May 20, 1947. J. H. SCHELLMAN 2,420,913

TAPER SNAP SWITCH

Filed Sept. 27, 1943 4 Sheets-Sheet 1

Fig. 1.

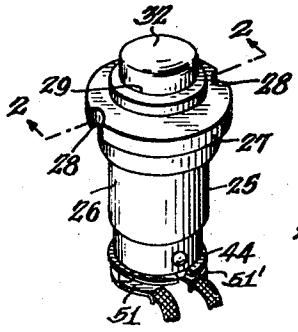


Fig. 2.

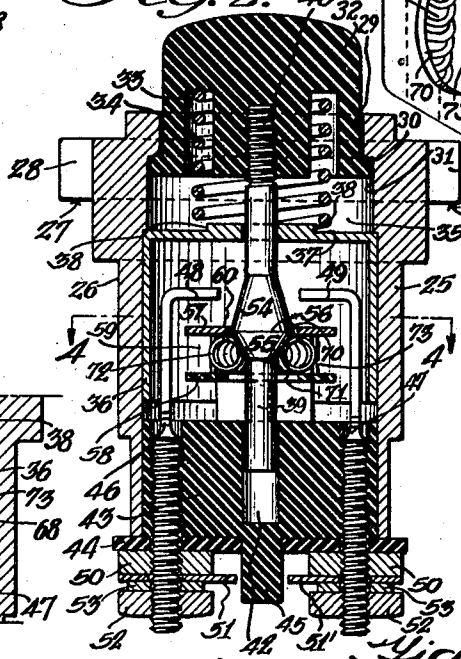


Fig. 6.

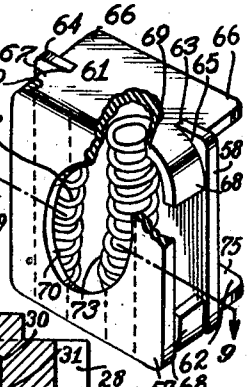


Fig. 3.

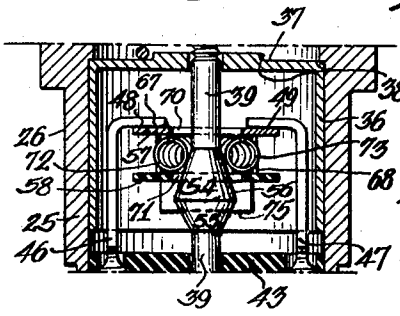


Fig. 8.

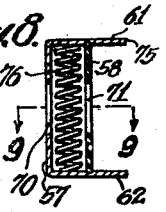


Fig. 5.

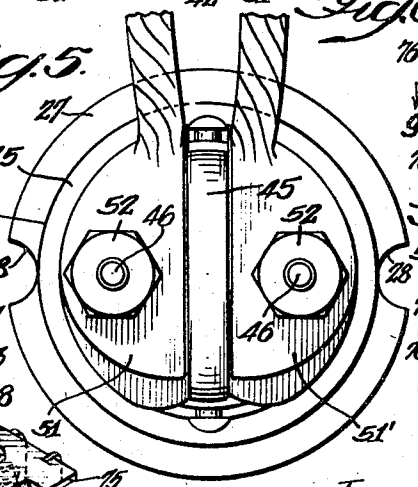


Fig. 4.

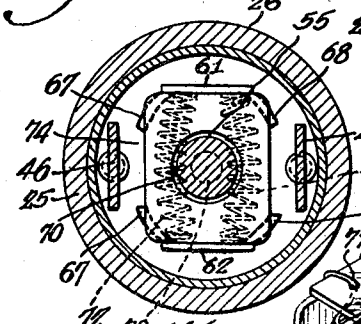


Fig. 9.

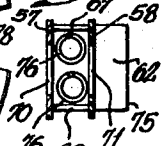
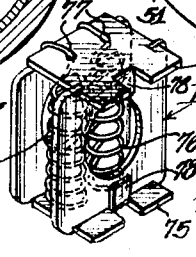


Fig. 7.



Witness:
Walter Thusy

Inventor
Joseph H. Schellman
by Steel Fechheimer & Eckhardt
Attorneys

May 20, 1947. J. H. SCHELLMAN 2,420,913

TAPER SNAP SWITCH

Filed Sept. 27, 1943 4 Sheets-Sheet 2

Fig. 10.

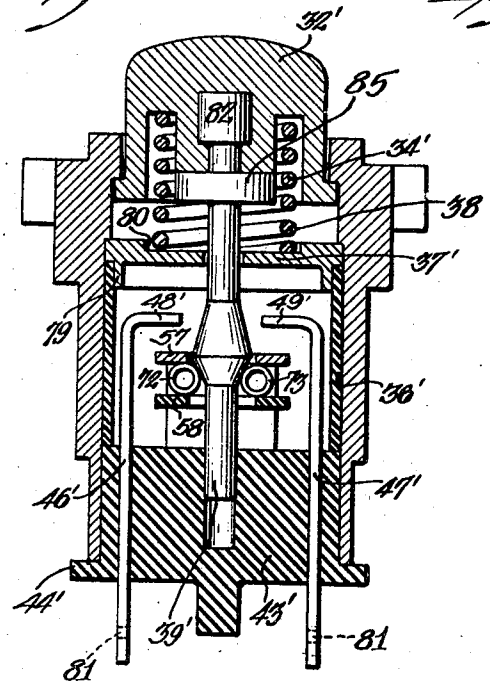
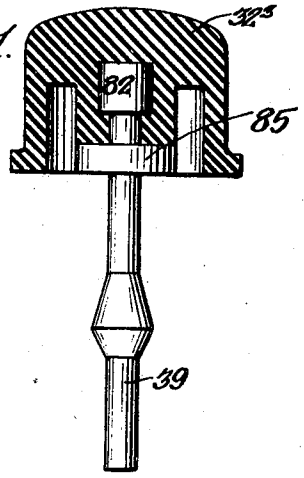



Fig. 11.



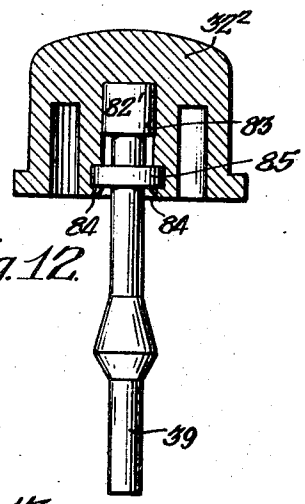




Fig. 12.

Fig. 14.

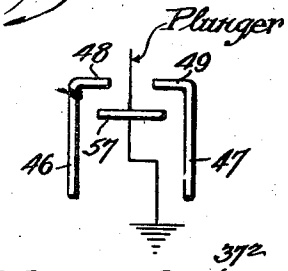



Fig. 13.

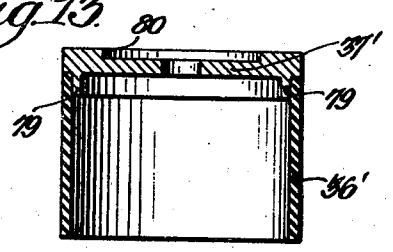
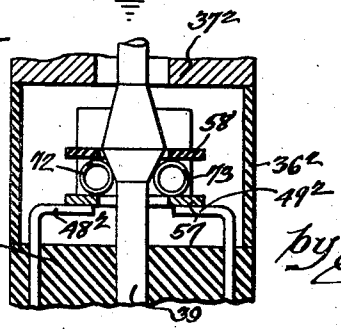



Fig. 25.




Witness:
Walter Chund

Inventor:
Joseph H. Schellman,
by Cushman, Darby & Cushman
Attorneys.

May 20, 1947. J. H. SCHELLMAN 2,420,913

TAPER SNAP SWITCH

Filed Sept. 27, 1943 4 Sheets-Sheet 3

Fig. 16.

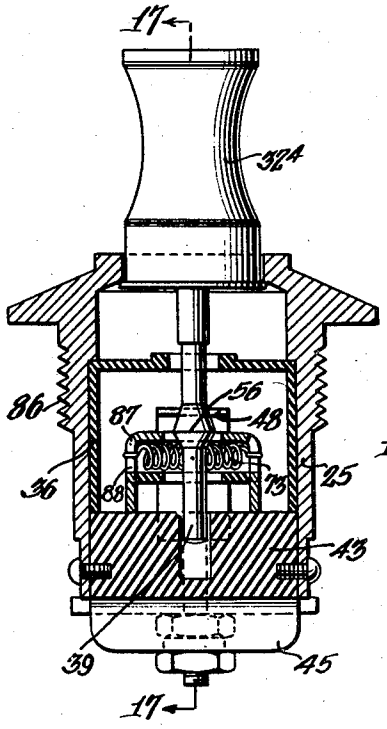



Fig. 17.

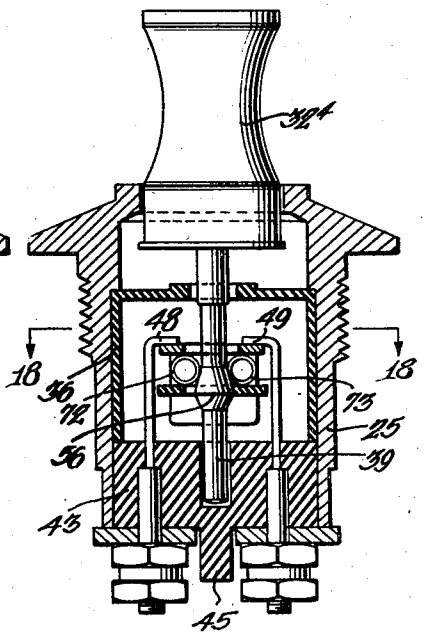



Fig. 19.

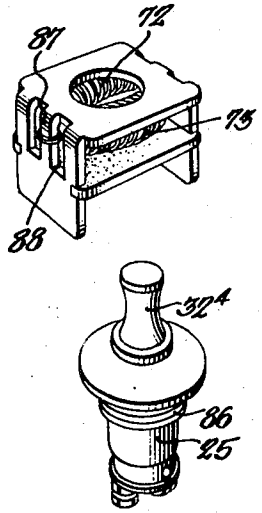



Fig. 18.

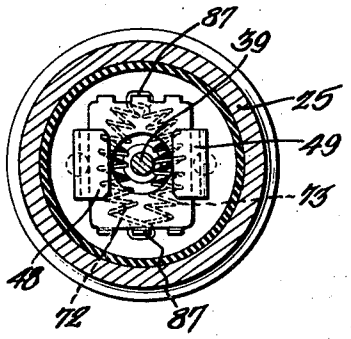



Fig. 15.

Witness:
Walter Chisu

Inventor
Joseph H. Schellman
by Wm. Steell Jackson and Son
Attorneys.

May 20, 1947. J. H. SCHELLMAN 2,420,913

TAPER SNAP SWITCH

Filed Sept. 27, 1943 4 Sheets-Sheet 4

Fig. 21.

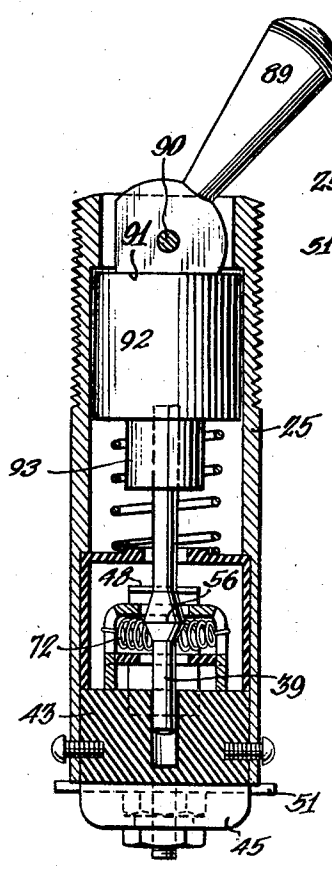



Fig. 20.

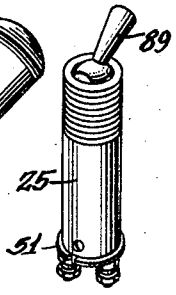



Fig. 22.

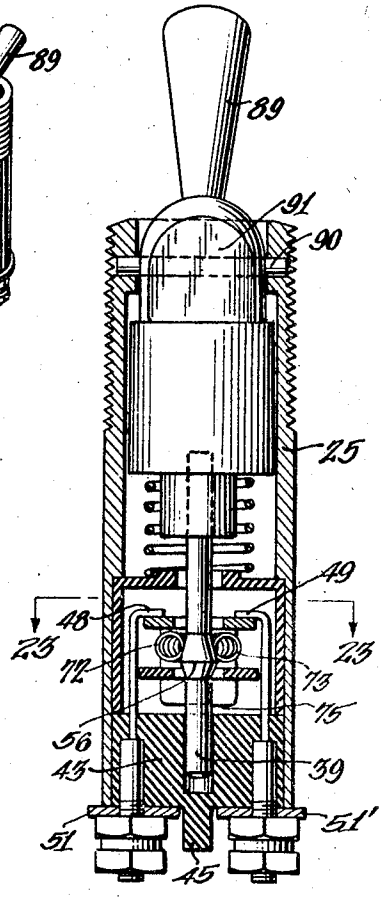



Fig. 23.

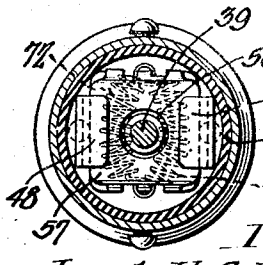
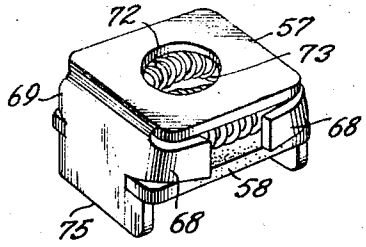



Fig. 24.




Witness:
Walter Chisnell

Inventor:
Joseph H. Schellman

by Schull, Jackson and Son
Attorneys.

Patented May 20, 1947 2,420,913

# UNITED STATES PATENT OFFICE

2,420,913

## TAPER SNAP SWITCH

Joseph H. Schellman, Ridley Park, Pa., assignor to Robert Hetherington & Son, Inc., Wilmington, Del., a corporation of Delaware

Application September 27, 1943, Serial No. 503,876

4 Claims. (Cl. 200—76)

1

My invention relates to a snap switch of the hill and valley type in which a shorting bar is snapped by a hill and valley plunger from open position in which the shorting bar or shuttle is disconnected from the contact terminals to a position in which the shorting bar closes a circuit or closes circuits, and in which the plunger may or may not be spring retracted.

A main purpose of the invention is to secure a very small, compact, reliable snap switch capable of carrying fairly high currents.

A further purpose is to provide a hill and valley plunger type of snap switch in which the slopes of the tapers on the plunger are different, providing for over-travel in one direction of movement and for a quick break of the circuit in the opposite direction.

A further purpose is to throw the shorting bar or shuttle of a hill and valley type snap switch by separate transverse operating springs held within the bar or shuttle by means effective at the ends of the springs.

A further purpose is to provide a shorting bar or shuttle for a hill and valley type snap switch in which opposite, transverse springs effecting the movement of the bar are anchored at their ends to the ends of the bar.

A further purpose is to adapt my switch construction to either normally open or normally closed switch construction by merely reversing the direction of shorting bar contact parts and reversing the position of the contacts to be made by them.

A further purpose is to facilitate assemblage of transverse springs in a shorting bar for a hill and valley type switch by dropping the springs into the shorting bar laterally and holding them in by closures of the lateral space at the sides of the ends of the springs.

A further purpose is to hold springs which are transverse to the plunger of a hill and valley type switch in position by side contact with the ends of the springs, determining the resistance to plunger travel by the distance and closeness with which the ends of the springs are confined within the shorting bar, permitting the same structure to be used for switches having different plunger operating pressures by making a slight adjustment.

A further purpose is to ground the shorting bar of a hill and valley type plunger switch so that two circuits may be handled by the switch, be it normally open or normally closed.

A further purpose is to form a shorting bar of a hill and valley type plunger switch of a contact plate turned transversely to form the ends of the bar and of a second plate permissibly of insulation held in place by its engagement with the ends of the shorting bar.

2

Further purposes will appear in the specification and in the claims.

I have preferred to illustrate a few forms only among many which are suitable for my purpose, selecting forms which are practical, effective, reliable and inexpensive and which at the same time well illustrate the principles of my invention.

Figure 1 is a perspective view of one form of the invention.

Figure 2 is an enlarged (vertical) section through line 2—2 of Figure 1.

Figure 3 is a fragmentary section corresponding with Figure 2 but having the parts in a different position.

Figure 4 is a transverse section of Figure 2 taken upon the line 4—4.

Figure 5 is a bottom elevation of the structure whose section is seen in Figure 2.

Figure 6 is a perspective showing the shorting bar or shuttle construction of the hill-and-valley switch of Figures 2 and 3.

Figure 7 is a perspective view showing a slightly modified form of the shorting bar structure of Figure 6.

Figure 8 is a section of Figure 7 taken between the springs, parallel to them and perpendicular to the front contact plate.

Figure 9 is a section of Figure 8 taken on line 9—9.

Figure 10 is a section corresponding generally with Figure 2 but showing a second desirable form.

Figures 11 and 12 are sections taken lengthwise through an operating button and a plunger showing variant forms.

Figure 13 is an axial section of a sleeve showing a form differing from that seen in Figures 2 and 10 and suited to a two-circuit grounding switch.

Figure 14 is a diagrammatic view showing two circuits to be grounded.

Figure 15 is a perspective view of a modified form of the invention.

Figures 16 and 17 are axial sections taken at right angles to each other showing the structure of Figure 10.

Figure 18 is a transverse section of Figure 17 taken upon lines 17—17.

Figure 19 is a perspective of a modified form of the shorting bar or shuttle seen in Figure 6.

Figure 20 is a perspective view of a further structure embodying my invention.

Figures 21 and 22 are longitudinal axial sections of Figure 20 taken at right angles to each other.

Figure 23 is a transverse section of Figure 22 taken upon line 23—23.

Figure 24 is a perspective view corresponding generally with Figure 6.

Figure 25 is a section showing the way in which any of my switches, with or without grounded plunger, can be made normally closed instead of normally open by merely turning the shorting bar upside down and putting the contacts below the shorting bar.

The present invention relates particularly to shorting bar or shuttle mechanism and to the associated taper or plunger and other switch structure for use with hill-and-valley switches. In these switches a spring-retracted plunger carries a double operating taper engaged by inwardly pressing springs within a shuttle. The springs react upon opposite faces of the double wedge or taper on the plunger, each taper face in turn carrying the springs, and hence their associated shuttle, down the slope of the wedge after the hump or crest of the plunger wedge or taper shall have been pushed—or tretracted—past the springs. By reason of the double (wedge) taper carried by the plunger this plunger in its entirety is also called a "taper."

The structures of Figures 1 to 9 and 15 to 24 are single-throw switches which use the shuttle or shorting bar to bridge across between contacts representing the opposite sides of the same switch gap. As a result, a circuit is opened and closed at two places. The structure of Figures 10–14 closes or opens a gap and grounds the circuits on opposite sides of the gap at the same time each at one point only. The switch is of single-throw type.

It makes no difference in this action whether the shorting bar close the circuit by upward movement or be turned upside down as in Figure 25 to normally close the circuit at the lower end of its stroke.

Describing the structure of Figure 1 to Figures 6 and 24, the casing **25** represents any suitable tubular casing. It may be metallic and electrically conducting if desired, so that it may be grounded and afford a ground for switch parts as in Figures 10–14. It is shown as separately or additionally insulated from the switch contacts to be "closed" in any event. The exterior of this casing is finished at **26** and flanged at **27** for mounting purposes. The milled grooves **28** are for keying purposes only.

The outer or front end of the casing is apertured at **29**, undercut at **30** and formed with a counterbore **31** for the purpose of accommodating a push button **32**. The push button is—or may be—of molded (insulating) material in all of the forms except that of Figures 10–14. The button is shown as internally annularly grooved at **33** to receive a retracting spring **34** by which the button is resiliently retarded in its rearward motion when pressed to close its circuit or circuits and is retracted forwardly to open the circuit or circuits.

Within the space **35** a generally cylindrical insulating sleeve or shell **36** protects the circuit contacts. The spring presses against a closed usually insulating (but in Figures 10–14 electrically conducting) end **37** of the sleeve and compresses against it. The sleeve is a tight enough fit within the casing to stay in its place and may be placed accurately in its position by engagement with a shoulder **38**.



The plunger or taper **39** is fixed rigidly at **40** within the insulating button and at its opposite (rear) end **41** is guided to slide within recess **42** in insulation block **43**. A plate **44** insulates the rear edges of the casing. The insulation **43** carries a rib **45** projecting across the rear of the structure.

Electrical terminals **46** and **47** are threaded into the insulation block **43** and at their front ends are transversely turned to form terminal contacts **48** and **49**, or **48'**, **49'** (Figure 25). At their outer threaded ends they receive nuts **50** against which outside circuit contact is made by conductors **51**, **51'** held in position by nuts **52** and washers **53**.

The plunger or taper carries conical wedge faces **54** and **55**, oppositely converging from bases at the crest **56**. The rear wedge face **55** is of steeper slope than the front face **54**. This provides for rapid switch breaking movement of the shorting bar or shuttle with slower switch closing movement and overtravel in the direction of closing movement.

About the plunger is located a shorting bar, messenger or shuttle comprising a front plate **57**, a rear plate **58**, connected to form a channel **59** between the two plates. The shuttle carries an electrically conducting annulus at its front face **60** which is to connect across from one inwardly turned contact bar to the other.

The front plate and the rear plate are connected by ends **61**, **62**, bent rearwardly from the end edges of the front plate **57** and cooperating with the rear plate **58** to hold the rear plate in position. The bent ends **61**, **62** can interfit variously with the rear plate.

In the particular form shown the lateral edges of the ends are notched at **63** to receive projections **64**, **65** from the sides of the rear preferably insulating plate **58** so that when the rear plate is in position and the ends of the front plate are bent rearwardly as seen in Figure 6, the notches in the ends receive the projections. The front plate ends lock the rear plate laterally by the projections **64**, **65** and rearwardly by the parts **66** of the bent ends adjacent the notches.

Movement of the rear plate forwardly is prevented by lateral ears **67**, **68** which are cut free from the ends at **69** and which in the blank before bending extend out farther laterally than the parts **66** of the ends.

The plunger or taper **39** moves through the openings **70**, **71** in the front and rear plates, respectively, and between two generally parallel spriral springs **72**, **73** which are held so as to press against the tapered surfaces of the plunger in order that with plunger movement they may react to carry the shorting bar or shuttle forwardly when the plunger moves rearwardly and rearwardly when the plunges moves forwardly.

The generally parallel lengths of spiral springs **72** and **73** are retained within the groove of the shorting bar by means shown differently in the various figures. In Figures 1 to 6 these spiral springs are held in place by the ears **67**, **68**, which limit the laterally outward movements of the ends of the springs and leave a predetermined intermediate length of each spiral spring which, subject to the support of the ends by the ears, may bulge through the space **74** between the ends of facing ears.

The generally parallel spiral springs may be loose at their ends within the shorting bar, i. e.,

not pressing against the inner faces of the ends of the bar, or may engage the inside faces of the ends of the bar adjacent the attached ends of the ears. In assembly the springs may be put in position within the shorting bar as the ends 61, 62 are being turned rearwardly or before they are turned rearwardly.

The ears 67, 68 may be bent inwardly from the ends when the sheet metal from which the front plate and ends are cut is being blanked out, or can quite obviously be bent inwardly after the ends have been bent down. In either case they can be placed so as properly to hold the springs in position. The rear plate is put into position as the ends or at least as one end is being bent rearwardly.

As will be seen in Figure 6, the extent to which the ears from the same end are bent inwardly toward each other will determine the amount of restriction placed upon the ends of the spiral springs and hence will regulate not only the ultimate extent of possible bulge of the springs away from each other but also the amount of resistance met with by the plunger during plunger movement.

The edges 75 of the ends act as stops to limit the rearward movement of the shorting bar to that shown in Figure 2.

In Figure 7, axially stretched spiral springs 76 on opposite sides of the plunger and bearing laterally against it are used to furnish the impulse for the operation of the shorting bar. These springs are stretched lengthwise and are fastened at their ends 77 to the ends of the shorting bar so as to press laterally against one or other of the oppositely facing plunger wedge faces.

In this form as in the first form shown one transverse face of the shorting bar must be electrically conducting and for this reason is made a metal front plate. Though metal would be entirely suitable for the rear plate of the bar here also in the normally closed circut form the rear plate is preferably made of insulating material which is quite stiff enough for the purpose but is much less expensive and much less scarce. In Figure 7 the rear plate is held at the rear by ears 78 pressed out of the ends of the front plate.

In Figure 10 an axial section corresponds generally with Figure 2 but shows a different form suited for grounding two circuits through the plunger.

The sleeve is in two parts. The cylindrical part of the sleeve is made of molded insulating material seen at 36' and the end 37' is no longer insulating but is a separate part, an electrical conductor, a force fit within the electrically grounded metal casing. It is intended to make electrical contact at its outer circumference with the inside of the casing and at an intermediate position with the retraction spring 34'. The retraction spring connects electrically with the plunger 39' through the electrically conducting button 32'. The plunger engages transverse shorting bar springs, shorting bar front plate and the separate contacts, which are the terminals to be grounded.

The separate electrically conducting end for the insulating sleeve is flanged at 79 in order that it may be assembled with and cling to the insulating cylindrical shell preliminarily and the two may then be handled as one piece in assembling the switch, handling the combination just as the part 36 is handled in assembling in the other forms.



The end 37' of the shell 36' is recessed at 80 in order to form a seat for the retracting spring which in this form is rested within the recess rather than applied to surround the shoulder 38 as in Figure 2.

The electrical terminals 46', 47' are straight, flat strips, interlocking with the insulation block 43'. They are molded into the insulation block and are laterally turned at their front ends. They are provided with apertured ends 81 in order that the connecting conductors leading to and from their circuits may be passed through these openings and soldered to the terminals.

In Figure 10 the metal button is cast about a case-hardened steel taper, the boss 82 of the taper or plunger being encased in the metal of the button. In Figure 12 another way of fastening a chrome plated plunger is shown in that the boss 82' is a forced fit within an opening 83 in the metal button and the lower end of sleeve 84 is peened about the flange 85 to hold the parts together. The plunger may be case hardened and the several parts may be brass plated or chrome plated or otherwise treated or coated as desired.

In Figure 11 a structure closely similar to that in Figure 10 is shown in that the button is molded about a case-hardened steel taper or plunger; differing from the button 32' and plunger construction of Figure 10 and from the button $32^2$ of Figure 12 $32^3$ is of insulating material and is made of molding compound.

In Figure 13 a separate view is shown of the cylindrical insulated sleeve and the separate metallic front end of the sleeve. The metallic front end may be forced into the casing so as to make good electrical contact with the inside of the casing, using a shoulder 38 to limit its position as in the case of the front end of the sleeve in Figure 2. The flange 44' serves the purpose of the plate 44.

Figure 14 is a diagrammatic view illustrating the short circuiting of the two laterally turned terminals 48 and 49 by the plunger so as to close and open two circuits at one point each, grounding them through the plunger as indicated, instead of closing and opening at two points one circuit which is not grounded. The contacts are closed and opened through the shorting bar which is constantly grounded by the plunger.

It will be noted that the only changes required from the structure of Figure 2 are to use an electrically conducting sleeve end and a metallic button electrically connected to the plunger.

In Figures 15, 16, 17, 18 and 19 the same type of construction is shown as in Figure 2 except that a different mode of holding the casing into its mount is used, the retraction spring is omitted, the casing is anchored to the insulation block and the contacts are held differently within the insulation block.

The omission of the retracting spring requires that the plunger be moved by hand or by power in both directions of stroke. As shown, it is intended to be hand operated by button $32^4$.

The outer part of the casing is threaded at 86 and the electrical conductors are molded into the insulation block. The same general form of shorting bar is seen as in Figure 7 except that the ends of the generally parallel operating springs are fastened to ribs 87 left between slits 88 cut in the rearwardly turned ends of the shorting bar.

In Figures 20, 21, 22 and 23 another form is shown which is operated by a cam lever and which is retained in closed switch position by the

position of the cam of this lever. The structures of the casing and switch operating mechanism are substantially the same as are seen in Figures 16 and 17.

The thread upon the casing extends clear to the front of the switch and the flanged face of the switch casing is omitted. The cam lever 89 is pivoted at 90 and throws a cam face 91 from the open switch position seen in Figure 21 to the closed switch position seen in Figure 22. The movement effected by the cam is communicated to the plunger through a cylindrical guide 92 which carries boss 93 which is surrounded by the retracting spring. The plunger is seated in the boss or in the cylindrical guide 92 or in both and the operation of the plunger and shorting bar are the same as in Figures 2 and 10.

In operation, in Figures 2 and 16, the button is pushed against the resistance of the retraction spring, the limit of movement being conveniently set either by the bottom of the press-button engaging the front of the sleeve or by the bottom of the plunger engaging the bottom of the recess in which the plunger operates. The transverse spiral springs have considerable lateral play but they are held securely against undue lateral movement and furthermore are thus held to their duty to give reliable retracting pressure to the plunger.

The shorting bar cannot move downwardly in Figure 2 because of engagement of the edges 75 of the ends with the insulation block and so the plunger moves through the springs stretching them laterally until the crest 56 of the double wedge passes the middle parts of the springs at which time the contraction of the springs causes the shorting bar to shift forwardly along the length of the plunger and until the front plate of the shorting bar engages and cross connects the contact parts of the terminals 48 and 49. This closes the circuit between the contact at 48 and the front plate of the shorting bar and again beween the front plate of the shorting bar and the contact 49.

In the form of Figure 10, grounding of the plunger through the retraction spring, metal end of the sleeve and casing results in grounding the shorting bar at all times and two circuits are closed through the two contacts 48' and 49' and ground.

In the forms of Figures 16, 17 and 21, 22, special operating mechanism is shown but the principles of operation are the same.

It will be evident that whether the electrically conducting front end of the sleeve (37') being extended inwardly or not will depend upon the amount of clearance between it and the contacts 48', 49', since this must not be short circuited. It does not make any difference in the normally closed form of this switch since the contacts will be below (using the directions of Figure 10) the shorting bar. In the normally closed form (of the type of Figure 25) the extended edges 75 of the shorting bar will face upwardly and will use the front end of the sleeve as a step to their travel. This will be permissible whether the front end be electrically conducting or insulating since the shorting bar will be disconnected from the contacts at the upper end of its stroke. The form of Figure 25 is, therefore, suitable for grounded plunger—and therefore grounded circuit through the plunger—use.

In Figure 25 the front end of the sleeve is made



flat instead of being flanged to fit within the sleeve, and may be electrically conducting for the grounded plunger form.

In Figure 25 the use of a plate $37^2$ as the front end of the sleeve $36^2$ permits either metal or insulation to be used for this front end as preferred, the metal accommodating use with a grounded plunger to ground the circuits and the insulation fitting in with the other forms. The contacts $48^2$ and $49^2$ may be connected with any type of terminals and are intended of course to be diagrammatic only.

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

1. A shorting bar for a hill and valley switch comprising an apertured front contact plate, a rear insulating plate, connections between the two plates, substantially parallel spiral springs lying between the two plates, and ears connected with the front plate and restraining the outer sides of the ends of the springs to limit lateral distortion of the springs.

2. A shorting bar for a hill and valley switch comprising an apertured front contact plate, a rear insulating plate, connections between the two plates, substantially parallel spiral springs lying between the two plates, and adjustable lateral holding means engaging the sides of the ends of the springs, retaining the springs against lateral distortion to an extent depending upon the adjustment of the ears and limiting bulging of the springs between the ears.

3. A shorting bar for a hill and valley plunger switch having an electrically conducting front face apertured for plunger passage, ends rearwardly turned from the front face, a rear face similarly apertured inter-fitting with the ends, ears extending from the ends, and springs between the two faces held in place laterally by the ears and adapted to engage the wedge faces of a hill and valley plunger.

4. In a hill and valley switch, a casing, insulation for the interior of the casing, electrical conductors entering the casing and insulated from it, transverse terminals from said conductors, a shorting bar having transversely extending springs and an electrically conducting front plate, a plunger cooperating with the shorting bar and carrying oppositely facing wedge surfaces pressing against the springs, and means for holding the springs within the bar, said means restraining the springs at their sides near the ends of the springs and determining the resistance of the springs to side distortion by the plunger by the extent of restraint given the springs.

JOSEPH H. SCHELLMAN.


## REFERENCES CITED

The following references are of record in the file of this patent:

### UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,162,866 | Klein | Dec. 7, 1915 |
| 1,222,214 | Klein | Apr. 10, 1917 |
| 1,554,319 | Zadek | Sept. 22, 1925 |
| 1,162,076 | Klein | Nov. 30, 1915 |
| 1,952,153 | Young | Mar. 27, 1934 |

### FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 164,185 | Great Britain | June 9, 1921 |