April 8, 1969 N. H. KOERTGE 3,437,773

CONVERTIBLE ELECTRIC SWITCH MODULE

Filed Aug. 24, 1967 Sheet 1 of 2

Fig. 1

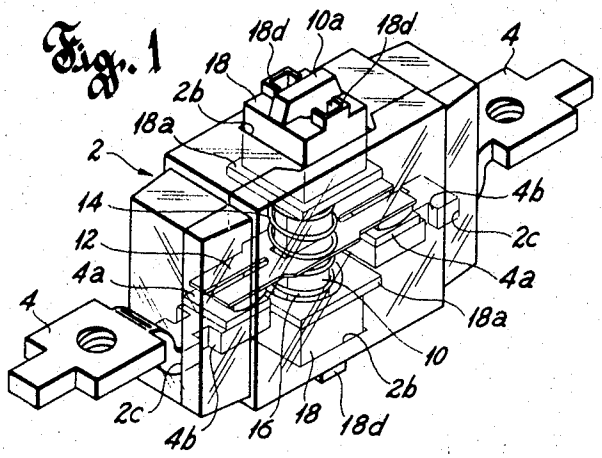


Fig. 5

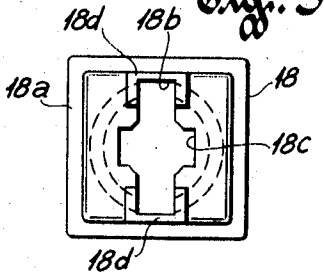


Fig. 2

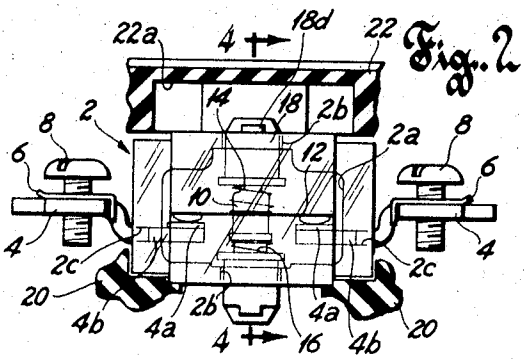


Fig. 3

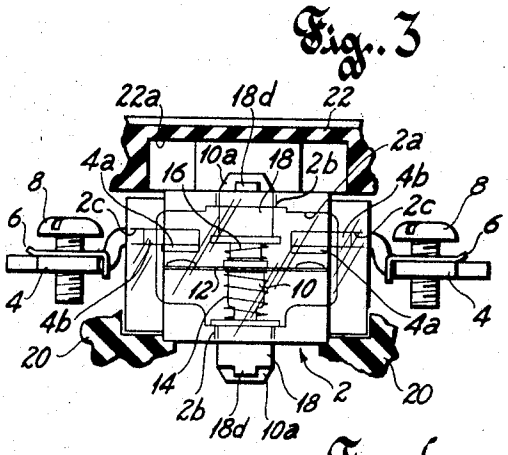


Fig. 4

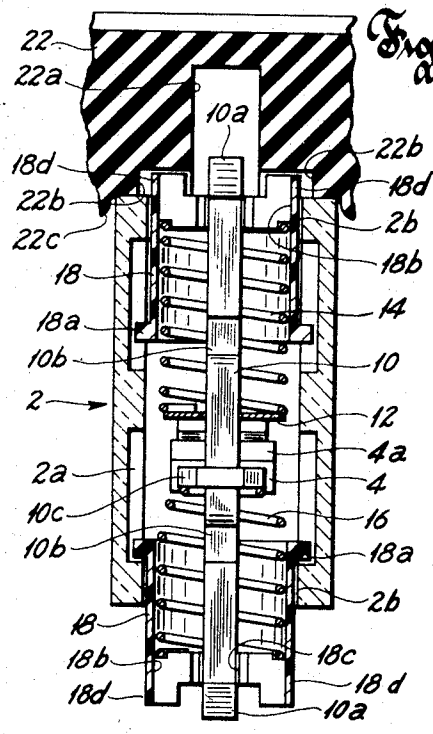
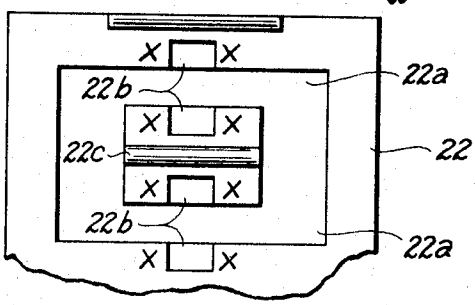


Fig. 6



Inventor
Nobel H. Koertge
By HR Rauser
Attorney

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Filed Aug. 24, 1967 Sheet 2 of 2

Fig. 7

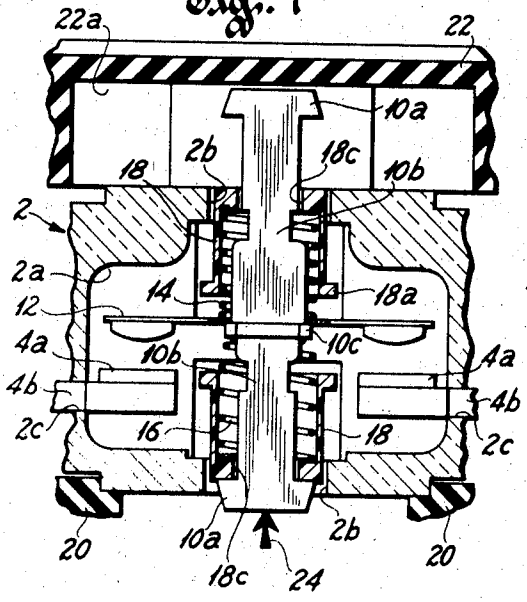


Fig. 8

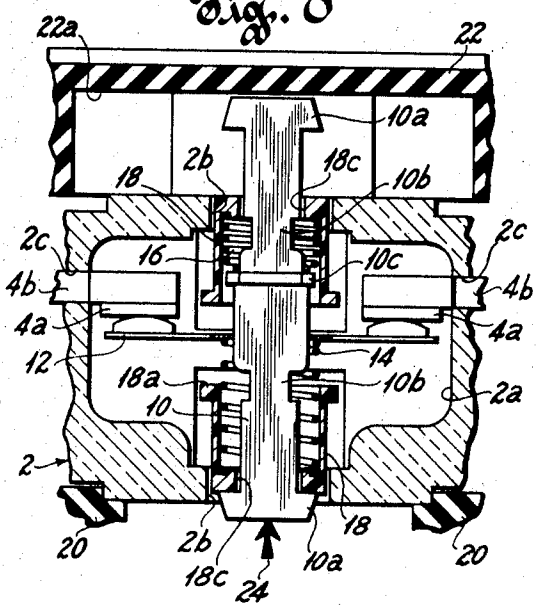
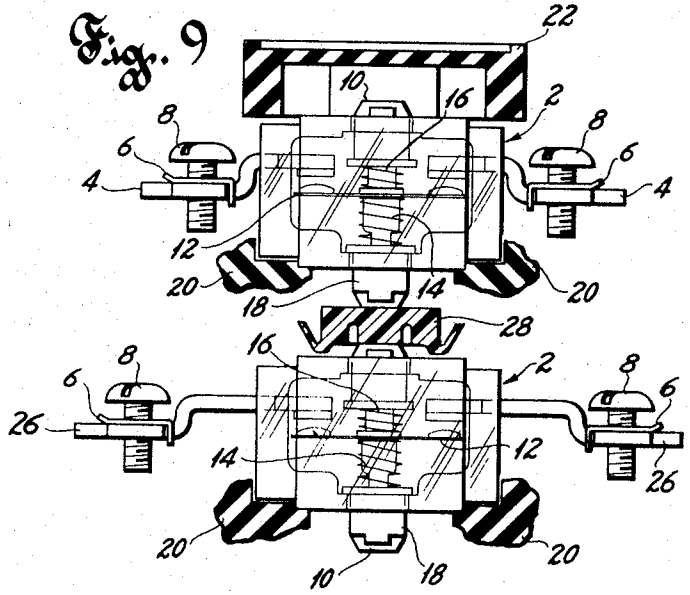


Fig. 9



Inventor
Nobel H. Koertge
By. H R Ratter
Attorney.

United States Patent Office

3,437,773

Patented Apr. 8, 1969

3,437,773

CONVERTIBLE ELECTRIC SWITCH MODULE

Nobel H. Koertge, Elm Grove, Wis., assignor to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

Filed Aug. 24, 1967, Ser. No. 663,160

Int. Cl. H01h 3/00

U.S. Cl. 200—166 6 Claims

ABSTRACT OF THE DISCLOSURE

A metal contact carrier is guided at opposite ends for straight through movement in a transparent case by spring retainers which are slidable with respect to both the carrier and the case. Two springs bias the retainers against the respective ends of the carrier and abut a flange on the carrier and a bridging contact carried thereby, respectively. By fixing either retainer with respect to the case and pushing the opposite end of the carrier, either normally closed or normally open contact actuation modes may be achieved.

Cross-reference to related applications

While the switch of this application may be used in various push-type operator control devices, it is particularly well suited to be used in electromagnetic control relays or the like such as described and claimed in my copending application Ser. No. 663,067 filed Aug. 24, 1967 and assigned to the assignee of the immediate application.

Summary of the invention

The switch of this invention is designed to be a completely self-contained convertible switch unit to be mounted to a control device housing structure and is convertible by inverting the switch within the housing structure. The module case is formed of a transparent electrical insulating material to provide a ready visual indication of both the contact condition and the position thereof. Contact pressure and return springs are contained within the module in a novel arrangement wherein one of the springs which is unnecessary to contact actuation in one contact mode is maintained in its original condition during operation and does not add unwanted spring pressure to the device.

It is, therefore, a primary object of this invention to provide a self-contained convertible switch module wherein a spring member unnecessary to one contact actuation mode thereof is maintained in an inactive state.

It is a further object of this invention to provide a convertible switch module which may be readily converted from normally closed to normally open contact actuation modes, or vice versa, by a simple inversion procedure.

It is still a further object of this invention to provide a convertible switch module wherein the condition of the contacts therein and their relative positions may be readily visualized by providing the module with a transparent, insulating case.

These and other objects will become more apparent in the following specification and claims when read in conjunction with the accompanying drawings.

Description of the drawings

FIGURE 1 is an isometric view of a switch constructed in accordance with this invention;

FIG. 2 is a side elevational view of the switch of FIG. 1 shown mounted in one contact actuation mode;

FIG. 3 is a view like FIG. 2, but showing the switch in an inverted position for another contact actuation mode;

FIG. 4 is a sectional view of the switch taken along line 4—4 of FIG. 2;

FIG. 5 is a top plan view of one of the elements of the switch;

FIG. 6 is a fragmentary view of the underside of a typical housing member for a control device in which the switch of this invention is to be utilized;

FIG. 7 is a sectional view of the switch as shown in FIG. 2, but in an operated condition thereof;

FIG. 8 is a sectional view of the switch of FIG. 3, but in an operated condition thereof; and

FIG. 9 is a view illustrating how the switch of this invention may be utilized in a tandem manner in a control device.

Description of the preferred embodiments

The switch module of this invention is pictorially illustrated in FIG. 1. The switch has a two-piece insulating case 2 molded of a natural transparent polycarbonate material such as that sold under the trade name "Lexan." The two pieces are joined together by some conventional method, preferably sonic welding, to establish an enclosed central switch cavity 2*a* therein. The upper and lower walls of case 2 are provided with rectangular openings 2*b* which communicate with the cavity 2*a*. The end walls of case 2 have slots 2*c* formed therein which also communicate with the cavity 2*a*. Slots 2*c* are stepped to be wider at the exterior surface than at the cavity surface to aid in anchoring the switch terminals which extend therethrough.

The switch terminals 4 are identical stamped metal members having contact tips 4*a* secured to one end and threaded openings formed in the other end. While the contact tips 4*a* are shown herein as being secured upon one surface of the terminals 4, it is to be understood that the tips 4*a* may also be inlayed to have the contact surface thereof flush with the surface of the terminal. The terminals have their opposite ends offset from each other to be in different planes. A pair of opposed notches 4*b* are formed in the ends of the terminals having the tips 4*a* thereon, the notches 4*b* fitting within the narrower portion of the slots 2*c* of case 2. The transverse edges of the notches 4*b* abut the step portions of the slots 2*c* and the inner cavity wall of the case, respectively, to firmly anchor the terminals 4 within the case 2 upon joining the two pieces thereof together.

The slight offset provided on the terminals 4 is disposed exteriorly of the case 2 to position the outer ends of the terminals in a central plane of the switch. As will be brought out in more detail later, the switch is designed to be convertible between normally open and normally closed contact modes by inversion of the module and it is therefore desirable to have the wiring terminals occupy substantially the same plane in either position. The terminals are further provided with conventional wire securing means such as a wiring clip 6 and a terminal screw 8 for connecting the module in a circuit.

The movable parts of the switch are assembled and placed within the cavity 2*a* as a single subassembly prior to joining the two pieces of the case together. The movable subassembly comprises a contact carrier 10, a bifurcated

bridging contact **12**, a pair of helical compression springs **14** and **16**, and a pair of identical spring retainers **18**.

The contact carrier **10** is a sintered metal part formed from a high density iron. This particular choice of material provides superb wear characteristics for both the carrier and its companion parts. The metal carrier is not prone to cause powdering of these parts due to movement and therefor effectively reduces the dielectric dust that may collect within a switch cavity to foul the contact faces.

As is best seen in the cross-sectional views of FIGS. 4, 7 and 8, the contact carrier **10** is a long, flat member having cross-head portion **10***a* formed at each end. Portions **10***b* of reduced cross-section are formed on the body of carrier **10** an equal distance in from each end. Carrier **10** is further provided with a transverse flange **10***c* formed on the body thereof at a point offset from its longitudinal center.

The bridge member **12** comprises a blanked spring metal member having a rectangular central opening. Bridge member **12** is disposed around the body portion of carrier **10** and rests upon one side of the transverse flange **10***c*. The outwardly extending arms of the bridge member have contact tips secured at their outer ends to be alined wtih contact tips **4***a*. The arms and contact tips of the bridge member **12** have been shown herein as being bifurcated, although it is to be understood that such configuration is merely a preferred choice of design and the invention is not limited thereto.

A first helical compression spring **14** is disposed over the carrier **10** to rest upon the bridge member **12**. A second helical compression spring **16** is disposed over the opposite end of carrier **10**. Spring **16** is formed with a reduced diameter at one end to abut the transverse flange **10***c* of carrier **10**.

A pair of identical spring retainers **18** are next attached to the contact carrier **10**. As will become more apparent in later description, spring retainers **18** also serve as bearing members for the reciprocal movement of carrier **10** and are therefor molded of a suitable self-lubricating material such as a combination nylon and Teflon material or the like.

Spring retainers **18** have a rectangular, box-like outer configuration with a cylindrical inner cavity open to a first side thereof. A peripheral flange **18***a* is formed on the members **18** at the first side. A second side of the members **18**, opposite the first side thereof, has a pair of intersecting rectangular openings formed therethrough to communicate with the cylindrical cavity. A first rectangular opening **18***b* (FIG. 5) is formed of length and width sufficient to allow the cross-head **10***a* to pass therethrough. A second rectangular opening **18***c* is formed at right angles to and bisecting the opening **18***b* and is of sufficient length and width to provide clearance for the body portion of carrier **10**. The corners formed by the junction of the two openings **18***b* and **18***c* have been cut away to define an imaginary circular central opening therein. The inner end of the cylindrical cavity has a peripheral groove molded therein to position the ends of the respective springs **14** and **16** in assembly. A pair of upstanding shrouds **18***d* are formed around the opposite ends of the first rectangular opening **18***b* for reasons that will become more apparent in the later description.

The retainer members **18** are attached to the carrier **10** by inserting the cross-head **10***a* of the carrier through the cylindrical cavity of the respective retainer member and through the first rectangular opening **18***b* to protrude from the second side of the retainer. The latter is then forced further onto the carrier **10** against the bias of the respective spring **14** or **16** until the reduced portion **10***b* of carrier **10** is alined with the imaginary circular opening at the junction of the two rectangular openings **18***b* and **18***c*. Carrier **10** is then rotated one-quarter turn with respect to the retainers **18** to cause the body portion thereof to be alined with the rectangular opening **18***c* and withdrawn under the bias of the spring **14** or **16** until the cross-head **10***a* abuts the outer surface of the retainer.

As mentioned earlier, the entire movable assembly is placed into the portion of cavity **2***a* of one of the pieces of the case **2**. The retainer members **18** are positioned within the rectangular openings **2***b* of the case and the bridging contact is alined with the stationary contacts. The flanges **18***a* of the retainers are wider than the openings **2***b* of the case and serve to limit the outward movement of the retainers **18** within the openings after the two pieces of the case are joined together.

The foregoing description represents the completed module, the movable assembly thereof being relatively free for reciprocal movement as a unit with respect to the case **2**. When the switch is oriented in a manner in which the contact bridge **12** is above the stationary contact tips **4***a* as is shown in FIG. 1, the bridge **12** rests upon the contacts under gravitational force. Conversely, when the switch is inverted so that the bridge member **12** is below the stationary contacts, the gravitational influence moves the assembly to a point wherein the flange **18***a* of the then lower spring retainer abuts the inner cavity wall adjacent the respective case opening **2***b* and the bridge **12** is separated from the contacts **4***a*.

The switch disclosed herein is designed to be used in conjunction with a control device which may have a mechanical or electromechanical operator for actuating the switch. The switch is suitably attached to the housing of the control device, a preferred method of attachment being more fully disclosed in the earlier mentioned copending application. This method, insofar as may be necessary to the understanding of the switch, is briefly described in the following.

The switch is supported within a pocked formed in the control device housing represented by the cross-hatched fragments **20** in FIGS. 2, 3, 7 and 8. The housing has an opening in the bottom of the pocket to expose the control device operator to the lower end of the switch contact carrier **10**. The pocket supports the switch at the lower corners of the case **2** against horizontal and downward movement. A second housing member, such as a cover shown fragmentarily at **22** in FIGS. 2, 3, 6, 7 and 8, is secured to the first housing member to overlie the case **2** and hold the switch within the pocket.

The underside of cover member **22** is shown in FIG. 6. While the particular configuration of the cover is relatively unimportant to this application, it is important that it provide means not only to hold the switch within the pocket, but also that it provide means to hold the outer, or second, surface of the upper spring retainer **18** flush with the upper surface of the case **2**. Additionally, the cover must also provide a space for the switch contact carrier **10** to move upward upon switch operation. The fragmentary cover shown in FIG. 6 has provisions for overlying two switches mounted side-by-side on a control device housing. A rectangular groove **22***a* is formed in the cover **22** to provide the clearance for movement of the carrier **10**. The inner and outer portions of the cover surrounding the groove **22***a* are on the same plane and bear directly on the switch case in assembly. Additionally, the portions marked with an "X" each extend over a corner of the upper spring retainer **18** to limit the upper surface thereof to a plane flush with that of the switch case. The cover **22** is further provided with pairs of recesses **22***b* for each switch module in which are disposed the upwardly extending shrouds **18***d* of the upper retainer **18**. Shrouds **18***d* and recesses **22***b* effectively increase the creepage distance between two adjacent contact carriers **10** should any arcing occur. A rounded rib **22***c* is also formed on the cover to extend between adjacent switch modules to additionally increase the creepage path.

When the switch is assembled to a control device housing in the aforedescribed manner and oriented as shown

FIG. 2, the bridge member **12** rests across the stationary contacts **4***a* to complete a circuit through the switch. The contacts are maintained in this normally closed contact mode under the bias of spring **14** bearing between the upper spring retainer **18** which is fixed relative to the case **2** by the cover **22** and the bridge member **12**, thus providing contact pressure for the switch. In this particular position the contact carrier **10** is under the influence of gravity, the upper cross-head **10***a* resting upon the outer surface of upper retainer **18**.

FIG. 7 illustrates the actuated condition of the normally closed switch of FIG. 2, the control device operator exerting an upward force represented by arrow **24** on the lower cross-head **10***a* of carrier **10**. The latter moves upward in response to the operator force against the bias of spring **14**, the upper portion of the carrier **10** occupying the groove **22***a*. The transverse flange **10***c* abuts the underside of bridge **12** during the upward travel to positively carry the bridge out of engagement with the contacts **4***a*. Upon removal of the force **24** of the operator, the spring **14** biases the bridge back to its normally closed position. It is important to note that in this version the spring **16** extending between the lower spring retainer **18** and the flange **10***c* is not flexed and does not add unwanted spring pressure to the switch.

To change the contact mode to a normally open condition the cover **22** is removed from the housing, the switch is removed from the pocket and inverted. Terminal screws **8** and clips **6** are changed to be on the opposite side of the terminals **4** and the switch is reinserted into the pocket and the cover **22** replaced. The normally open position is illustrated in FIG. 3, the cover **22** again overlying the upper retainer **18** to maintain it flush with the upper surface of case **2**. The carrier **10** is under a gravitational influence and assumes a position limited by the engagement of the flange **18***a* of the lower retainer **18** with the inner wall of the cavity **2***a* surrounding the lower opening **2***b*. Spring **14** biases the bridge member against the flange **10***c*.

The actuated position of the normally open contact mode is depicted in FIG. 8 wherein the operator force is again represented by the arrow **24**. The operator acting against the lower cross-head **10***a* of carrier **10** moves the carrier upward into the groove **22***a* against the downward bias of spring **16**. Bridge member **12** engages the stationary contacts **4***a* during the travel and compresses the spring **14** somewhat to provide contact pressure. Upon the removal of the operator force **24**, spring **14** couples with spring **16** to urge the carrier downward in the early travel, prior to contact separation. Thereafter the spring **16** urges the carrier downward until the upper cross-head **10***a* engages the surface of the upper retainer member **18**. Gravitational force then causes the movable assembly to assume its original position wherein the flange **18***a* of lower retainer **18** abuts the cavity wall surrounding the lower opening **2***b*.

The reciprocal movement of contact carrier **10** is guided in each of the foregoing orientations by the spring retainers **18**. The upper retainer in each instance remains stationary with respect to the case **2** and the carrier body is guided for movement within the rectangular opening **18***c*. The lower retainer in each instance moves directly with the carrier, the retainer being guided by the opening **2***b* of the case **2** and the carrier being positioned within the opening **18***c*.

Due to the straight through movement of contact carrier **10**, which extends through both top and bottom surfaces of the case **2**, the control device housing may also be modified to accommodate tandemly arranged switch modules as shown in FIG. 9. To provide better access to the wiring screws **6** when the switch is used tandemly, the lower switch is provided with longer terminals **26**. Since the contact carriers **10** are of electrical conducting material and are conductive when the bridging members engage the stationary contacts, an insulating member **28** is disposed between the switches. Member **28** is slidably secured in the control device housing to be movable in response to movement of the carriers **10**.

While the foregoing description has primarily contemplated a switch utilized in a control device housing wherein operation occurs from the bottom, it is to be understood that the switch is susceptible to various other applications without departing from the scope of the appended claims. One such modification exemplary of this would be a push-button operator wherein the operator housing may be mounted to a panel and have a depending support strap or the like to encompass the case **2** and fix the lower retainer **18**. The operator would therefor bear upon the upper end of carrier **10** to move the latter downwardly for switch actuation.

I claim:

1. A convertible electric switch module comprising, in combination:

an insulating case having an enclosed central cavity therein, alined openings in the upper and lower walls thereof communicating with said cavity, and spaced stationary contact means alined within said cavity and having portions thereof extending exteriorly of said case through opposite side walls thereof;

a movable contact assembly mounted for reciprocal movement within said case, said assembly comprising;

a contact carrier extending through said alined openings in said case, said carrier having transversely extending cross-head portions formed on each end thereof and a transverse flange formed on the body portion thereof to be disposed within said cavity;

a bridging contact member slidably disposed on said contact carrier and having the ends thereof cooperably alined with said stationary contact means for engagement therewith;

a pair of spring retainer members slidably mounted on said contact carrier at the ends thereof and slidably disposed within said alined openings of said case;

a first spring member disposed around said contact carrier and extending between said transverse flange and one of said retainer members to bias that member against the respective transversely extending cross-head portion; and

a second spring member disposed around said contact carrier and extending between said bridging contact member and the other of said retainer members to bias that member against the respective transversely extending cross-head portion and to bias said bridging contact member towards said transverse flange.

2. The combination according to claim **1** wherein said alined openings in said case and said spring retainer members are formed to have a complementary configuration having at least one straight side to prevent rotary movement of said retainer members within said openings and to provide guided reciprocal movement therein.

3. The combination according to claim **2** together with outwardly extending flange portions formed on the inner ends of said spring retainer members to interfere with the cavity wall adjacent said alined openings in said case to provide a limit for outward movement of said retainer members with respect to said case.

4. The combination according to claim **1** together with means overlying portions of the spring retainer member at one end of said contact carrier to maintain said retainer at a fixed limit of outward travel with respect to said case, and operating means engaging the opposite end of said contact carrier to move said carrier slidably through said fixed retainer against the bias of a respective one of said spring members to cause contact actuation of said switch module.

5. The combination according to claim **4** wherein said contact carrier member is constructed of an electrically conductive material and the portion of said operating

means which engages said carrier is constructed of an electrical insulating material.

6. The combination according to claim 1 wherein said case is formed of a transparent electrical insulating material.

References Cited

UNITED STATES PATENTS

2,897,311	7/1959	Schleicher	335—198
3,188,405	6/1965	Scheib	335—132
3,238,341	3/1966	Haydu.	
3,251,964	5/1966	Lawrence et al.	335—198
3,253,092	5/1966	Landow.	
3,272,949	9/1966	Lawrence.	
3,339,161	8/1967	Conner et al.	

ROBERT K. SCHAEFER, *Primary Examiner.*

H. O. JONES, *Assistant Examiner.*

U.S. Cl. X.R.

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