May 1, 1962 H. G. SIIBERG 3,032,620

SNAP ACTION SWITCH

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Fig. 1.

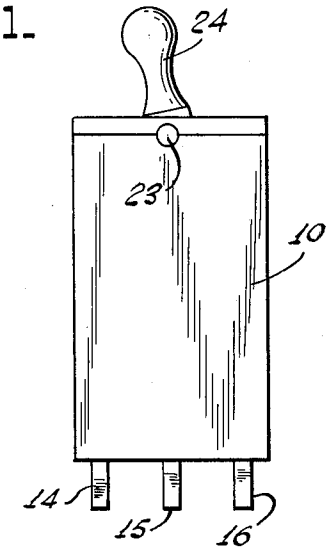


Fig. 2.

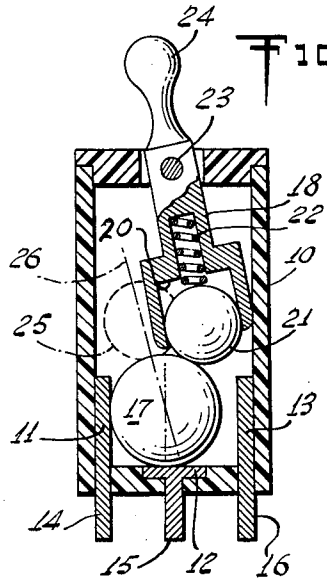


Fig. 3.

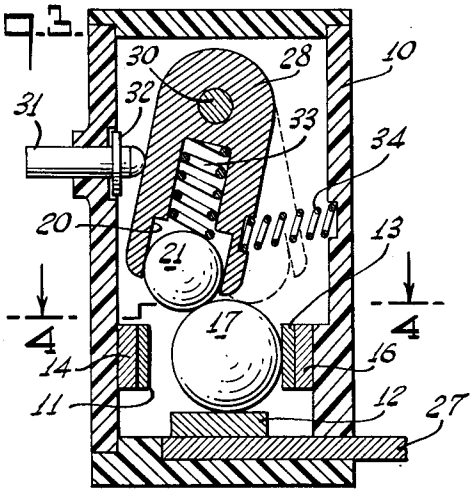


Fig. 4.

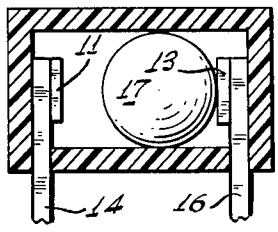


Fig. 5.

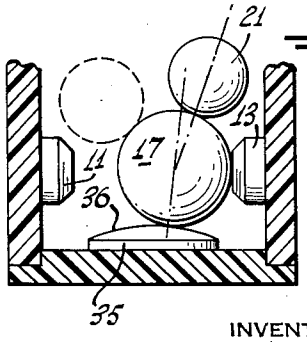
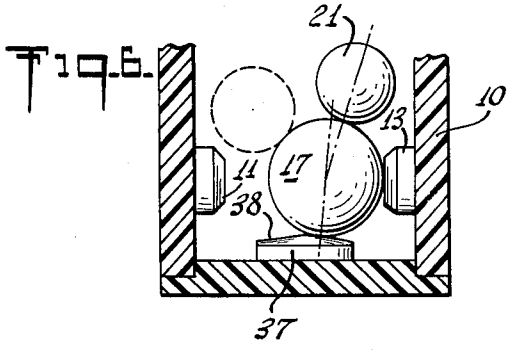


Fig. 6.



INVENTOR
HEMMING G. SIIBERG
BY Eyre, Mann & Lucas
ATTORNEYS

May 1, 1962 H. G. SIIBERG 3,032,620

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Fig. 7.

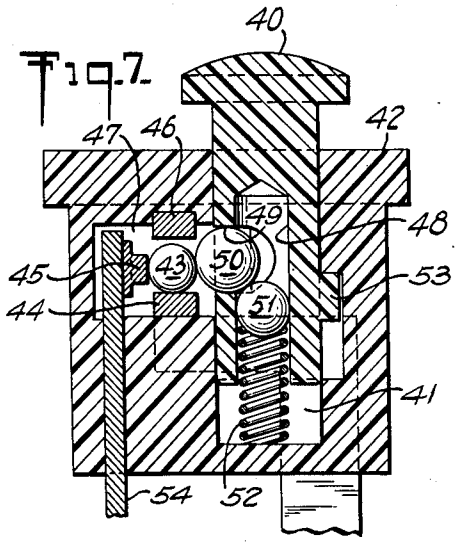


Fig. 8.

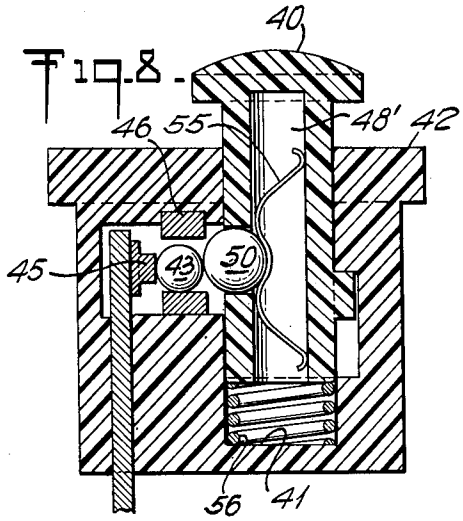


Fig. 9.

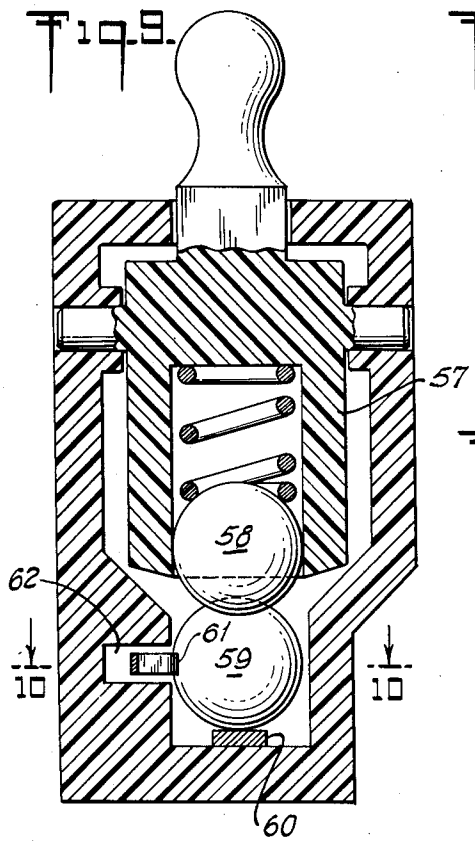


Fig. 10.

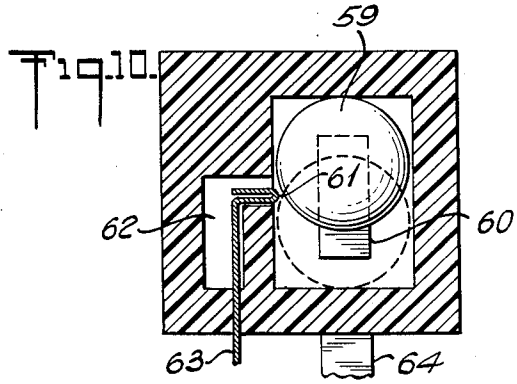
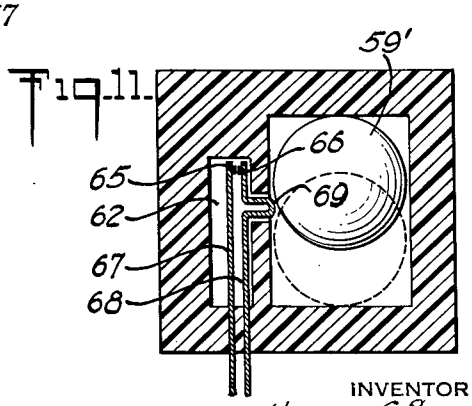


Fig. 11.



INVENTOR
HEMMING G. SIIBERG
BY
Eyre, Mann & Lucas
ATTORNEY

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Fig. 12.

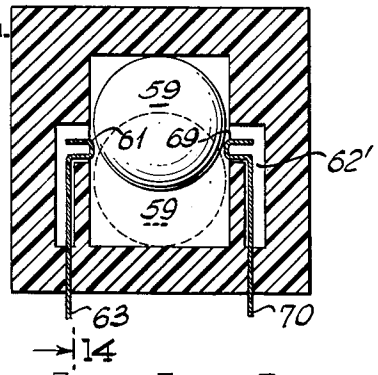


Fig. 13.

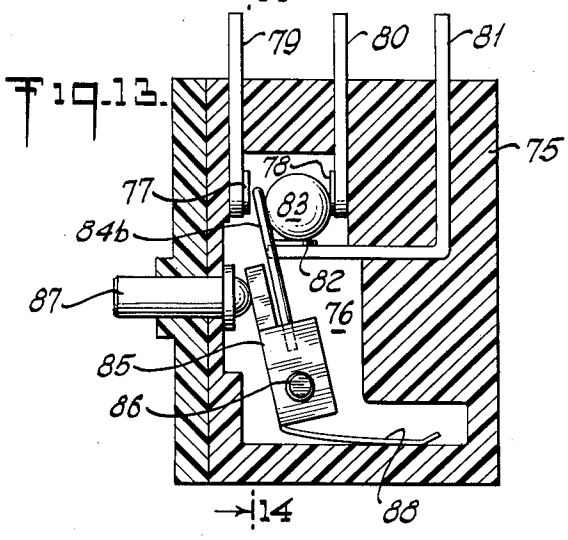
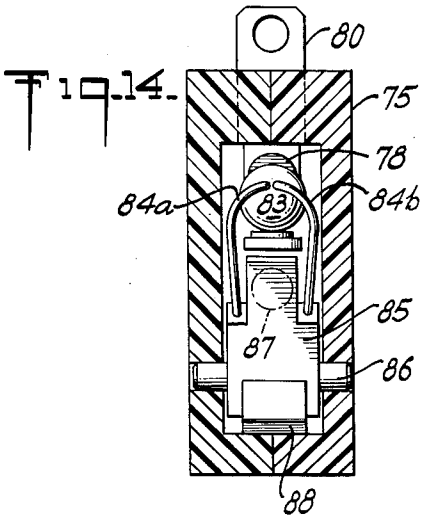


Fig. 14.



INVENTOR
HEMMING G. SIIBERG
BY
Eyre, Mann & Lucas
ATTORNEY

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3,032,620

SNAP ACTION SWITCH

Hemming G. Siiberg, Cranford, N.J., assignor to Tung-Sol Electric Inc., a corporation of Delaware

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8 Claims. (Cl. 200—67)

The present invention relates to snap acting switches of the type adapted for actuation by means external to a housing enclosing the switch mechanism, and comprises a novel rugged switch construction that requires relatively few parts, that is positive in action and can be made in miniature sizes.

The new switch includes a hard freely movable ball that rolls abruptly from one position to another under the influence of resilient means, and in so moving controls the opening or closing of contacts. The ball, in certain embodiments of the invention, is of conductive material and serves to complete a circuit in one or both positions or in passage therebetween. The resilient means in certain embodiments of the invention act on the movable ball through the intermediary of a second hard ball which is in rolling contact with the movable ball. The actuating means for the new switch may or may not include spring means biasing the movable ball to one of its two positions.

For a better understanding of the present invention, and of specific embodiments thereof, reference is made to the following description taken in connection with the accompanying drawings, of which:

FIG. 1 is a side view of a switch embodying the invention and showing an external actuating arm and three conducting terminals;

FIG. 2 is a cross sectional view of the switch shown in FIG. 1 and shows a conducting movable ball and a resiliently biased actuating ball within the housing;

FIG. 3 is a cross sectional view of an alternate form of snap action switch wherein the actuating arm is resiliently stressed to return to a normal position after actuation;

FIG. 4 is a cross sectional view of the switch shown in FIG. 3 and is taken along line 4—4 of that figure;

FIG. 5 is a partial cross sectional view of a switch similar to that shown in FIG. 3 but having a common terminal formed with a convex surface;

FIG. 6 is a partial cross sectional view similar to FIG. 5 but showing a common terminal formed with two planes set at an angle to each other;

FIG. 7 is a vertical sectional view through a snap action switch representing a further embodiment of the invention and adapted for actuation by longitudinal movement of a plunger;

FIG. 8 is a fragmentary sectional view of a switch similar to that of FIG. 7 but illustrating an alternative construction of a part thereof;

FIG. 9 is a vertical sectional view of a snap action switch embodying the invention and particularly adapted for use as a pulse or trigger switch;

FIG. 10 is a transverse sectional view taken on the line 10—10 of FIG. 9;

FIGS. 11 and 12 are transverse sectional views similar to FIG. 10 but illustrating alternative constructions of pulse or trigger switches;

FIG. 13 is a vertical sectional view of a snap action device embodying the invention wherein a conducting movable ball is directly acted upon by resilient actuating means; and

FIG. 14 is a detailed sectional view of the resilient actuating means and taken on the line 14—14 of FIG. 13.

Referring now to FIGS. 1 and 2 the snap action switch illustrated therein includes a housing 10 which may be made of molded plastic. At the lower end of the switch three terminals 11, 12 and 13 are mounted and these terminals are connected to lead-in conductors 14, 15 and 16 respectively. While these figures show a switch having three terminals it is obvious that either one of the terminals 11 or 13 secured to the inside of the housing may be omitted.

A conducting ball 17 is positioned inside the housing and always rests in contact with common terminal 12. The size of the housing and the ball 17 are such that when the ball is pressed into contact with two of the terminals as indicated in FIG. 2 a non-conducting space lies between the ball and the third terminal. This space is about one-fifth of the diameter of the ball but this relationship is not critical and other spacings may be employed.

The means for moving the conducting ball 17 from one contact position to another comprise a rocker 18 which includes a cavity 20 for holding an actuating ball 21. The ball 21 is resiliently stressed into contact with the conducting ball 17 by a helical spring 22 which is mounted in a recess in the rocker. The rocker is pivoted on a short shaft 23 and is actuated by a switch handle 24 which extends outside the housing. As shown in FIG. 2 the movement of the rocker 18 is limited by the inside surface of housing 10.

When the switch is in operation, the rocker arm may be in either one of two positions. In the position of the rocker arm shown in FIG. 2 the actuating ball 21 presses against the conducting ball 17 forcing it into conductive contact with terminals 11 and 12. When the rocker is actuated to its other position by manually moving switch handle 24, the ball 21 first moves to the position indicated by the dotted line 25. At this position the actuating ball exerts a force on the conducting ball in a direction indicated by dotted line 26 and this force quickly moves the conducting ball to its other position thereby making electrical contact between terminals 12 and 13.

The snap action switch shown in FIG. 3 is similar to that shown in FIGS. 1 and 2 except that the rocker arm is actuated from the side of the housing and includes an additional spring 34 which biases the arm toward the position shown in solid lines. This alternate form of switch includes a housing 10, a base lead-in conductor 27, and terminals 11, 12 and 13 as before. The conducting ball 17 is mounted as before and the actuating ball 21 is mounted in a cavity 20 in a rocker 28. The rocker 28 is mounted on a shaft 30 which is secured to a portion of the housing 10 and the rocker is actuated by a push button 31 which makes contact with the rocker and includes a limiting washer 32. The actuating ball 21 is resiliently stressed by a helical spring 33 and the rocker arm 28 is coupled to a spring 34 which moves the rocker 28 to its biased position, as shown in FIG. 3, when the button 31 is unactuated. The spacing of the conducting ball 17 and the three terminals is substantially the same as shown in FIG. 2 and the action of the conducting ball is the same as described above.

The cross sectional view shown in FIG. 4 shows that the conducting ball 17 is limited in its movement by the side walls of the housing 10 and the ball either makes contact with terminal 11 or 13. The lead-in conductors 14 and 16 may enter the housing from the side as indicated in FIG. 4.

Additional snap action may be secured by providing a convex upper surface to the common terminal. In FIG. 5, the common terminal 35 includes a convex surface 36 and in FIG. 6, a common terminal 37 includes another form of convex surface 38. Surface 36 may be formed as a portion of a sphere or a cylinder. In either case the action is the same since the conducting ball 17 rolls over the central portion of contact 35. When a convex surface is used, the traveling distance between terminals 11 and

13 is somewhat greater than when a flat surface is used but the action is faster and the force which presses the conducting ball into contact with either pair of terminals is considerably greater. The upper surface of terminal 37 is formed with two plane surfaces making an angle with each other and having an intersecting line positioned at the center of the terminal and the housing.

In the embodiment of the invention illustrated in FIG. 7 the actuating arm 40 is a plunger which is movable in a cavity 41 in the housing 42. A movable conducting contact ball 43 is positioned between three terminals or contacts 44, 45 and 46 in a recess 47 offset from the cavity 41. The plunger 40 has a longitudinal passage 48 therein which is open at its lower end and communicates through an opening 49 in the side wall of the plunger with the recess 47. An actuator ball 50 is positioned within the opening 49 and engages the contact ball 43 under pressure exerted on the actuator ball by a third ball 51. The ball 51 is resiliently urged against the actuator ball 50 by means of a spring 52 one end of which engages the undersurface of the ball 51 and the other end of which bears against the base of the cavity 41. Thus, in the position shown in the drawing, the contact ball 43 engages the contacts 44 and 45 under pressure. When the plunger 40 is depressed to compress the spring 52 the actuator ball 50 rolls over the surface of the contact ball 43 and moves that ball upwardly with a snap action into engagement with contact 46 and out of engagement with contact 44. Upon release of the plunger 40 the parts return to the position shown in FIG. 7. A stop, 53 by engagement with shoulders of the housing 42 limits the travel of the plunger in the housing. It will be understood that the contacts 44 and 46 are connected to external leads such as the lead 54 shown connected to the contact 45.

An alternative and simpler construction of the means for retaining the actuator ball 50 within the plunger opening and in resilient contact with the contact ball 43 is shown in FIG. 8. In this embodiment of the invention the ball 51 is omitted and replaced by a leaf spring 55 which engages the actuator ball 50 and presses it against the contact ball 43. In this embodiment of the invention the return spring 56 acting upon the plunger 40 is interposed between the base of the cavity 41 and the base of the plunger 40. The recess 48' in the plunger is preferably square in cross section. The operation of the switch being similar to that described in connection with FIG. 7, needs no further description.

The pulse or trigger switch illustrated in FIGS. 9 and 10 is similar in some respects to the switch illustrated in FIGS. 1 and 2 in that a rocker arm 57 through the intermediary of an actuator ball 58 moves a contact ball 59 transversely of the housing and with a snap action from one position to another. In this embodiment of the invention, however, circuit closure is effected only during transverse movement of the contact ball 59. As shown best in FIG. 10 the ball 59 continually engages a contact 60 but in either extreme position is out of engagement with any other contact. However, during movement from the position shown in full lines in FIG. 10 to the position shown in dotted lines in FIG. 10 the ball 59 engages a spring contact 61 positioned within a recess 62 of the housing. With a terminal 63 connected to the contact 61, and a terminal 64 connected to contact 60, a load connected in series with a source of energy across the terminals 63 and 64 will be pulsed each time the ball 59 passes from one position to the other position, that is, each time the rocker 57 is moved.

An alternative contact arrangement in a switch of the general type of that of FIG. 9 is shown in FIG. 11. In this embodiment of the invention the movable ball 59' need not be of conductive material. In the recess 62 of the base, a pair of contacts 65 and 66 are mounted on spring connections 67 and 68 respectively, the spring connections normally biasing the contacts out of engagement. Contact 60 is omitted. The spring connection 68 has a looped portion 69 which, during movement of the movable ball 59' from one position to the other is engaged and moved to bring the contacts 65 and 66 into momentary engagement.

Another arrangement in a trigger switch, and one in which the movable ball is of conductive material is shown in FIG. 12 wherein the contact 61 of FIG. 10 is retained, contact 60 omitted and a contact 69 is oppositely disposed to the contact 61 in a similar recess 62' in the base. When the ball 59 in its movement from one position to the other engages the contact 69 it also engages the contact 61 and thereby momentarily closes a circuit between lead 63 and a lead 70 connected to contact 69.

In the embodiment of the invention illustrated in FIGS. 13 and 14, a plastic housing 75 has an L-shaped cavity 76 therein. Oppositely disposed on the upper side walls of the cavity are contacts 77 and 78 connected respectively to terminal connections 79 and 80. A conducting L-shaped arm 81 comprising a third connection extends into the cavity and has a contact 82 mounted thereon upon which rests a conducting movable ball 83. In the position of the parts illustrated in FIG. 13 the ball 83 engages both contacts 78 and 82 and is urged into engagement there with by two leaf springs 84*a* and 84*b* (see FIG. 14). The lower ends of the springs 84*a* and 84*b* are mounted in a rocker element 85 which is pivotally mounted on a pin 86 extending transversely through the cavity with its ends fixed in the housing. The element 85 is biased into engagement with the inner end of an actuating plunger 87 by a leaf spring 88 one end of which is secured to the element and the other end of which extends into the arm of the L-shaped cavity 76. The plunger 87 extends out from the housing 75 for manipulation by an operator.

As best shown in FIG. 14 the normal spacing between the free ends of the springs 84*a* and 84*b* is less than the diameter of the ball 83. Hence when element 85 is rotated clockwise (as viewed in FIG. 13) by actuation of the plunger 87, the springs are first spread apart by engagement with the ball to the full diameter of the ball and then in moving back toward each other snap the ball away from contact 78 and into engagement with contact 77. Upon release of the plunger, spring 88 rocks element 85 counterclockwise and the ball snaps back into position to connect contacts 78 and 82.

The foregoing disclosure and drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense. The only limitations are to be determined from the scope of the appended claims.

I claim:

1. An electrical snap action switch comprising in combination a housing having a cavity therein, a hard movable ball in said cavity constrained by the walls thereof for travel in a given path between two extreme positions, means resiliently urged into contact with said ball and adapted, when actuated to ride over said ball and snap it from one extreme position of travel to the other extreme position, means accessible externally of said housing for actuating said resiliently urged means and electrical contacts within said housing controlled in response to movement of said ball.

2. The snap action switch as set forth in claim 1 wherein said ball is of electrically conducting material, and wherein one of said contacts is positioned for engagement with the ball throughout its path of travel and another of said contacts is positioned for engagement with the ball only at one extreme position of its travel.

3. The snap action switch as set forth in claim 1 wherein said ball is of electrically conducting material and said contacts are positioned at opposite sides of the path of travel of said ball and spaced for momentary engagement therewith during movement from one extreme position to the other whereby said switch serves as a trigger switch.

4. The snap action switch as set forth in claim 1 where-

in there are two contacts in said cavity spring biased apart and an element connected to one of said contacts and extending into the path of travel of said ball adapted, when engaged by said ball during movement from one extreme position to the other, to move the connected contact into engagement with the other.

5. An electrical snap action switch comprising, a terminal base including a first conducting terminal, a housing secured to said base and supporting a second conducting terminal, a conducting ball in said housing in contact with the first terminal, an actuating element mounted for movement in said housing and including an actuating ball resiliently pressed against the conducting ball, limit means secured to said housing for limiting the movement of said element and actuating ball to a predetermined distance, said actuating ball and said housing limiting the conducting ball to move between a position where the first and second terminals are connected and a position where said terminals are not connected.

6. The switch as set forth in claim 5 wherein said actuating element is a rocker mounted for pivotal movement.

7. The switch as set forth in claim 5 wherein said actuating element is a plunger mounted for longitudinal movement.

8. An electrical snap action switch comprising a terminal base including a first conducting terminal, a housing secured to said base and supporting a second conducting terminal, a conducting ball in said housing engaging said first terminal, an actuating element mounted for movement in said housing and including means resiliently pressed against the conducting ball, said element resiliently stressed to move to an unactuated position, and means external to the housing for moving the element to an actuated position, said means and said housing limiting the conducting ball to move between a position where the first and second terminals are connected and a position where said terminals are not connected.

References Cited in the file of this patent

UNITED STATES PATENTS

1,935,498	Bentley	Nov. 14, 1933
2,721,237	Yunker	Oct. 18, 1955

FOREIGN PATENTS

131,245	Australia	Feb. 3, 1949
1,063,686	Germany	Aug. 20, 1959