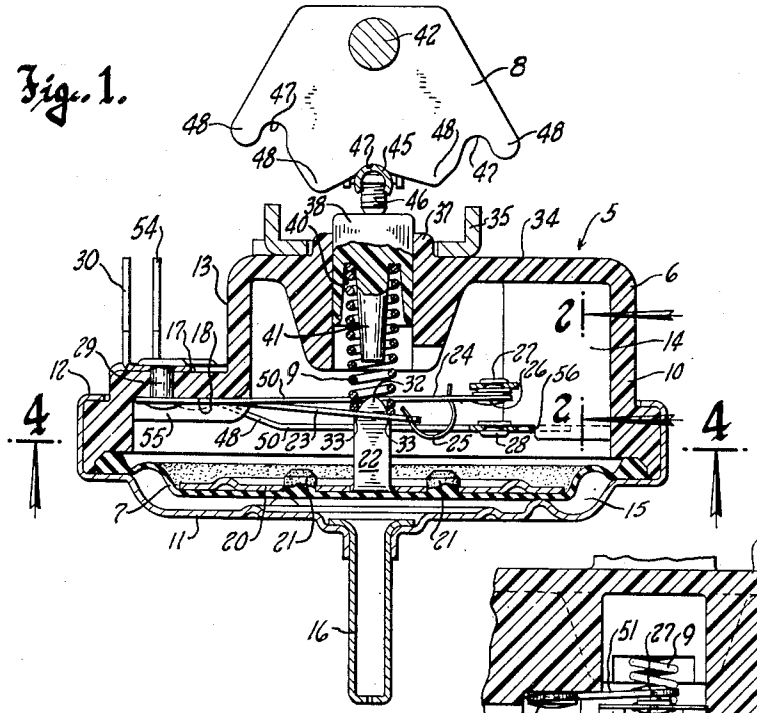
March 4, 1958 W. E. BELLER ET AL 2,825,780

SNAP ACTION SWITCH

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Fig. 1.



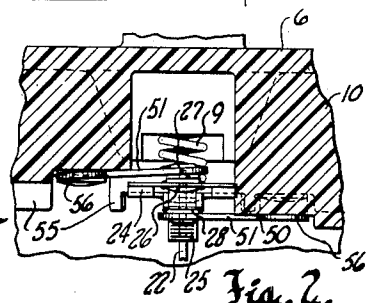
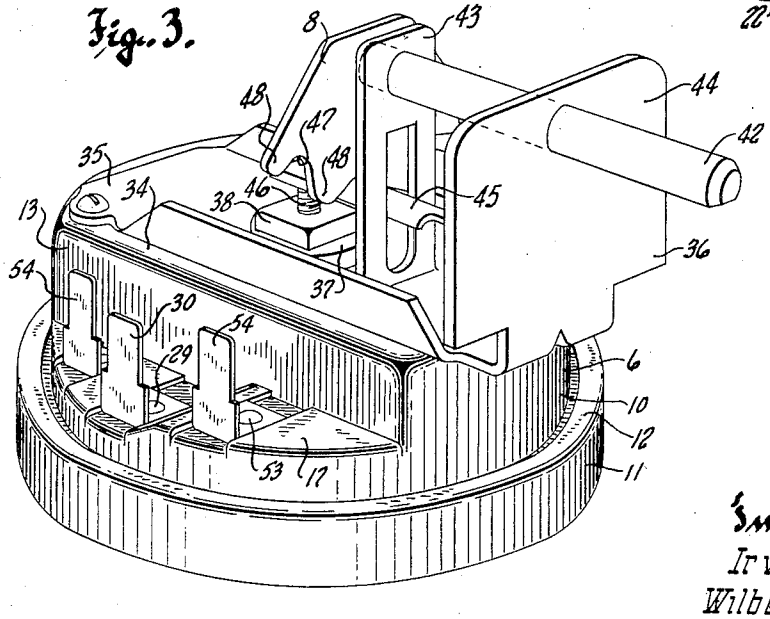


Fig. 2.

Fig. 3.



Inventors
Irving Gebel
Wilbert E. Beller
By Drake Sutton & Jones
Attorney

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Fig. 4.

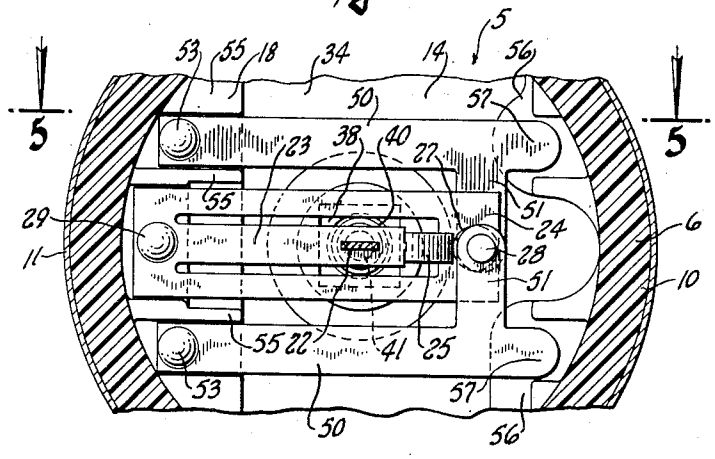


Fig. 5.

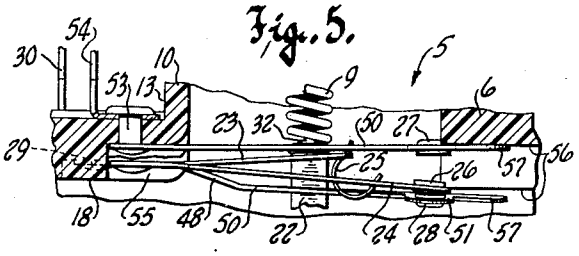


Fig. 6.

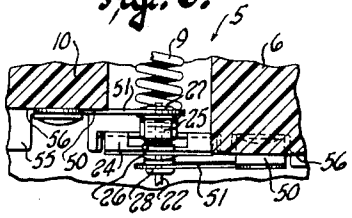


Fig. 7.

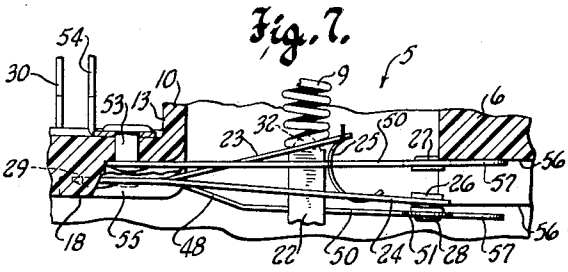
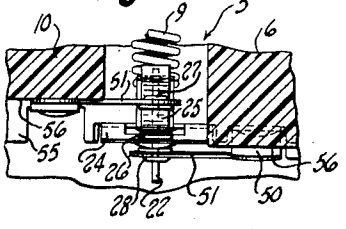


Fig. 8.



Inventors
Irving Gebel
Wilbert E. Beller
By [illegible]
Attorney

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2,825,780

SNAP ACTION SWITCH

Wilbert E. Beller, Park Ridge, and Irving Gebel, Oak Park, Ill., assignors to Controls Company of America, Schiller Park, Ill., a corporation of Delaware

Application July 15, 1955, Serial No. 522,206

8 Claims. (Cl. 200—67)

This invention relates to electric switches and refers more particularly to overcenter snap acting switches wherein a compression spring confined between an actuating member and a contact carrying member is loaded by movement of the actuating member toward a critical position relative to the contact carrying member and snaps the contact carrying member from one defined position to another as the actuating member passes through the critical position.

Certain features of the switch of this invention are disclosed in the companion copending application of Wilbert E. Beller and Irving Gebel Serial No. 520,946, filed July 11, 1955.

As is well known, one of the advantages of an overcenter snap acting switch is that such a switch may be readily designed so that the movable contact on the contact carrying arm engages a stationary contact on the switch under substantial force which is maintained right up to the point where the actuating member is moved past its critical position and the contact carrying arm is snapped away from engagement with the stationary contact to another position. However, where the stationary contact is rigidly mounted in a fixed position, the contact pressure varies as the actuating member moves from point to point, decreasing slowly as the actuating member is moved toward its critical position and then abruptly going to zero practically simultaneously with snapping of the movable contact out of engagement with the stationary contact and to its other position. If, as frequently happens, the actuating member is moved further in the direction away from its critical position after the contact carrying arm has snapped over into engagement with a stationary contact, this overtravel of the actuating arm relaxes some of the compressive force in the overcenter spring, with a consequent decrease in the force with which the movable contact engages the stationary contact. Under certain conditions of stationary contact location and overtravel of the actuating arm, the movable contact may separate slightly from the stationary contact at or near the limit of overtravel, which separation is obviously very undesirable.

When the stationary contact is very rigidly supported and comprises relatively hard material, the abrupt impact of the engaging contacts creates a rebound similar to that of a ball bearing dropped on a plate of glass, and this contact bounce, obviously, is also very undesirable.

With this in mind, it is an object of the present invention to provide a yieldable mounting for the stationary contacts of a snap acting switch whereby the abrupt impact of the movable contact engaging a stationary contact is cushioned to prevent contact bounce and whereby contact separation is prevented because the yieldable mounting for the stationary contacts insures the maintenance of substantial contact engaging bias between the stationary and movable contacts during motion of the actuating member towards its critical position, right up to the point where the contact carrying arm is snapped over, and insures the maintenance of contact engagement during substantial overtravel of the actuating member beyond its critical position.

In attaining this objective it is another object of this invention to provide an inexpensive and simple mounting for the stationary contacts of a switch of the character described, which mounting makes for an unusually compact switch.

Another object of this invention resides in the provision of mounting means for the stationary contacts of an overcenter snap switch having the advantages described above and providing the further very important advantage of enabling all of the switch terminals to be located on the same side of the housing, closely adjacent to one another, where they may be readily accessible even when the switch is installed in close quarters.

A further object of this invention resides in the provision of an overcenter snap acting switch which may be provided with a compact housing, have a stepped biplanar top wall, and wherein the switch terminals may be mounted in the step defined by the lower level of the top wall to be readily accessible and at the same time be protected by the step defining walls of the housing against collision damage.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a vertical sectional view of a fluid pressure responsive switch device incorporating a snap acting switch embodying the principles of this invention;

Figure 2 is a fragmentary vertical sectional view taken on the plane of the line 2—2 in Figure 1;

Figure 3 is a perspective view of the switch device;

Figure 4 is a fragmentary sectional view taken on the plane of the line 4—4 in Figure 1;

Figure 5 is a fragmentary view taken on the plane of the line 5—5 in Figure 4, showing the switch immediately after it has snapped out of its position shown in Figure 1;

Figure 6 is a fragmentary view similar to Figure 2 but showing the switch in its Figure 5 position;

Figure 7 is a view similar to Figure 5 but showing the switch in the position which it assumes when the actuating member overtravels substantially beyond its critical position; and

Figure 8 is a view similar to Figure 2 but showing the switch in its Figure 7 position.

Referring now more particularly to the accompanying drawings, in which like numerals designate like parts throughout the several views, the numeral 5 designates generally an overcenter snap acting switch which, by way of illustration, is shown embodied in a fluid pressure responsive switch device. In general the device of which the switch 5 is a part comprises a housing 6, a resilient diaphragm 7 mounted across the bottom portion of the housing and connected with the switch to actuate the same in response to changes in fluid pressure exerted on the underside of the diaphragm, and an indexing cam 8 by which the compressive force upon a return spring 9 may be regulated and by which the actuating force exerted upon the diaphragm may be overridden to reset the switch.

More specifically, the housing 6 comprises an upper cup-like insulative body portion 10, open at its bottom,

and a closely fitting metal cover 11 closing the open bottom of the body portion.

The lower portion of the cup-like housing body is circular in horizontal section, and the cover 11 fits snugly around its lower portion of the body and is crimped or rolled over an annular upwardly facing shoulder on the exterior of the body, as at 12, so as to be held securely in place. The upper portion of the cup-like housing has a straight side wall portion 13 which defines a stepped biplanar top wall, the lower level of which provides a ledge 17 at the exterior of the body and a ledge 18 at the interior thereof.

The resilient diaphragm 7 extends laterally across the interior of the housing and has its peripheral portion clamped between the cover and the rim portion of the cup-like body, thus dividing the housing into two compartments, namely an upper switch mechanism compartment 14 in which is housed the snap switch 5 and a lower pressure compartment 15 into which air, water or other fluid may be introduced through a nipple 16 secured in the cover.

A rigid disk 20, smaller in diameter than the diaphragm, flatwise overlies the central portion thereof and is held in position by a pair of integral tits 21 projecting upwardly from the upper face of the diaphragm through closely fitting holes in the disk. Struck out of the disk is an integral post or stud 22 which projects upwardly from the center of the disk to connect the diaphragm with the switch mechanism.

The switch mechanism 5 is a conventional overcenter snap acting switch of well known type, except for its stationary contacts, and comprises an actuator arm 23 mounted for up and down swinging motion and connected for snap actuation with a contact carrying arm 24 by means of a U-shaped overcenter spring 25 which is confined under compression between the two arms. The actuator arm and contact carrying arm are preferably formed as integral parts of a single piece of spring metal, the actuator arm being defined by a substantially U-shaped cutout, as best seen in Figure 4.

The contact carrying arm has a movable contact 26 secured thereto at its end adjacent the overcenter spring for cooperation with upper and lower stationary contacts 27 and 28, respectively, as more fully described hereinafter; while the other end of the unitary blade assembly is secured to the ledge 18 at the interior of the housing body as by means of a rivet 29 which also secures a terminal lug 30 to the ledge 17 at the exterior of the body and electrically connects the terminal lug 30 with the contact carrying arm of the switch.

The switch arms project from the ledge 18 across the interior of the housing body, and the post or stud 22 projecting up from the rigid disk 20 has a pointed reduced free end portion 32 which projects through a narrow locating slot in the actuator arm, directly above the central zone of the diaphragm. Shoulders 33 flanking the reduced end portion of the post engage the underside of the actuator arm to translate upward flexure of the diaphragm, in response to increasing fluid pressure thereon, into upward swinging motion of the actuator arm.

The upper level 34 of the body top wall has a flat exterior surface and the base 35 of a bracket 36 which supports the indexing cam 8 flatwise overlies it. An integral boss 37 having a non-circular hole therethrough projects downwardly from the upper level of the body top wall, and a plunger 38, having a non-circular cross section corresponding to that of said hole, is slidably guided for lengthwise up and down movement therein. The position of the plunger along its path of motion is adjustably determined by means of the cam 8, and the plunger, in turn, imposes more or less compressive force upon the return spring 9 to thus regulate the amount of pressure which must be imposed upon the lower face of the diaphragm before the actuator arm will be swung past its critical position against the bias of the return spring.

To insure that the convolutions of the coiled return spring 9 will at all times remain substantially coaxial, the plunger has a relatively deep downwardly opening well 40 in which the uppermost convolutions of the return spring are nested while the lower convolutions encircle the reduced upper end portion 32 of the post. Further assurance against buckling of the spring is provided by a rigid pilot-like downward projection 41 on the plunger which has its base at the bottom of the well, coaxial therewith, and which projects downwardly into the return spring a substantial distance below the body of the plunger to be encircled by a substantial number of spring convolutions. The non-circular cross section of the plunger further assures that the return spring will exert uniform forces under each condition of adjustment because the plunger cannot rotate and thus impose unwanted torque upon the spring.

The cam 8 is non-rotatably mounted on the rear end of a shaft 42 which is journaled in aligned apertures in a pair of upstanding flanges 43 and 44 on the bracket. The front end portion of the shaft projects beyond the front flange 44 to have a suitable manual actuator (not shown) mounted thereon. The front flange, in addition to providing a mounting means for the device, supports a unitary spring finger 45 which is biased toward the cam and cooperates therewith to provide a detent indexing cam follower and a connection with the plunger whereby the latter is positioned in accordance with the position of the cam. This connection between the cam follower and the plunger is provided by an adjusting screw 46 threaded into the free end portion of the spring finger and bearing upon the top of the plunger.

The cam, bracket and spring finger are described in detail in the aforesaid copending application, to which reference may be made for a more complete description of the manner in which these members cooperate with one another. Suffice it to say that there are circumferentially spaced detent depressions 47 in the lower edge portion of the cam, separated and defined by projecting lobes 48, and engagement of the spring finger in these depressions defines detents at the several positions of the cam. Since the bottoms of the several depressions in the cam are disposed at different radial distances from the shaft axis, rotation of the cam from one detent defined position to another effects adjustment of the position of the plunger and hence governs the amount of compression to which the return spring is subjected; and this in turn controls the fluid pressure forces required to be imposed upon the diaphragm to actuate the switch from one of its positions to the other.

As brought out in the aforesaid copending application, when the cam is rotated to have one of the cam lobes ride up onto the cam follower, the plunger is thereby temporarily depressed a distance greater than the normal spacing between the lower end of its pilot-like downward projection and the reduced upper end portion of the post 22, so that the diaphragm will be pressed downwardly against the force exerted thereon by fluid in the pressure chamber and the actuator arm will be moved downwardly past its critical position by the return spring 9. Thus the switch will be reset each time the fluid pressure level adjustment of the cam is changed.

Actuation of the actuator arm by means of the diaphragm may result in a substantial overtravel of the arm beyond the critical position at which the contact carrying blade is snapped over from engagement with the upper stationary contact 27 to engagement with the lower stationary contact 28, particularly where the diaphragm is actuated by a sudden surge of fluid pressure. If the lower stationary contact were immovably mounted, the relaxation of the biasing force of the overcenter spring upon the contact arm resulting from such overtravel would tend to encourage separation of the movable and stationary contact.

In the switch of this invention, however, the contact separation which might otherwise occur in consequence of such overtravel is prevented by reason of the provision of novel mounting means for the lower stationary contact 28; and the upper stationary contact 27 is likewise so mounted that any tendency toward bouncing of the movable contact against it is inhibited. The mounting for each stationary contact comprises a resilient blade 50, one end of which is secured to the ledge 18 at the interior of the housing, edgewise adjacent to the fixed end of the contact carrying arm. The two blades 50 extend alongside the contact carrying arm spaced from opposite edges thereof, substantially parallel to it, and each has near its free end a lateral finger 51 extending across the contact end portion of the contact carrying arm. Each of the stationary contacts 27 and 28 is mounted on the free end portion of one of these lateral fingers, in a position to be engaged by the movable contact, and the projection to which the stationary contact 27 is affixed of course overlies the face of the contact carrying arm which is remote from the other stationary contact 28; or in other words the contact 27 is disposed above the movable contact while the contact 28 is supported beneath it. To provide for this vertical displacement of the stationary contacts the ledge 18 may be suitably stepped to dispose the blades at different levels and one of the blades may be given a slight S-curvature along its length, as at 48. If the surfaces of the ledge 18 which support the fixed ends of the blades are coplanar with that supporting the fixed end of the switch arms, then both blades 50 can be given slight S-curves and made identical with one another.

As in the case of the contact carrying arm, rivets 53 which secure the blades 50 to the ledge 18 also serve to secure terminal lugs 54 to the external ledge 17, and to electrically connect said terminal lugs with the blades and thus with the stationary contacts. It will be apparent that the three switch terminals 30 and 54 are thus mounted in closely adjacent relationship, all disposed at one side of the switch housing where they will be readily accessible, thereby greatly facilitating installation of the switch in close quarters. Attention is also directed to the fact that the terminal lugs are afforded substantial protection against damage during handling and shipment by reason of their location in the step defined by the ledge 17 and the straight side wall portion 13 of the housing.

Rotation of the blades and the contact carrying arm about their respective rivets is precluded by integral ridges 55 on the interior ledge 18 of the housing which abut the side edges of these members.

To stabilize the positions of the stationary contacts, each of the blades is flatwise biased upwardly against an abutment 56 on the housing spaced from the anchored end of the blade. In this instance the abutments comprise downwardly facing shoulders at the side of the housing opposite the ledge 18 and integral with the housing side wall opposite said ledge. Each of the blades has an endwise extension 57, projecting beyond the lateral finger 51 which engages the adjacent shoulder, although the abutment could be so disposed as to be engaged by any other portion of the blade which is spaced from its anchored end and from the fixed contact thereon.

When pressure is applied to the diaphragm, the actuator arm is of course swung upwardly; and as it passes its critical position, in which it is substantially coplanar with the contact carrying arm, the contact carrying arm will snap into engagement with the lower stationary contact 28. The abrupt engagement of these contacts is cushioned by reason of the fact that the resilient blade 50 yields downwardly to absorb the impact of the movable contact against the stationary contact. This yielding displacement of the stationary contact 28 is in part accounted for by torsional flexing of the blade due to the mounting of the contact at the end of the finger 51 and to a greater extent by lengthwise flexing of the blade. The ability of the stationary contact to follow the movable contact during any motion of the movable contact away from the stationary contact is due to the fact that the abutment is so located as to dispose the stationary contact slightly above the position which it assumes when the movable contact is engaged therewith and at rest. Stated another way, the stationary contact is so located that upon engagement by the movable contact it is necessarily carried slightly beyond the position it otherwise occupies, so that the contacts are urged together by biasing forces exerted by both the overcenter spring (acting through the contact carrying arm) and the blade 50. This mutual bias obtains throughout an appreciable range of movement of both contacts so that the stationary contact tends to follow the movable contact during any tendency of the latter to bounce or flutter.

Although the blade 50 which carries the upper stationary contact 27 is not free for upward lengthwise flexure because of its engagement with its abutment 56, it is capable of limited torsional flexure in response to twisting force imposed thereon through the lateral finger 51. Thus the mounting of the upper stationary contact to a substantial extent accommodates overtravel of the plunger 33 during switch resetting depression thereof and likewise effectively overcomes any tendency for the contacts to bounce apart by cushioning the impact of the movable contact against the upper stationary contact. It will be understood that the upper stationary contact, like the lower, is supported in such a position that some motion is necessarily imparted thereto by the movable contact upon engagement thereby.

From the foregoing description taken together with the accompanying drawings, it will be readily apparent that this invention provides mounting means for the stationary contacts of a snap acting switch whereby contact bounce and undesired separation of the contacts is eliminated and whereby all of the switch terminals may be readily accessibly located closely adjacent to one another and on one side of the switch housing. It will also be apparent that the stationary contact mounting means of this invention makes for an unusually compact switch wherein the terminal lugs at the exterior of the switch housing, in addition to being readily accessible, are protected from damage by portions of the switch housing.

What we claim as our invention is:

1. A snap switch comprising: an insulative base; a contact carrying arm having a movable contact at one end thereof; means mounting the other end of said arm on the insulative base and providing for swinging movement of said first named end of the arm in opposite directions; means for actuating said arm from one to another of a pair of defined positions with a snap action; an elongated resilient metal blade; means anchoring one end of the blade to the insulative base adjacent to the mounted end of the arm and disposing the blade alongside the arm, said blade being mounted at said one point only and flexible over its entire length; an integral finger on said blade projecting laterally therefrom over the arm and having a stationary contact engageable by said movable contact; and an abutment on the insulative base spaced from the anchored end of the blade, against which the blade is biased and which holds the blade in a position wherein the stationary contact is engaged by the movable contact on the arm a very small distance before the arm reaches one of its said defined positions and yieldingly accommodates overtravel of said arm beyond said defined position, so that the contacts are at all times held together by biasing force upon both the stationary and movable contacts until the arm is snapped out of its said one defined position.

2. A snap acting switch comprising: a housing having a stepped top wall, the lower level of which provides a ledge at the interior of the housing; a contact carrying

arm having a movable contact at one end thereof; means mounting the other end of said arm on said ledge at the interior of the housing with the arm projecting therefrom across the interior of the housing and with the first named end of the arm swingable toward and from the top wall of the housing; means including a movable member carried by the housing for actuating said arm from one to another of a pair of defined positions with a snap action; an elongated resilient metal blade; means anchoring one end of the blade to said ledge at the interior of the housing, edgewise adjacent to the mounted end of the arm, and disposing the blade alongside the arm, said blade being flexible in said directions; an integral finger on said blade projecting laterally therefrom over the arm and having a stationary contact engageable by said movable contact; and an abutment on the housing flatwise engaged with a portion of the blade and toward which the blade is biased, said abutment holding the blade, against its bias, in a position wherein the stationary contact is engaged by the movable contact on the arm a very small distance before the arm reaches one of its said defined positions and thus yieldingly accommodates overtravel of said arm beyond said defined position by reason of the fact that the contacts are at all times held together under force exerted by both the contact carrying arm and said blade until the arm is snapped out of its said one defined position.

3. The snap acting switch of claim 2 wherein said lower level of the stepped top wall of the housing also defines a ledge at the exterior of the housing; and wherein said means mounting said arm and said means anchoring the blade are electrically conductive fasteners which also secure terminals for the switch on said ledge at the exterior of the housing in readily accessible side-by-side relation but protected against accidental damage by reason of their location in the step on the housing.

4. The snap acting switch of claim 2 wherein the other position of said arm is defined by a stationary contact on a laterally projecting finger of a second similarly shaped and mounted elongated blade extending alongside the edge of the arm remote from said first designated blade and with its lateral extension projecting over the arm at the side thereof remote from the stationary contact on said first designated blade.

5. The switch of claim 1 wherein said mounting means for the arm and said means for anchoring one end of the blade comprise electrically conductive fastening means; and wherein said fastening means also secure terminal connectors to the insulative base adjacent to one another.

6. A switch comprising: an insulative housing having a stepped top wall, the lower level of which provides a ledge at the interior of the housing and a ledge at the exterior of the housing; a plurality of terminal connectors; a contact carrying arm having a movable contact at one end thereof; a conductive fastener mounting the other end of said arm on said ledge at the interior of the housing with the arm projecting therefrom across the interior of the housing and with the first designated end of the arm swingable toward and from the top wall of the housing, said fastener also securing a terminal connector on said ledge at the exterior of the housing; means including a movable member carried by the housing for actuating said contact carrying arm to carry the movable contact to and from a defined position; an elongated conductive member having at one end thereof a stationary contact cooperable with the movable contact on said arm; and a conductive fastener securing the other end of said conductive member to said ledge at the interior of the housing edgewise adjacent to the mounted end of the arm and projecting across the interior of the housing to dispose the stationary contact in a position to be engaged by the movable contact in said defined position of the latter, said fastener also securing a terminal connector on said ledge at the exterior of the housing so that the terminal connectors are all readily accessibly situated at one side of the housing but are protected by the step-defining wall portions of the housing.

7. A switch blade comprising: an elongated flexible blade of conductive material having two end portions; means on one end portion of the blade providing for anchoring the blade with said end portion thereof flatwise overlying a flat supporting surface; an integral finger on the blade remote from said one end portion of the blades, said finger projecting from one side edge of the blade from the other end portion of the blade to provide an abutment engageable with a stop; and means on the outer end portion of said finger providing a contact engageable by a movable contact.

8. The switch blade set forth in claim 7 wherein said one portion of the blade is offset flatwise from the portion of the blade having the finger thereon.

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