plate.

10. The invention defined in claim **7**, wherein said switch operating member comprises:

a toggle lever pivoted for reciprocal movement and having a substantially spherical end;

and a tapered recess in said driving plate into which said spherical end extends and whereby said driving plate is moved.

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