Jan. 15, 1957 C. L. COX, JR 2,777,911

HILL-AND-VALLEY SWITCH

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Fig. 1.

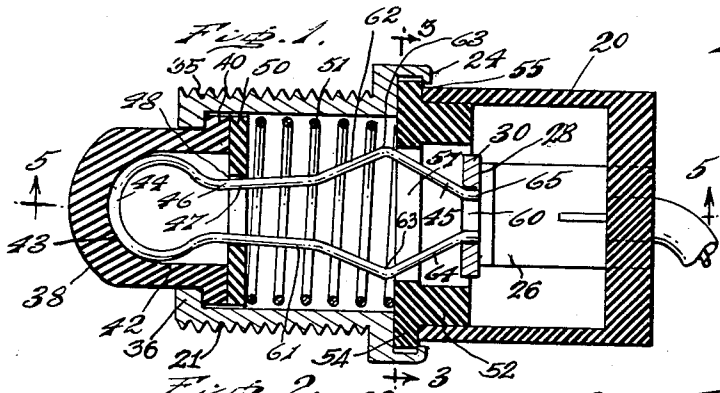


Fig. 3.

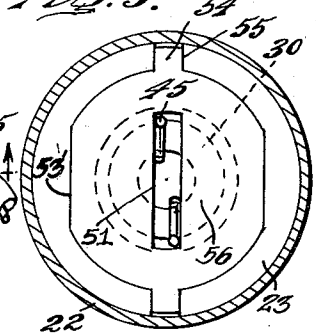


Fig. 2.

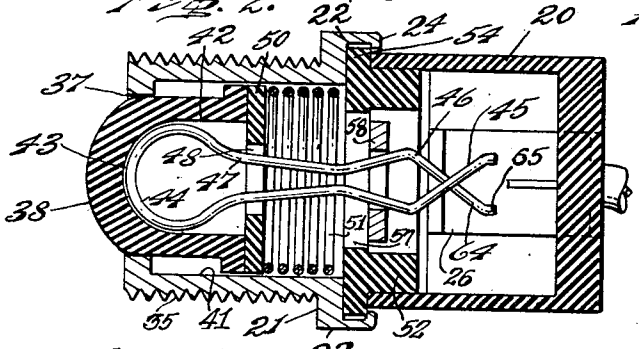


Fig. 4.

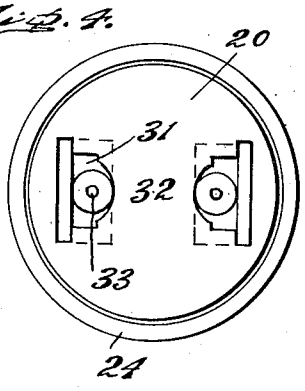
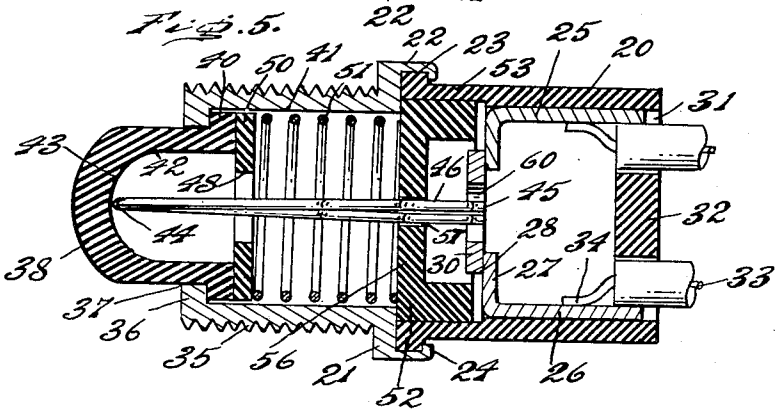


Fig. 5.



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Fig. 6.

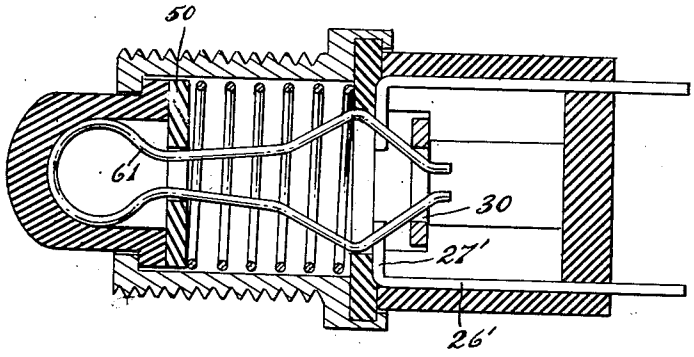


Fig. 7.

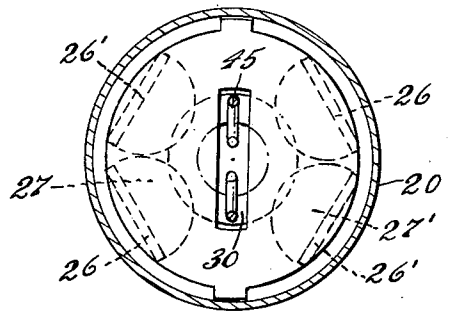
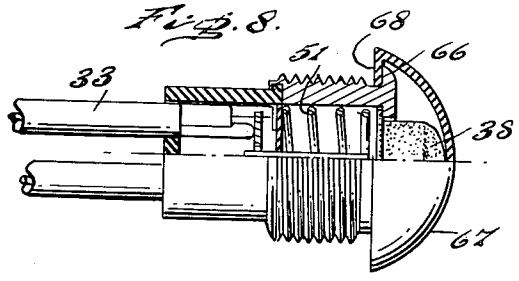


Fig. 8.



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HILL-AND-VALLEY SWITCH

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Application November 24, 1954, Serial No. 470,844

6 Claims. (Cl. 200—77)

The precent invention relates to hill-and-valley switches of the type used for controlling electric circuits, and primarily for instantaneous opening or closing of circuits.

A purpose of the invention is to make hill-and-valley switches more reliable in operation and particularly to remove the hazards incident to failure of shorting bar springs.

A further purpose is to incorporate the hill-and-valley cam function into a spring member which will itself move the shorting bar.

A further purpose is to guide a hill-and-valley spring member by the walls of a slot in insulating material to prevent the spring member from turning.

A further purpose is to secure the U-bend of a hill-and-valley spring member to the push button of the switch.

A further purpose is to provide an eye at the U-bend of the hill-and-valley spring member and to secure the eye in floating position in the socket of a push button.

A further purpose is to restrain the eye in the socket of the push button by a washer spring urged against the push button by a retraction spring.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which my invention may appear, selecting the form shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is an axial section of a hill-and-valley switch according to the invention in retracted position.

Figure 2 is a view similar in Figure 1 showing the push button advanced.

Figure 3 is a transverse section on the line 3—3 of Figure 1.

Figure 4 is a rear elevation.

Figure 5 is an axial section of the switch in retracted position, the section being taken on the line 5—5 of Figure 1.

Figure 6 is a diagrammatic longitudinal section showing the invention applied to a normally open switch, whereas Figures 1 to 5 show a normally closed switch.

Figure 7 is a front end transverse section showing the switch of the invention applied to a two circuit arrangement, one circuit being normally closed and the other circuit normally open.

Figure 8 is a longitudinal half section showing a flanged switch in accordance with the invention.

Describing in illustration but not in limitation and referring to the drawings:

Hill-and-valley switches have been widely employed using a rigid hill-and-valley cam, and a shorting bar having a shorting spring or springs which urge the shorting bar to one of two opposed longitudinal positions as the hill-and-valley cam moves. Efforts have also been made with limited success to employ a hill-and-valley spring to manipulate a rigid shorting bar.

One of the advantages of the present invention is that

the hill-and-valley spring member is securely anchored against turning so that it is not likely to move into a position in which it could interfere with switch functioning.

A further advantage of the invention is that it is not necessary to anchor the hill-and-valley spring member rigidly with respect to the push button nor is the push button restrained against turning. The hill-and-valley spring member suitably floats with respect to the push button, and an eye formed on the U-bend end of the hill-and-valley spring member is held in a socket on the push button preferably by an insulating washer.

The lateral dimension of the switch has been reduced to a minimum by providing for crossing of the free ends of the hill-and-valley spring member in one position. Furthermore, positive assurance of holding the shorting bar in its normal position is obtained by providing dwells or parallel stretches on the ends of the hill-and-valley spring member to hold the shorting bar.

Considering now the drawings in detail, the switch housing is formed by a rear insulating cup 20 and a front metallic housing portion 21 joined together by a flange 22 on the front metallic portion which extends around opposed rim portions 23 at the front of the cup and is rolled over at 24.

The insulating cup has a hollow interior and secured as by comolding in the walls at suitably diametrically opposite positions are metallic contacts 25 and 26 which have forward radially inward projecting portions 27 which lie in a common shorting plane at 28 to engage a metallic shorting bar or washer 30 of electrically conducting material in closed position of the switch.

Openings 31 adjoining the fixed contacts extend through the insulating back wall 32 of the cup and receive wires or pigtails 33 which are united to the contacts in any suitable way as by soldering at 34.

The forward housing portion 21 has an externally threaded shank 35 which is intended to be mounted in the control panel, suitably on an airplane, automobile or other installation, by nuts not shown. At the front the housing is inwardly flanged at 36 and provides a suitably round push button opening 37 through which extends the forward portion of a push button 38 suitably of insulating material such as phenolic plastic.

The push button at its rearward end is outwardly flanged at 40 to engage and ride in a longitudinal bore 41 in the forward housing, the flange 40 in normal position preventing the push button from moving forward far enough to leave the housing. The push button has a desirably circular concentric rearwardly directed socket 42 which desirably conforms to a segment of a sphere at its forward end 43. The socket receives and engages a generally circular eye portion 44 at the base of the U of a hill-and-valley wire spring member 45 suitably of spring metal such as spring steel, spring-grade stainless steel, beryllium copper or the like. Rearwardly of the eye 44 the spring member has opposed cooperating arms 46 which are relatively close together at 47 to the rear of the eye, and pass through opening 48 at the center of an insulating washer 50 suitably of the outside diameter of the flange portion 40 of the push button, and interposed between the push button and a helical retracting spring 51 which acts in the bore 41 behind the push button. The inside diameter of the insulating washer is small enough to hold the eye portion 44 of the hill-and-valley spring member against the push button. The retracting spring seats at the rear on an insulating guide washer 52 which is generally tubular, is held in a recess 53 at the forward end of the insulating cup 20, and is positioned and keyed against turning or moving longitudinally by insulating ears 54 best seen in Figures 1, 2 and 3 which extend out into notches 55 at diametrally opposite positions in the forward end of the

cup and are secured by engagement on one side by the metallic housing portion and on the other side by the insulating cup and the rolled-over portion **24** of the metallic housing flange. Also flats **53'** on the recess **53** mate with corresponding flats on the guiding washer and prevent turning.

The guiding washer **52** has a partition **56** which extends across the interior of the housing and provides a narrow elongated guiding slot **57** through which pass the arms **46** of the hill-and-valley spring member. Thus the hill-and-valley spring member cannot turn because of engagement with the walls of the slot **57**, but the push button is free to turn independently.

The partition **56** limits the forward movement of the shorting bar by engaging and holding it at **58** as best seen in Figure 2.

The shorting bar has an axial interior opening **60** which receives the free ends of the arms of the hill-and-valley spring member. Rearwardly of the eye the hill-and-valley spring member continues straight at **61** behind the washer **50**, and then has opposed rearwardly diverging tapered portions **62**, then opposed apexes **63**, then opposed rearwardly converging tapered portions **64** and finally generally parallel dwell portions **65** at the very rear.

In operation, with the switch in normal position, the dwell portions **65** behind the rearwardly converging tapered portion **64** engage the interior of the shorting bar and hold it firmly in circuit closing position against the shorting plane **28** of the contacts. When the operator pushes in on the push button as shown in Figure 2, the rearwardly converging tapered portion **64** are first forced together by cam action on the interior of the shorting bar until the apexes **63** are passed and then the rearwardly diverging tapered portion **62** of the spring hill-and-valley member cause the shorting bar to snap or jump forward, breaking the contact suddenly with a minimum of arcing, and reaching the open switch position of Figure 2, in which the shorting bar engages the insulating partition. As the hill-and-valley spring member has moved inwardly its free ends engaging one another have desirably crossed in a side by side position as shown in Figure 2, thus minimizing the diameter required. When the operator releases his finger from the push button, the push button retracts under the action of the retracting spring **51** and as the push button retracts it carries with it the hill-and-valley spring member due to the pull of the walls of the opening in washer **50** on eye **44**, and the rearwardly diverging tapered portions **62** of the hill-and-valley spring member first are pulled through the opening in the shorting bar until the apexes **63** are passed, and then the shorting bar encountering the rearwardly converging taper portions **64** of the hill-and-valley spring member snaps rearwardly into closed position as shown in Figures 1 and 5, closing the switch suddenly.

In either open or closed position the user is free to turn the push button and this has no effect in causing short circuiting because the hill-and-valley spring member is restrained against turning and the hill-and-valley spring member floats in the socket of the push button.

The question of whether the shorting bar makes contact in its rearward or forward, or in both forward and rearward, positions is relatively immaterial, and accordingly the form shown in which the circuit is broken in the forward position of the shorting bar and closed in the rearward position is merely illustrative of one of the possible forms.

The invention is equally applicable to normally open switches or to normally closed switches and to single circuit and multiple circuits. In the form of Figures 1 to 5 the switch is normally closed.

Figure 6 shows diagrammatically a similar switch having normally open contacts **26'** having inwardly projecting portion **27'** which are closed by the shorting bar **30** when the switch is depressed.

Figure 7 shows a two circuit switch having contacts **26** in the position of the contacts in Figures 1 to 5 inclusive which are normally closed and contacts **26'** in the position of the contacts of Figure 6 which are normally open. The contacts **26'** have inwardly projecting portions **27'** placed similarly to the inwardly projecting portions **27'** in Figure 6.

While the switch in the forms previously shown is tubular at the front, it is sometimes preferable to employ a flanged switch as shown in Figure 8. Here the housing is flanged over at the front at **66** and receives an elastomer cap **67** which extends over the push button and grips around the housing under the flange at **68**.

The question of whether the terminals are made by wire pigtails, by solder terminals or by binding post attachment devices is immaterial from the standpoint of the invention.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an electric switch including a housing, spaced contacts having contact portions in a common shorting plane in the housing, a shorting bar in the housing having an interior opening and movable from a position remote from the contacts to a position in the shorting plane against the contacts, push button means reciprocable in the housing and retracting spring means for the push button means, the invention which comprises a generally U-shaped hill-and-valley spring having opposed arms, secured at one end to the push button, extending at the other end through the opening in the shorting bar, and having opposed cooperating hump portions which are adapted to pass through the opening in the shorting bar and deflect the shorting bar toward and away from the shorting plane, and an insulating guide secured to the housing, having a slot through which the hill-and-valley spring passes between the push button and the shorting bar and restraining the hill-and-valley spring against turning.

2. An electric switch according to claim 1, in which the base of the U of the hill-and-valley spring is in the push button means.

3. An electric switch according to claim 2, in which there is a socket in the interior of the push button means receiving the base of the U of the hill-and-valley spring, and the hill-and-valley spring has an eye in the socket, in combination with a washer interposed between the retracting spring means and the push button means, having an opening through which the hill-and-valley spring passes which is too small to pass the eye.

4. An electric switch according to claim 3, in which the push button socket turns freely around the eye.

5. An electric switch according to claim 1, in which the ends of the hill-and-valley spring arms cross when the shorting bar moves to the position nearest the push button means.

6. An electric switch according to claim 1, in which the hill-and-valley spring has arms have parallel dwell portions at the ends which hold the shorting bar in the limiting position remote from the push button means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,466,970	Schellman	Apr. 12, 1949
2,722,579	Rohacs	Nov. 1, 1955

FOREIGN PATENTS

427,865	Germany	Apr. 21, 1926