

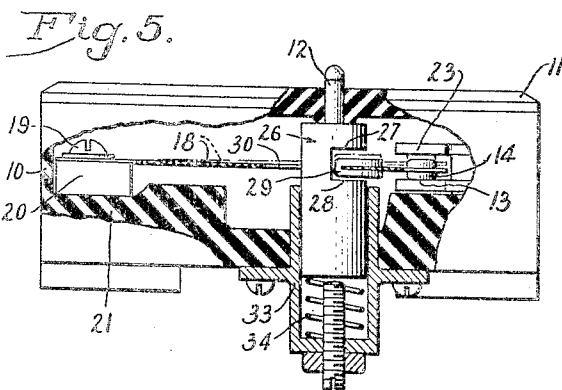
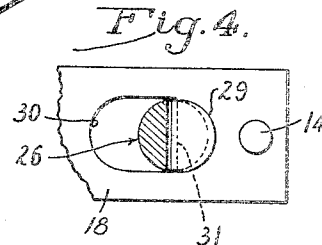
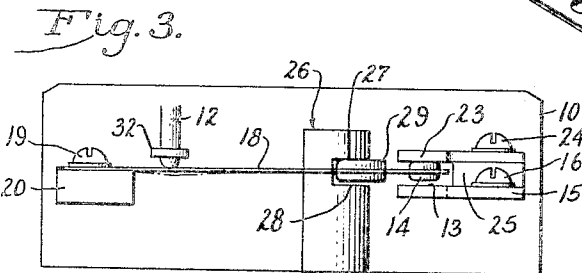
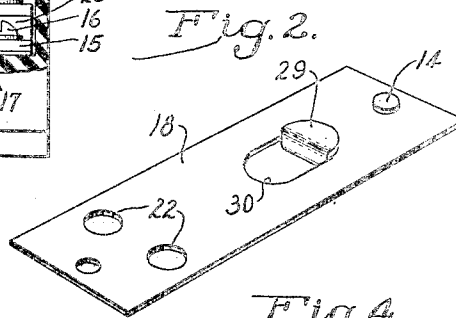
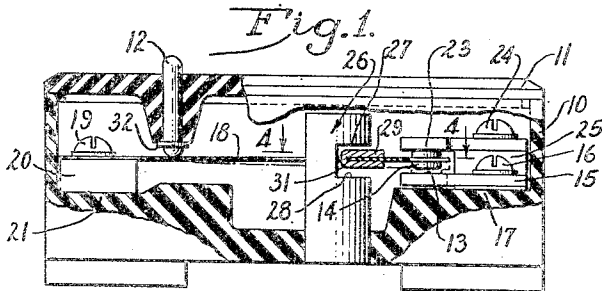
Aug. 15, 1950

E. D. LILJA
SNAP SWITCH

2,518,480

Filed June 1, 1946

3 Sheets-Sheet 1



INVENTOR.
Edgar D. Lilja
BY
Carlson, Peterson & Wolf
ATTORNEYS

Aug. 15, 1950

E. D. LILJA
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Fig. 6.

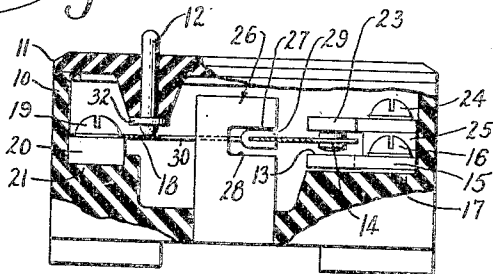


Fig. 7.

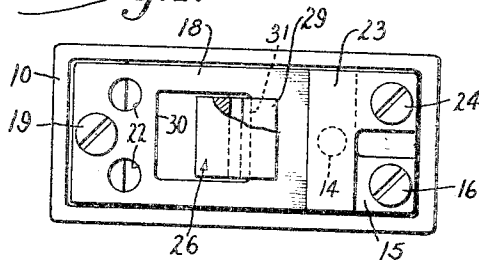


Fig. 8.

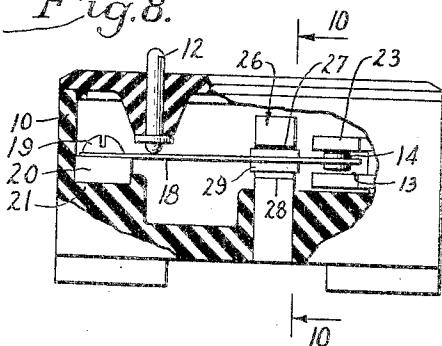


Fig. 9.

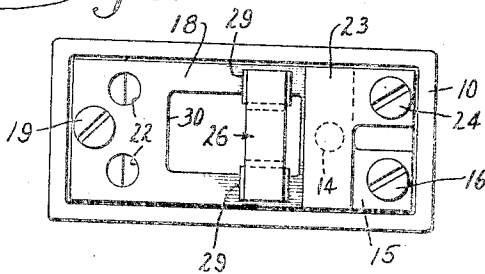
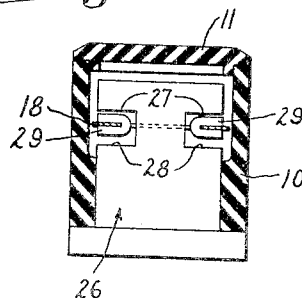


Fig. 10.



INVENTOR.
Edgar D. Lilja
BY
Carlson, Patzner, Hubbard & Wolf
ATTORNEYS

Aug. 15, 1950

E. D. LILJA
SNAP SWITCH

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Filed June 1, 1946

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Fig. 11.

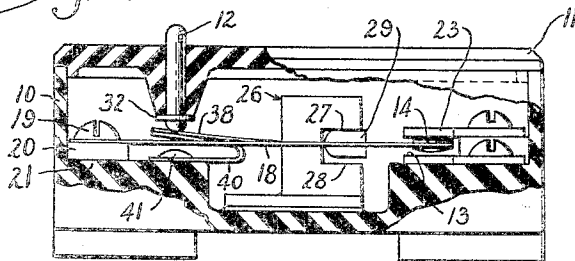


Fig. 12.

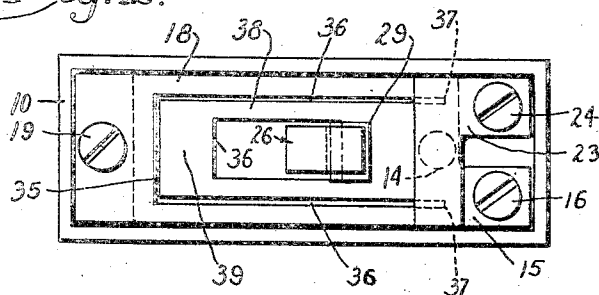


Fig. 13.

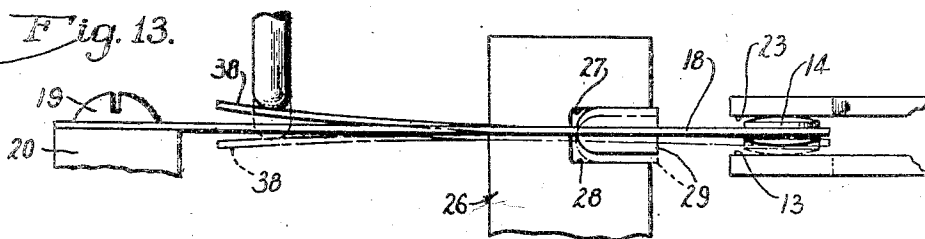
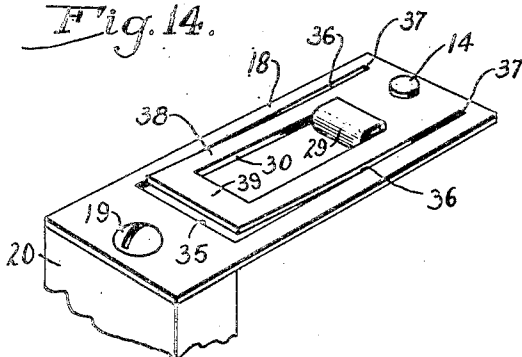


Fig. 14.



INVENTOR.
Edgar D. Lilja
BY
Carlson, Pitzner, Hussman & Wolfe
ATTORNEYS

UNITED STATES PATENT OFFICE

2,518,480

SNAP SWITCH

Edgar D. Lilja, Rockford, Ill., assignor to Barber-Colman Company, Rockford, Ill., a corporation of Illinois

Application June 1, 1946, Serial No. 673,750

5 Claims. (Cl. 200—67)

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This invention relates to snap acting switches of the type which are operable from a point externally of the casing in which the switch parts are housed.

The primary object is to provide a switch of the above character which is made more reliable and durable in its operation and simplified in construction and manufacture through the use of a novelly arranged magnet which is utilized to produce a detent or snap action.

A more detailed object is to provide such a switch in which the magnet is extended through an aperture formed in the contact carrying arm of the switch.

Another object is to provide a switch of the above character embodying a novel magnetic detent and a construction of the contact arm which provides for increasing the contact pressure up to the point of actual opening of the switch.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is an elevational view of the improved switch with a portion of its casing broken away and shown in section.

Fig. 2 is a perspective view of the contact arm.

Fig. 3 is a view of the operating parts illustrating a modification thereof.

Fig. 4 is a fragmentary sectional view taken along the line 4—4 of Fig. 1.

Figs. 5 and 6 are views similar to Fig. 1 showing modifications.

Fig. 7 is a plan view of the switch shown in Fig. 6 with the cover removed.

Figs. 8 and 9 are views similar to Figs. 6 and 7 showing another modification.

Fig. 10 is a section taken along the line 10—10 of Fig. 8.

Figs. 11 and 12 are views similar to Figs. 6 and 7 showing still another modification.

Fig. 13 is an enlarged elevational view of the principal parts of the switch shown in Fig. 11.

Fig. 14 is a perspective view showing the contact arm of the switch shown in Fig. 11.

In the illustrated embodiments of the improved switch, the switch proper and the operating parts thereof are mounted on and housed in an elongated box-like casing 10 preferably molded from plastic insulating material and closed by a cover 11 interfitting with or secured to the upper open end of the box. Actuation of the switch to open or close the circuit controlled thereby is effected by endwise movement of a pin 12 projecting

through and guided in the cover 11 perpendicular to the latter at a point spaced from one end thereof. The switch proper is of the open contact type comprising two opposed contacts 13 and 14, the former of which is formed by the flat upper surface of an L-shaped piece 15 of metal secured by a screw 16 against a ledge 17 which is spaced above the bottom of the casing. The other, or movable, contact 14 of the switch comprises a raised button on the free end of an elongated arm in the form of a thin strip 18 of resilient metal such as beryllium copper on the order of .010 of an inch in thickness. The strip is generally rectangular, and its other end is clamped by a screw 19 against a metallic block 20 which in turn is secured by the screw to a raised portion 21 on the casing bottom. A frictionless cantilever mounting is thus provided which permits free flexure of the arm 18, such flexure being facilitated by punching holes 22 in the strip adjacent its mounting.

Preferably the top of the block 20 is inclined upwardly toward the actuating pin 12 at a small angle sufficient to place the spring 18 under some initial tension. Thus, the free or contact end of the arm 18 tends to swing upwardly against a stop 23 formed by an overlying L-shaped piece of metal secured by a screw 24 to a ledge 25. The piece 23 cooperates with the movable contact 14 and may, if desired, form a second switch. The contacts 13 and 23 are spaced apart to allow the contact arm to move through the required range, usually about .012 of an inch.

In accordance with the present invention, the arm 18 is apertured intermediate its ends for projection therethrough of a permanent magnet 26 whose pole faces 27 and 28 are disposed on opposite sides of the arm and coax with an armature 29 carried thereby so as to cause movement of the arm with a snap or over center action. Preferably the aperture is a hole 30 of generally rectangular shape punched in the strip 18 nearer the contact end of the latter and centered laterally with respect to the longitudinal center line of the strip. The size and shape of the hole are such as to permit extension of the magnet through the latter during assembly of the switch.

The magnet 26 is preferably composed of highly retentive material such as that sold under the trade name "Alnico," and comprises a block of round (Figs. 1, 3, and 4), rectangular (Figs. 6 to 9), or other suitable uniform cross section formed on at least one side and near one end with a rectangular slot whose opposed parallel side walls constitute the pole faces 27 and 28. The

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other end of the magnet block is pressed into or molded in the casing bottom so as to locate the magnet pole faces in proper overlying and underlying relation with respect to the armature 29 and the space center between the contacts 13 and 23.

The armature 29 is formed in this instance by bending the flat piece of magnetic material upon itself and projecting the U thus formed over the edge 31 of the hole 30 after which the legs of the U are pressed together to fasten the armature to the contact arm. The armature projects substantially to the bottom of the slot in the magnet, and its thickness is correlated with the location and spacing of the pole faces so that when the contact 14 is centered in between its limit stops or coacting contacts 13 and 23, the armature surfaces will be spaced equidistant from the pole faces. For most applications it is desirable to space the armature and pole faces farther apart than the range of movement of the contact 14 so that the armature does not engage the pole faces in the opposite limit positions of the contact (see Fig. 1). If, however, greater pressure between the movable contact 14 and its cooperating contact is desired, the spacing of the pole faces is made such that the armature comes into actual engagement with the faces in the opposite limit positions of the movable contact as illustrated in Fig. 3.

The magnetic structure above described provides for movement of the contact arm 18 between limit positions with a quick snap action in response to the application of inward pressure to the actuating pin 12 or the release of such pressure on the pin, such movement of the pin effecting relative movement between the magnet and the arm 18. In the form shown in Figs. 1 to 4 and 6 to 10, the actuating force is applied directly to the contact arm, and, for this purpose, the actuating pin is positioned for engagement of its inner end with the center of the contact arm 18 at a point spaced a short distance from the mounting block 20. Under the initial stress of the contact arm, the pin 12 is urged outwardly to a limit position determined by engagement of a shoulder 32 with the underside of the cover boss. Under this stress, together with the upwardly directed attractive force exerted on the armature by the magnet, the movable contact is held up against the stop 23. As the pin 12 is pressed inwardly, the arm 18 is bent downwardly as illustrated in phantom in Fig. 3, thereby exerting on the armature a downwardly directed mechanical force which acts in opposition to the upwardly directed magnetic force. When this mechanical force exceeds the magnetic force, the armature starts to move downwardly and the magnetic force decreases more rapidly than the mechanical force, thereby causing the armature to move quickly. As the armature reaches the magnetic center between the pole faces, the magnetic force reverses, thereby pulling the armature downwardly until the contact 14 engages the lower contact 13 as shown in phantom in Fig. 1. The entire movement of the contact 14 takes place with the desired snap action.

Reverse movement of the contact 14 to open the switch occurs when the pressure on the pin 12 is released. The magnet then operates in a similar way, but in the reverse direction, to produce the snap action which is initiated when the force stored in the spring strip 18 overcomes the magnetic force on the armature.

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It will be observed that the detent action for opening and closing the switch, being produced magnetically, does not depend on friction or other variable factors nor on a precise adjustment of mechanical parts. It is obtained by relatively simple and compact structure made possible by extension of the magnet through an aperture in the spring contact arm. This arrangement reduces the size of the magnet to a minimum and facilitates its mounting in the switch case. The resulting switch structure may be manufactured at a low cost and is more durable and reliable in its operation than switches of the same general type heretofore produced.

Instead of applying the actuating force directly to the spring arm 18, the pin 12 may be mounted on the magnet 26 as shown in Fig. 5 so that the pole faces are moved back and forth to actuate the switch. For this purpose, the magnet is guided for axial movement in a sleeve 33 on the casing base and urged upwardly to a limit position by a spring 34. If desired, the magnet 26 may take other forms in addition to those of rectangular or circular cross section mentioned above. For example, the magnet may be H-shaped as shown in Figs. 8 to 10 and formed with two sets of pole faces 27 and 28 defining two slots which open laterally relative to the contact arm instead of longitudinally of the latter as in the forms previously described. These pole faces coact with two armatures 29 mounted at the sides of the hole 30 in the spring arm so as to balance the magnetic forces with respect to the longitudinal center line of the contact arm 18. In this case, the magnet is turned through a right angle to permit insertion thereof through the hole 30 and then twisted into the position shown before the parts are fastened together.

The magnetic detent arrangement described above may be utilized to advantage to produce a switch in which the pressure between the switch contacts is increased up to the time of separation of the contacts in response to an applied actuating force. This may be accomplished with the construction shown in Figs. 11 to 14 in which the spring strip 18, in addition to being punched out to form the hole 30, is severed transversely at 35 to points short of the opposite side edges of the strip and is also formed with longitudinal splits 36 extending along opposite sides of the strip to points 37 short of the free or contact end of the strip 18. The cantilever mounting of the strip as a whole is thus preserved, but the central portion 38 thereof with the hole 30 therein is itself adapted to flex independently about an axis extending transversely of the contact end of the strip so as to constitute an auxiliary cantilever disposed within the main cantilever arm 18 but projecting in the opposite direction. The actuating pin 12 is arranged to act on the free end 39 of the auxiliary cantilever at the center thereof. This end is urged upwardly by a separate spring 40, herein shown as of the hairpin type, having one leg anchored at 41 on a raised portion of the casing bottom with its other leg bearing upwardly on the underside of the free end 39 of the auxiliary spring arm 38.

When the external pressure on the actuating pin is released, the auxiliary ram 38 is urged upwardly (Fig. 11), producing a resultant force which, together with the upwardly directed attractive force of the magnet, flexes the main spring arm 18 upwardly to hold the contact 14 against the contact 23 and allow the armature 29 to freeze against the upper pole face 27. As

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the pin 12 is pressed inwardly, the auxiliary arm 38 is flexed downwardly past the plane of the main arm 18 thereby storing energy in the arm 38 until the resulting mechanical force overcomes the magnet force so as to move the armature and the contact 14 downwardly as permitted by flexure of the main spring arm 18, this position of the parts being shown in phantom in Fig. 13. During this flexing of the arm 38 and until the magnet force is actually overcome, the auxiliary arm fulcrums about the pole face 27 so that the energy stored in the arm is applied in an upward direction to increase the pressure between the contacts 14 and 23 up to the point of separation of these contacts.

When the pressure on the actuating pin is released, the reverse action takes place under the force of the spring 40 which bends the auxiliary arm 38 upwardly causing the latter to fulcrum about the pole face 28 and increase the pressure between the contacts 13 and 14. Finally, when the magnet force is overcome, the armature and the movable contacts snap upwardly back to the position shown in Fig. 11. By thus increasing the contact pressure up to the point of switch opening, the switch is well suited for actuation by delicate instrumentalities and under adverse conditions, for example, to vibration of the parts on which the switch is mounted.

I claim as my invention:

1. A switch comprising a base, a flat spring arm extending along said base, means securing one end of said arm to said base to provide a cantilever mounting for the overhanging portion of said arm, means coacting with the opposite free end of said arm to limit the movement thereof in opposite directions, an independently flexible auxiliary cantilever arm carried by said first arm at said free end with the auxiliary arm projecting along said main arm to a point adjacent the anchorage of the latter, said auxiliary arm having a hole therein intermediate its ends, a magnetic armature carried by said auxiliary arm at one edge of said hole, a magnet on said base projecting through said hole and providing pole faces on opposite sides of said armature spaced apart so that one face engages said armature when said free end is engaging the corresponding one of said stops, spring means engageable with the free end of said auxiliary arm and tending to bend it in one direction, and actuator means for moving such end in the opposite direction.

2. A switch comprising a flat metallic strip, means supporting one end of said strip to provide a cantilever mounting for the overhanging portion of said strip, means coacting with the opposite free end of said arm to limit the movement thereof in opposite directions, an independently flexible auxiliary cantilever arm punched out of said strip and projecting along said strip to a point adjacent the anchorage of

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the latter, said arm having a hole therein intermediate its ends, a magnetic armature carried by said arm, a magnet projecting through said hole and providing pole faces on opposite sides of said armature and acting thereon to cause movement of the arm between said stops with a snap action, and means engageable with the free end of said arm tending to bend the latter in opposite directions.

3. A switch comprising means providing two flexible cantilever arms one mounted on the free end of the second arm and projecting along the latter toward the anchored end thereof, means engageable with the free end of said second arm to limit the opposite flexing movements thereof, an armature carried by said first arm, a magnet having spaced pole faces disposed on opposite sides of said armature and respectively engageable therewith in the opposite limit positions of said free end, and actuating means engageable with the free end of said first arm to flex the latter in opposite directions.

4. A switch comprising an elongated flexible arm supported at one end for lateral flexure of the projecting end portion, contact means associated with the free end of said arm to limit the movements thereof in opposite directions, an actuating member movable transversely of said arm, an auxiliary arm mounted on the free end of said first arm and engageable at its free end with said member, and magnetic means acting on said second arm to cause movement thereof with a snap action while providing a fulcrum for increasing the pressure on said contact means up to the point of initial movement of said first arm.

5. A switch comprising an elongated flexible arm supported at one end for lateral flexure of the projecting end portion, contact means associated with the free end of said arm to limit the movements thereof in opposite directions, an actuating member movable transversely of said arm, an auxiliary arm mounted on the free end of said first arm and engageable at its free end with said member, and magnetic means acting on said second arm to cause movement thereof with a snap action.

EDGAR D. LILJA.

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