Sept. 29, 1959 F. O. MOODY ET AL 2,906,132

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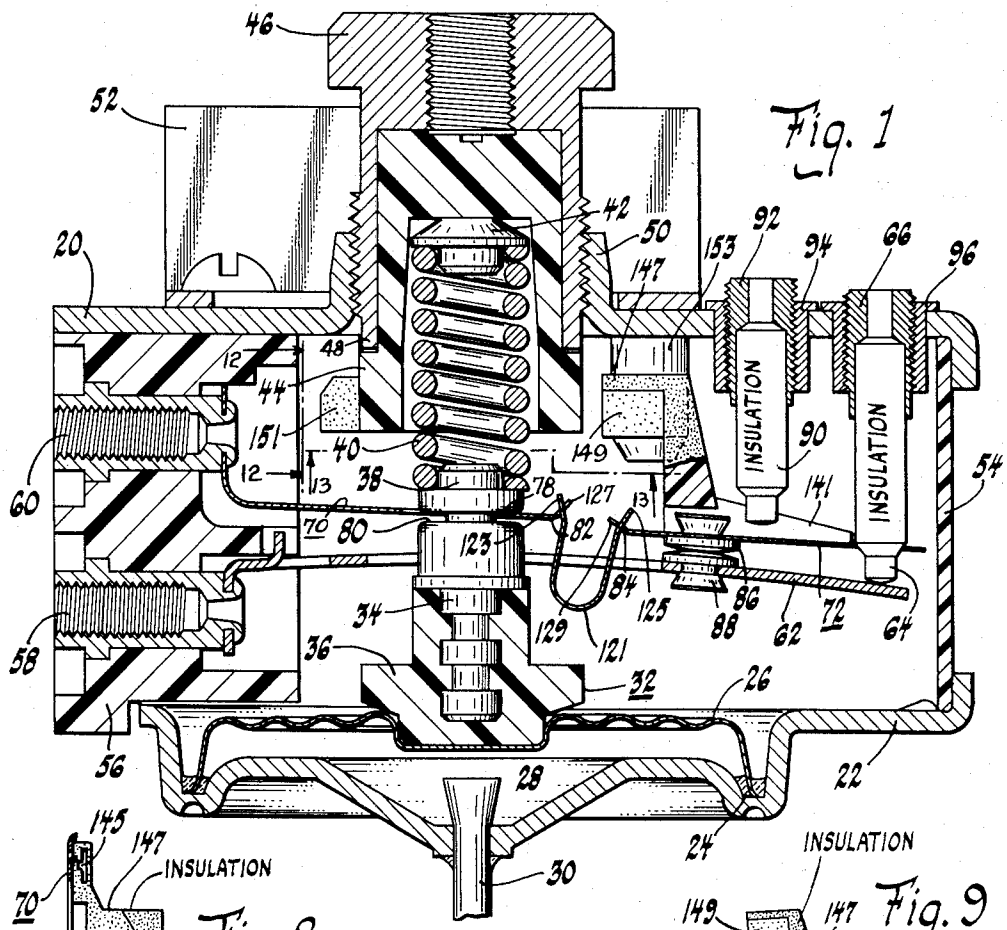


Fig. 1

Fig. 8

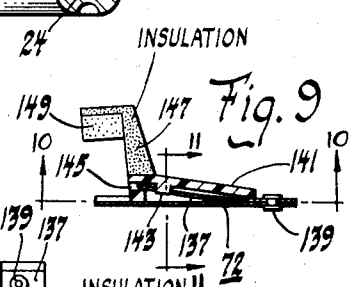


Fig. 9

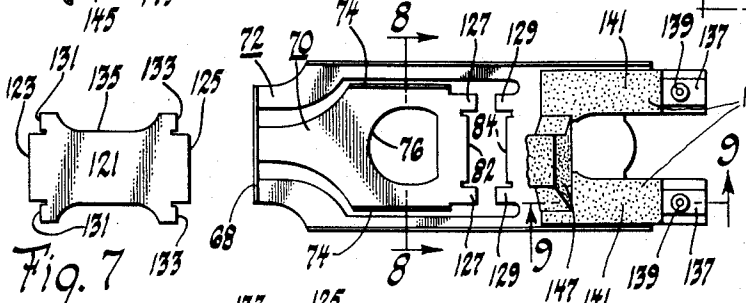


Fig. 7

Fig. 4

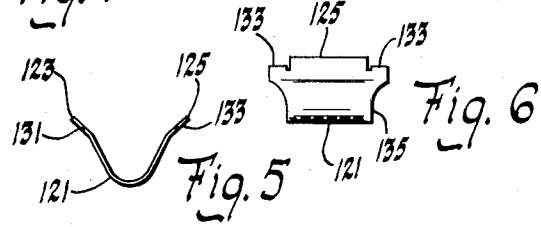


Fig. 6

Fig. 5

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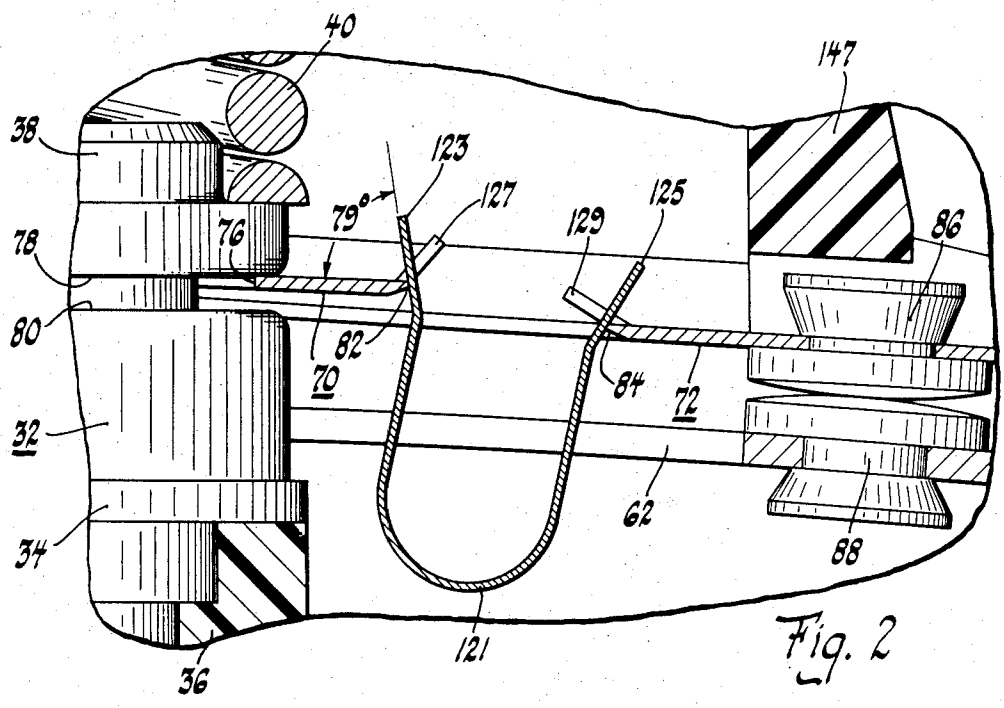


Fig. 2

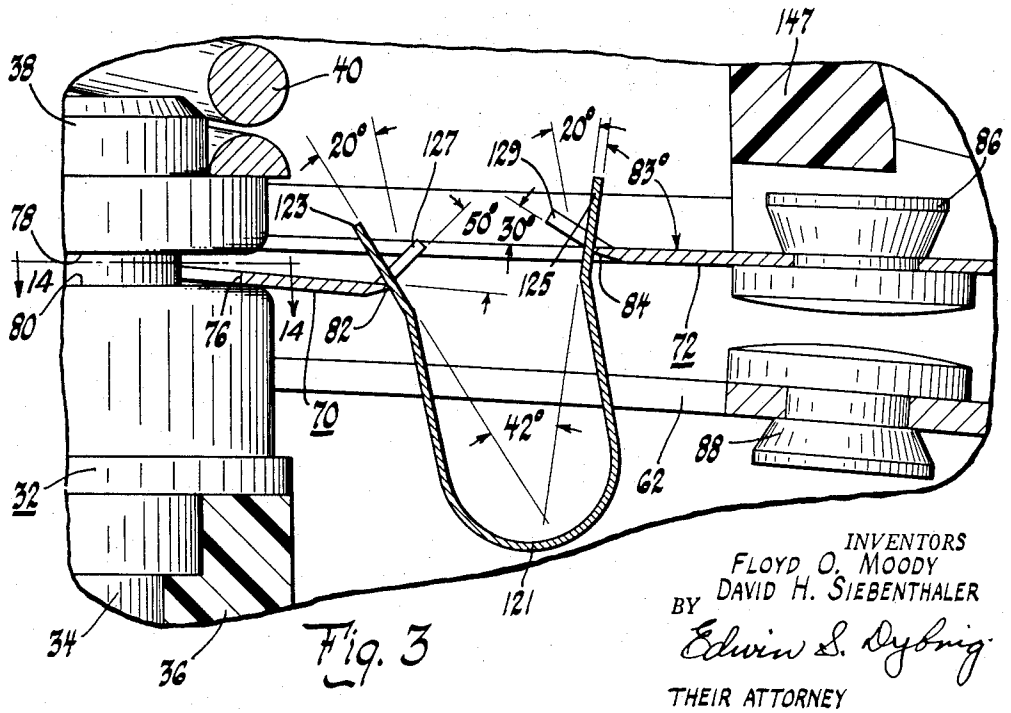


Fig. 3

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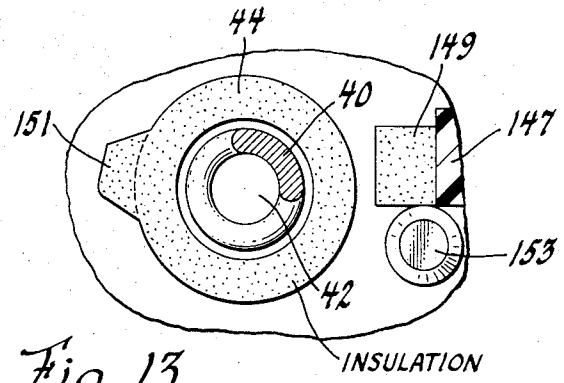


Fig. 13

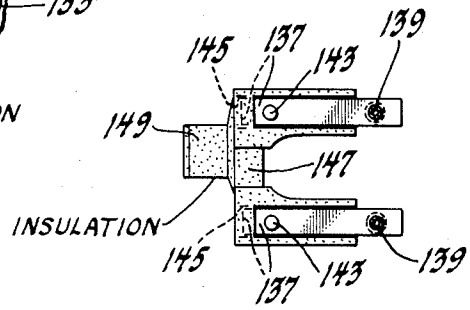


Fig. 10

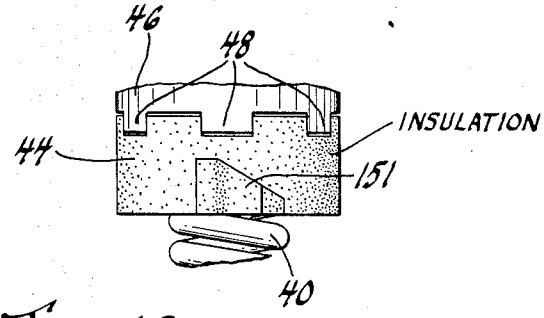


Fig. 12

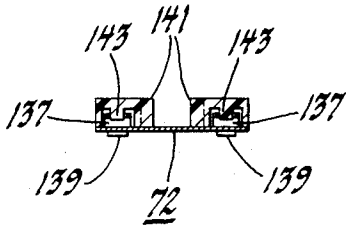


Fig. 11

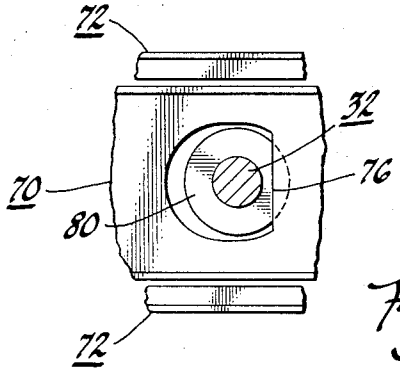


Fig. 14

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TOGGLE

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Application June 4, 1956, Serial No. 589,314

7 Claims. (Cl. 74—100)

This invention relates to electrical apparatus and more particularly to snap action toggles such as are used in switches.

Many toggle switches are made in wide varieties of forms and sizes. There is a trend toward smaller, cheaper, more accurate and reliable toggle designs with high current carrying capacity and a minimum of arcing when applied to switches. One of the difficulties which increases in importance as the size is reduced is the friction of the bearing surface of the pivoting points of the toggle. Another difficulty is the wandering and variation in the exact location of the theoretical pivoting points during the operation of a switch and between different switches manufactured on a mass production basis.

It is an object of this invention to provide a toggle which is accurate in smaller sizes and which can be manufactured in mass quantities at low cost.

It is another object of this invention to provide a toggle having a pivoting arrangement which is low in friction and accurate when made at a low cost in mass production.

It is another object of this invention to provide an improved simplified manual switch opening arrangement for a toggle switch.

These and other objects are attained in the form of a toggle switch shown in the drawings in which a thin diaphragm (which may be made of different thicknesses) is moved by a high pressure volatile vapor and liquid. A follower of electric insulating material has a lost motion connection with the tongue of a toggle snap action blade mechanism. The contact portion of this blade mechanism is inherently sprung downwardly to keep it in engagement with a normally stationary contact so that this together with the lost motion connection provides satisfactory contact pressure up to the time of toggling. The tongue of the blade mechanism is inherently sprung in the opposite direction to eliminate any hesitation in the snap action. The expansion of the diaphragm is opposed by the range spring which may be made in various sizes of wire to provide different rates for different applications.

To reduce the friction the bearing points for the toggle pivoting points are provided with coin pressed blunt chisel-shaped bearing ends rounded by being tumbled with wetted small rounded abrasive particles in a barrel. The U-shaped blade type toggle spring is provided with diverging end portions in contact with the chisel-shaped bearing edges so that it always has a force component in one direction at all times. The blades and U-shaped springs also have interengaging stops for preventing the component from causing lateral movement between the toggle spring and the bearing ends. These stops are aligned with the bearing ends. These stops have their bearing surface aligned with the bearing edges of the blade so that the pivoting points are accurate and do not wander and are low in friction.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is an enlarged vertical sectional view through a diaphragm operated toggle switch embodying one form of my invention;

Figure 2 is a greatly enlarged fragmentary view showing the toggle spring and the adjacent portions of the toggle mechanism and other parts of the switch in the closed circuit position;

Figure 3 is a view similar to Figure 2 but showing the toggle mechanism tripped to the opposite open circuit position;

Figure 4 is a plan view of the toggle blade and shut-off cam follower;

Figure 5 is a view in elevation of the toggle spring in its unsprung state;

Figure 6 is an end view of the toggle spring in its unsprung state;

Figure 7 is a plan development of the toggle spring;

Figure 8 is a fragmentary sectional view of the toggle blade shown in Figure 4 taken along line 8—8 of Figure 4;

Figure 9 is a fragmentary sectional view taken along line 9—9 of Figure 4;

Figure 10 is a fragmentary sectional view taken a long the line 10—10 of Figure 9;

Figure 11 is a fragmentary sectional view taken along the line 11—11 of Figure 9;

Figure 12 is a fragmentary elevational view taken along the line 12—12 of Figure 1;

Figure 13 is a fragmentary sectional view taken along the line 13—13 of Figure 1; and

Figure 14 is a fragmentary sectional view taken along the line 14—14 of Figure 3.

Referring now to the drawings and more particularly to Figure 1, there is shown a switch including an inverted U-shaped upper housing channel 20 and a lower housing plate 22 which extends across the bottom of the housing channel 20 to form the bottom of the enclosure. The bottom plate 22 of the housing is provided with an annular integral groove 24 into which is soldered the rim of a flexible metal diaphragm 26. This provides a diaphragm chamber 28 between the diaphragm 26 and the bottom plate 22. A capillary tube 30 connects into the interior of this diaphragm chamber 28 to move the diaphragm 26 upwardly and downwardly in accordance with changes in pressure which may be applied thereto. For example, this capillary tube 30 may connect to or form a thermostatic bulb and contain a volatile liquid or it may be connected to a source of varying pressure.

The diaphragm 26 is provided with annular corrugations which augment its flexibility and has a central recess for receiving the bottom of the diaphragm follower 32 having a metal core 34 surrounded by electrical insulating material 36. The metal core 34 extends upwardly to form a spring retainer 38 for the lower end of a compression spring 40. The upper end of the compression spring 40 is held by a metal spring retainer 42 which is mounted to rotate within a hollow member 44 of an electric insulating plastic. This hollow member 44 fits within the hollowed out bottom portion of a hexagonal headed screw 46. The lower skirt of the screw 46 is provided with teeth 48 which engage complementary teeth formed by the lower flange of the hollow member 44 so that the two may be coupled in a number of different angular relationships. The screw 46 is threaded into the outwardly extruded threaded opening 50 in the top of the upper housing channel 20. The top of the housing channel 20 also is provided with a mounting bracket 52 fastened to the upper housing member 20.

The right end of the switch is enclosed by a plate 54 of a suitable electrically insulating plastic. The left end of the switch is enclosed by a terminal member 56 of

electrical insulating plastic. This terminal member 56 includes the imbedded electric terminals 58 and 60. Riveted to the inner end of the terminal 58 is a spring contact blade 62 which is sprung upwardly against the lower insulated portion 64 of the adjusting screw 66.

Riveted to the inner end of the terminal 60 is the turned up end 68 of a snap acting toggle blade mechanism which includes an inner tongue 70 and an outer tongue 72. The inner tongue 70 includes upwardly turned flanged edges 74 and a central D-shaped aperture 76. This aperture 76 is of sufficient size to fit over the upper spring retainer of the end 38 of the metal portion 34 of the follower 32. The flat side of the aperture 76 (that is the straight edge) extends between the upper and lower shoulders 78 and 80 which are spaced apart a distance to prevent the contact pressure from going to and remaining at zero when the tripping pressure is approached. The proper amount of lost motion depends upon the downward force of the blade 72, the gap between the contacts 86 and 88 and the travel between trip points of the followers 32. This arrangement accurately locates the contact surface between the inner tongue 70 and the follower 32 so that accuracy in this connection can be easily attained in mass production.

The inner tongue 70 is provided with wide central bearing portion 82 which is coined so as to form a blunt chisel-shaped end. The outer tongue 72 is likewise provided with an opposing bearing surface 84 likewise coined into a blunt chisel-shaped end. These bearing edges face each other a short distance apart and are rounded by small pellets of abrasive material in a tumbling process. The outer tongue 72 has riveted thereto a contact 86 adapted to cooperate with a contact 88 which is riveted to the contact carrying blade 62. The separating movement of the contacts 86 and 88 is limited by the ceramic end portion 90 of an adjusting screw 92. Instead of the ceramic material 90, other electrical insulating materials may be used. The adjusting screws 92 and 66 thread within press fitted split threaded bushings 94 and 96 extending through apertures in the top portion of the U-shaped casing 20.

Between the two rounded chisel-shaped bearing edges 82 and 84 is the toggle spring 121. This toggle spring 121 is U-shaped when in position contacting the bearing edges 82 and 84 as best shown in Figures 2 and 3. As shown in Figures 6 and 7 the toggle spring 121 includes wide central tongues 123 and 125 which are bent outwardly so that they diverge from each other at an angle of about 42° when they are in contact with the bearing edges 82 and 84. The toggle spring 121 is shown in its normal unsprung shape in Figure 5 and the end portions are bent outwardly at approximately 20° relative to the adjacent straight portions. The angle of divergence of the tongues 123 and 125 is sufficiently great that in all positions of the toggle spring 121, there is an upward reaction component between these tongues and the bearing edges 82 and 84.

To prevent movement upwardly of the toggle spring 121, the inner tongue 70 is provided with projections 127 on either side of the bearing surface 82. The outer tongue 72 is provided with the projections 129 on either side of the bearing surface 84. The projections 127 and 129 are so bent that their lower faces are substantially aligned with the central portion of the blunt chisel-shaped bearing edges 82 and 84. To limit the upward movement of the toggle spring 121, these projections 127 and 129 are engaged by the bearing shoulders 131 on either side of the tongue 123 and the bearing surface 133 on either side of the tongue 125. These bearing surfaces 131 engage the lower face of the projection 127 while the bearing surfaces 133 engage the lower face of the projection 129. The central portion of the spring 121 is necked in as indicated by the reference character 135 so as to concentrate the bending in the rounded portion thereof to preserve the angularity of the end portions thereof. It also provides for wider bearing areas without increasing the spring force of the toggle.

The engagement between the tongue 123 and the bearing edge 82 provides one theoretical pivot line and the engagement between the aligned bearing edges 131 and the tongue 127 provides a second theoretical pivot line and these two lines substantially coincide at all times. The tongue 123 always makes an acute angle relative to the inner tongue 70 so that the reaction formed by the spring force of the toggle spring 121 forms a component which tends to hold the bearing surfaces 131 against the lower face of the projection 127 at all times. For best operation, the projection 127 is preferably bent upwardly at an angle of about 50° to the line of the inner tongue 70. Also the tongue 125 is bent outwardly and the spring action of the toggle spring 121 will provide an upward force component to cause it to tend to move upwardly across the bearing surface 84 since the outward angle of the tongue 125 always makes an acute angle with the outer tongue 72. This provides an upward reaction to hold the bearing surfaces 133 against the lower face of the projection 129. For best operation the projection 129 is bent upwardly at an angle of about 30° to the line of the tongue 72. Thus under all pivoting positions the bearing surfaces are held against the identical portions of the tongues and projections at all times and all are substantially aligned with each other so that the pivot points are accurately maintained and the pivoting is accomplished with a minimum of friction. Thus, as the pressure within the diaphragm chamber 28 is reduced and the follower 32 is lowered, the contact pressure between the contacts 86, 88 is maintained by the downward spring force of the outer tongue 72. The inner tongue 70 is held by its own upward spring force against the upper shoulder 78 until this shoulder 78 reaches the point of equilibrium or tripping point. The contact pressure between the contacts 86, 88 continues to be maintained by the downward spring force of the outer tongue 72 until the inner tongue 70 is in movement from the upper shoulder 78 to the lower shoulder 80 accompanied by the tripping of the toggle spring 121. The separation of the contacts 86, 88 does not take place until the toggle spring 121 has begun to move. This arrangement therefore insures that this switch may be made in mass production at a low cost in a size which may be less than one-third the size shown in Figure 1. The contact arrangement also makes it possible to control relatively heavy currents so that they may be used for controlling motors of one-half horsepower or more.

The switch is also provided with an ingenious shut-off mechanism arranged so that the blades are not likely to be damaged thereby. For this purpose, small short spring members 137 are fastened by the rivets 139 to the forked end of the outer tongue 72. These spring members 137 extend through the hollow legs 141 which contain a projection 143 extending through an aperture in the loose end of the spring members 137. This loose end of the spring 137 extends into a slot 145 so that the cam projection 147 is sprung against the outer tongue 72. The cam projection 147 is integral with the hollow legs 141 and are molded of a suitable electrically insulating plastic. The cam projection 147 is provided with a cam surface 149 which is adapted to be engaged by the cam surface 151 upon a projection extending from and rotatable with the hollow member 44. This engagement of the cam surfaces 149 and 151 will cam the outer tongue 72 upwardly so as to move the upper contact 86 away from the lower contact 88 while the contact member 62 is held by the end 64 of the adjusting screw 66. This separation will continue until the outer tongue 72 engages the insulated end 90 of the adjusting screw 92. Any further camming will not impose any substantial strain upon the tongue 72 since the springs 137 will yield to allow the cam surfaces 145 to move upwardly relative to the tongue 72. The tongue 72 is also protected from

the reactions of the cam surfaces 149 and 151 by a pin 153 projecting downwardly from the upper portion 20. This pin 153 prevents excessive bending of the tongue 72 by the reactions of the cam surfaces 149 and 151.

The differential of the switch is controlled by the adjustment of the screws 92 and 66 which determine the closing and opening temperatures or pressures respectively. The range may be shifted by turning the screw 46 and the hollow member 44. This construction therefore provides a low cost switch which can be made accurately in mass production.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A toggle including a first movable blade portion having an edge portion provided with a pivotal bearing surface and an adjacent projection extending beyond the bearing surface, a second movable blade portion having an edge portion facing oppositely to the edge portion of the first movable blade portion and provided with a pivotal bearing surface and also an adjacent projection extending beyond the bearing surface, a toggle spring means having a tongue extending transversely across and contacting each bearing surface and a recessed edge bearing against each of said adjacent projections of each of said blade portions, means for limiting the relative movement of said first and second portions and thereby limiting the angular movement of said toggle spring means, said tongues diverging at their points of contact with said bearing surfaces at an angle greater than the maximum angular movement of said toggle spring means to hold said recessed edges against said adjacent projections.

2. A toggle including first and second relatively movable portions, a toggle spring means pivotally connecting said relatively movable portions, a cam follower means, a spring connection between said cam follower means and one of said movable portions, and a cam means cooperating with said follower means for holding said one movable portion.

3. A toggle including first and second relatively movable blade portions, toggle spring means pivotally connecting said blade portions, one of said blade portions having a D-shaped aperture therein, and an actuator having a circular shoulder on each side of said one blade overlapping the blade portion on the flat side of said aperture and being otherwise free of said blade.

4. A toggle including first and second relatively movable blade portions, each of the blade portions having an adjacent end provided with a narrow bearing edge between two projections, a leaf type toggle spring having at its opposite ends a tongue between two aligned bearing edges, said tongues each extending transversely across and contacting one of said narrow bearing edges, said projections each extending transversely across and contacting one of said aligned bearing edges, said tongues at the contact with said bearing edges diverging away from each other to provide a continuous resilient force holding said aligned bearing edges in contact with said projections.

5. A toggle including a first movable blade portion having an edge portion provided with a pivotal bearing surface and an adjacent projection extending beyond the bearing surface, a second movable blade portion having an edge portion facing oppositely to the edge portion of the first movable blade portion and provided with a pivotal bearing surface and also an adjacent projection extending beyond the bearing surface, a toggle spring means having a tongue extending transversely across and contacting each bearing surface and a recessed edge bearing against each of said adjacent projections of each of said blade portions, means for limiting the relative movement of said first and second portions and thereby limiting the angular movement of said toggle spring means, said tongues diverging at their points of contact with said bearing surfaces at an angle greater than the maximum angular movement of said toggle spring means to hold said recessed edges against said adjacent projections, said adjacent projections extending at an angle to the major surfaces of their respective blade portions toward said tongues.

6. A toggle including a first movable blade portion having an edge portion provided with a pivotal bearing surface and an adjacent projection extending beyond the bearing surface, a second movable blade portion having an edge portion facing oppositely to the edge portion of the first movable blade portion and provided with a pivotal bearing surface and also an adjacent projection extending beyond the bearing surface, a leaf spring extending generally in a U shape having its end portions bent outwardly to diverge at an acute angle, said bent end portions each having a tongue extending across and contacting the adjacent bearing surface and a recessed edge bearing against the adjacent projections of said blade portions.

7. A toggle including first and second relatively movable portions, a toggle spring means pivotally connecting said relatively movable portions, one of said portions having a blade end portion provided with a pivotal bearing surface and an adjacent projection having one face substantially in alignment with said pivotal bearing surface and extending beyond the pivotal bearing surface, means for limiting the relative pivotal movement of said blade end portion and said spring means, said toggle spring means having a recessed edge bearing against said one face of said adjacent projection and a tongue having a contacting surface extending transversely across and contacting said bearing surface at all times at an acute angle to said blade, said toggle spring means having a spring force forcing said contacting surface against said bearing surface to provide a continuous resilient component of force holding said recessed edge against said one face.

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