

A Toggle Switch

FIELD OF INVENTION

5 The present invention relates broadly to a toggle switch and a method of fabricating a toggle switch.

BACKGROUND

10 Toggle switches, which provide electrical switching by way of mechanical levers, are used in a variety of devices and components to allow the user to provide an input to the device to hence control the device. For example, toggle switches may be used in handheld remote controllers which allow the user to remotely control a radio controlled model car or aeroplane. In the particular example of a radio controlled aeroplane, the
15 toggle switch may be used to switch between different modes of operation of the remote controller, such as between an automated flying mode for novice users and a manual flying mode for advanced users.

 In typical toggle switches, there are no mechanisms to prevent unintentional switch actuation by the user, such as unintentionally brushing against the switch lever by
20 e.g. a stray finger of the user. Such unintended switch actuation/selection can result in serious malfunction of the remote controlled device that can present a safety hazard. Returning to our earlier example of the radio controlled aeroplane, accidental switching from the automated flying mode to the manual flying mode could potentially crash the
25 radio controlled aeroplane if the user were not properly trained to handle the manual flying mode, or if the operator was not aware that the manual flying mode had been selected.

 The problem of accidental switching is further exacerbated when there may be
30 an intermediate mode, which may be regularly switched in and out of. For example, a user may switch between modes 1 and 2 regularly, while occasionally requiring mode 3 operations. Accidental switching to mode 3 may have dangerous consequences and should hence be prevented. Because there is regular switching between modes 1 and 2,

a user may accidentally switch to mode 3 instead of e.g. mode 1 or 2, without realising the error. This is because during operation, the user's attention may be fixed on the remote controlled device. Moving from one switch position to another is carried out based on the feel from the operator's fingers and it is therefore easy for the operator to
5 select an incorrect mode by overshooting the required position of the switch lever.

To overcome accidental switching, pull-to-activate type switches have been used in place of normal toggle switches. Figures 1a-c show front views of a typical toggle switch 100 of the prior art providing access to three different modes. The toggle switch
10 100 comprises a mechanical lever 102, and a base portion 104. A locking sleeve 110 encompasses the top end of the mechanical lever 102. A pair of teeth 108a and 108b are mounted on the base portion 104 and act as stoppers to a stump 106 located at the bottom of the locking sleeve 110 to prevent the mechanical lever 102 from switching between the various modes. A loaded spring (not illustrated) is located within the locking
15 sleeve 110 to provide a force to keep the stump 102 engaged to the teeth 108a and 108b. Figure 1a shows the toggle switch 100 resting in the mode 2 position. To switch to the mode 3 position of Figure 1c, the user will have to first pull the locking sleeve 110 away from the base portion 104, disengaging the stump 106 from the teeth 108a and 108b as illustrated in Figure 1b before the user can move the lever 102 to the mode 3
20 position. Figure 1c shows the mechanical lever 102 resting in the mode 3 position as tooth 108b acts as a stopper to stump 106, preventing the mechanical lever 102 from sliding back to the mode 2 position. The mode 1 position is not illustrated, but will be appreciated to involve the stump 106 stopper-ed by tooth 108a.

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Because an accidental switching force may be applied at an angle such that the locking sleeve is accidentally lifted, the pull-to-activate type switches may still be accidentally pulled out of their resting positions, and moved to an unintended position, actuating an incorrect mode of operation.

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Pull-to-activate type switches also suffer from slow switching speeds when compared with simple toggle switches. This is clearly evident as the user will have to deliberately pull the switch to dis-engage the stump from the teeth before switching can occur. In contrast, a relatively simpler flick action is all that is required to change the

switch position in a typical toggle switch. In this regard, should the speed of switching between modes be critical, the pull-to-activate type switches may not be able to provide the necessary speed.

- 5 Therefore, there exists a need to provide a toggle switch and a method for fabricating a toggle switch to address one or more of the problems mentioned above.

SUMMARY

- 10 In accordance with a first aspect of the present invention there provided a toggle switch comprising a base portion; and a stoppered lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration; wherein said lever structure comprises a surface slanted towards the second switching
15 position.

The slanted surface may be formed at a top portion of the lever structure, and has an increasing gradient as the top portion extends from the base portion of the stoppered lever structure.

- 20 Another side of the slanted surface at the tip end may provide an undercut surface to allow the stoppered lever structure to be pulled away from the base portion.

- 25 The stoppered lever structure may comprise a lever attached to the base portion; a sleeve for providing a means for locking the lever in the at least respective first and second switching positions; and a cap for providing an exterior shape to the stoppered lever structure; wherein the slanted surface is formed on the cap.

- 30 The sleeve may further comprise a stump on a near end facing the base portion and the base portion may further comprise a stopper; said stump capable of being engaged by the stopper to lock the lever.

The toggle switch may further comprise means for attaching the cap onto the lever such that the cap is rotationally rigid on the lever.

5 The means for attaching the cap onto the lever may comprise first and second locking pins, wherein the first locking pin engages the lever and sleeve, and the second locking pin engages the cap and the sleeve.

The lever structure may be made of stainless steel.

10 The lever structure may be polished to mirror shine.

In accordance with a second aspect of the present invention there provided a method of fabricating a toggle switch, comprising the steps of providing a base portion; and providing a stoppered lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration; and forming, on the lever structure, a surface slanted towards the second switching position.

20 The slanted surface may be formed at a top portion of the lever structure, and has an increasing gradient as the top portion extends from the base portion of the stoppered lever structure.

The method may further comprise providing an undercut surface on an other side of the slanted surface at the tip end to allow the stoppered lever structure to be pulled away from the base portion.

25 The stoppered lever structure may comprise a lever attached to the base portion; a sleeve for providing a means for locking the lever in the at least respective first and second switching positions; and a cap for providing an exterior shape to the stoppered lever structure; wherein the slanted surface is formed on the cap.

30 The sleeve may further comprise a stump on the near end facing the base portion and the base portion further comprises a stopper; the method further comprising engaging the stump with the stopper to lock the lever.

The method may further comprise attaching the cap onto the lever such that the cap is rotationally rigid on the lever.

- 5 The method may further comprise engaging the lever and sleeve using a first locking pin; and engaging the cap and the sleeve a second locking pin.

The lever structure may be made of stainless steel.

- 10 The lever structure may be polished to mirror shine.

- In accordance with a third aspect of the present invention there provided a toggle switch comprising a base portion; and a lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration, and for toggling between at least a third switching position and the first or second switching in a biased configuration.
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- In accordance with a fourth aspect of the present invention there provided a method of fabricating a toggle switch, comprising the steps of providing a base portion; and providing a lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration, and for toggling between at least a third switching position and the first or second switching in a biased configuration.
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BRIEF DESCRIPTION OF THE DRAWINGS

- Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:
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Figures 1a-c show front views of the typical toggle switch 100 of the prior art providing access to three different modes.

Figure 2a shows a perspective view of a toggle switch of an embodiment of the present invention.

5 Figure 2b shows an exploded perspective view of the toggle switch of Figure 2a.

Figure 3a-d show side views of the toggle switch of Figure 2a.

10 Figure 4 shows a side view of the cap illustrating the shape of the cap in the embodiment of Figure 2a.

Figure 5 illustrates an example of the slippage when an unintended accidental force is applied to the cap, in the embodiment of Figure 2a.

15 Figure 6 illustrates a user gripping the cap with the index finger and thumb, in the embodiment of Figure 2a.

Figure 7 shows a flow chart illustrating a method of switch toggling according to an example embodiment.

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Figure 8 shows a flow chart illustrating another method of switch toggling according to another example embodiment.

25 DETAILED DESCRIPTION

Embodiments of the present invention seek to provide a system and method for a toggle switch. In the embodiment described, switching between three basic modes of operation is provided for, where modes 1 and 2 are modes which are
30 switched between frequently, while mode 3 is a mode which is switched into (and out of) infrequently. Accidental actuation of switching into mode 3 should be avoided as it may pose safety risks in the hands of an untrained user or even a trained user who is unaware that mode 3 has been selected. At the same time, modes 1 and 2

are of relatively lower risk, and easy switching between the two modes (modes 1 and 2) should be provided.

Figure 2a shows a perspective view of the toggle switch 200 of an embodiment of the present invention while figure 2b shows an exploded perspective view of the toggle switch 200. The toggle switch 200 comprises a mechanical lever 202, a base portion 204, a locking sleeve 206, a spring 208, a pair of locking pins 210, 214 and a cap 212. The base portion 204 further comprises stoppers 216a and 216b also mounted on the top of the base portion 204. Stumps 218a and 218b (not shown), corresponding to each one of the stoppers 216a and 216b, are located at the bottom of the locking sleeve 206. Collectively, the lever 202, locking sleeve 206 and cap 212 may be referred to as embodying a lever structure.

Figure 3a-d show side views of an embodiment of the toggle switch 200. Figures 3a, 3b and 3d illustrate the toggle switch 200 in modes 1, 2 and 3 respectively. The mechanical lever 202 extends from the base portion 204 of the toggle switch 200 and its position determines the mode the switch 200 is in. The locking sleeve 206 is hollow such that the mechanical lever 202 can be fitted within the locking sleeve 206. The locking pin 210 is threaded through hole 210a of the locking sleeve 206 and hole 210b of the lever 202 to secure the locking sleeve 206 to the mechanical lever 202. Also, the locking pin 210 prevents the lever cap 206 from being rotated around the mechanical lever 202 while it is attached. The locking sleeve 206 may be allowed to slide along the mechanical lever 202 within the confines of the hole 210a, but is kept against the base portion 204 by means of the loaded spring 208 (Figure 2). The spring 208 is kept loaded by virtue of it being kept between the locking sleeve 206 and the cap 212.

The cap 212 is also hollow such that the locking sleeve 206 can be fitted within the cap 212. The locking pin 214 is inserted (with an anaerobic or other adhesive in the example embodiment) through hole 214b of the cap 212 and a groove 214a of the locking sleeve 206. The locking pin 214 acts to secure the cap 212 to the locking sleeve 206, preventing the cap 206 from being rotated on the locking sleeve 206 and mechanical lever 202. In this way, toggling the cap 212, indirectly causes the toggling of the mechanical lever 202 via the locking sleeve 206.

The stopper 216a is mounted on the top of the base portion 204 and acts to block stump 218a of the locking sleeve 206 to prohibit accidental switching of the mechanical lever 202 between the modes 2 and 3. The loaded spring 208 (Figure 2),
5 keeps the stump 216 of the locking sleeve 206 against the base portion 204.

To switch between modes 1 and 2, the user may flip or push the cap 212 and hence the mechanical lever 202 in the direction of the intended mode. For example, assuming the switch to be in mode 1 and the mechanical lever 202 is at one end of
10 the base portion 204 (Figure 3a) and the user wishes to actuate mode 2 (Figure 3b). The user may push the cap 212 in the direction F as indicated in Figure 3a such that the mechanical lever 202 is in the centre position as shown in Figure 3b. The stopper 216a prevents the mechanical lever 202 from accidentally actuating the protected mode 3 (Figure 3d). Conversely, a force applied in the reverse direction of
15 F allows the mechanical lever 202 to actuate mode 1.

It will be appreciated by a person skilled in the art that biasing means may be built into the interface between base portion 204 and the lever 202 to maintain the position of the lever 202 in a particular mode. A small force may need to be applied
20 to overcome the biasing means to switch between e.g. modes 1 and 2. The force of the spring 208 pushes the stump 218a against the surface profile of the stopper 216a. The surface profile of is notched slightly at the positions of mode 1 and mode 2, to provide a detent type of action in the example embodiment. This means that a slightly greater force must be applied in order to start the lever moving away from
25 either the mode 1 or mode 2 position. Once the lever is moving, the shape of the profile of 216a allows smooth travel while the lever is between mode 1 and mode 2 positions.

To switch to the mode 3 position (Figure 3d) from either one of modes 1 or 2,
30 locking sleeve 206 is first pulled away from the base portion 204, disengaging the stump 218a from the stopper 216a as illustrated in Figure 3c before the lever 202 can be moved to the mode 3 position at an opposite end of the base portion 204. Figure 2d shows the mechanical lever 202 resting in the mode 3 position. Similarly, the stopper

206 also prevents the mechanical lever 202 from being pushed back to the mode 2 position if the “pulling” step is not performed to disengage stump 218a and stopper 216a.

5 It will be appreciated by a person skilled in the art that similar “locking” may be achieved by the stopper 216b on stump 218b on the opposite side of the toggle switch not illustrated here in Figures 3a-d.

To facilitate the pulling of the locking sleeve 206 away from the base portion 204, the locking sleeve 206 is further provided with a cap 212 shaped such that the user may
10 grip the switch lever with the index finger and thumb, to lift the stump 218a clear of the stopper 216a.

Figure 4 shows a side view of the cap 212 illustrating the shape of the cap 212 in greater detail. The cap 212 comprises a substantially cylindrical bottom 402, which
15 gradually narrows/flattens as it extends away from the bottom 402. The flattened end is further curved away from its direction of extension to form a flap 404. As can be observed, a concave under-cut 406 hence exists on the underside of the flap 404, while a curved outer surface 408 is created on the upper surface of the flap 404. The gradual flattening of the cap 212 as it extends away from the bottom 402 also provides for a
20 slanted outer surface 410.

As illustrated in Figure 4, a top portion 401 of the lever structure 403 has a surface slanted towards the mode 3 position (compare Figure 3d), with an increasing gradient as the top portion 401 extends from the base portion 204. More particular,
25 an initial constant gradient slanted outer surface 410 followed by a radial surface 408 of the flap 404 advantageously promotes slippage should an accidental force be applied by a users finger accidentally engaging the top portion 401 in the direction of the mode 3 position. Figure 5 illustrates an example of the slippage when an unintended accidental force is applied to the cap 212. The applied force can be resolved into 2 main
30 components F_x and F_y . F_y will always be a greater force component than F_x , due to the fact that F_y is always acting perpendicular to the contact surface and F_x is a product of the friction between the thumb and the toggle surface.

When pushing harder, slippage occurs and the thumb or finger providing the

force will slide off the top of the flap 404. In this way, F_x will be kept at a minimum or even zero level. As the thumb slips along the curved surface of the toggle, F_x will always remains tangential to the curvature. In this way, preferably no or negligible upward force is generated which could lift the cap 212.

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The slanted outer surface 410 and radial surface 408 can ensure that F_y is always pushing toward the position of the stopper 214. The increasing gradient slope of the surface of the top portion 401 ensures that early slippage will occur if any accidental upward force component is applied.

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To further prevent such accidental lifting of the locking sleeve, the surfaces of the cap 212 are preferably made of e.g. stainless steel and polished to mirror shine and smoothness such that the index finger will slip off from the cap 212 if excessive force is being applied onto it.

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The following describes the fabrication processes of the toggle cap 212 according to an example embodiment:

- Turn an inverted stainless steel cone with a computer numerical control (CNC) lathe
- Proceed to cut the inner recess 406
- Transfer the work piece to a CNC milling machine and proceed to complete the constant gradient slant surface 410 and the radial (concave) surface 408
- The resulting shaped cap is polished on a buffing machine with polishing wax

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Figure 6 illustrates a user gripping the cap 212 with the index finger 602 and thumb 604. As the entire toggle surface is made extremely smooth, it is easy for a user's fingers to slip off the cap 212 when the intention is to pull it upward. The user grips the cap 212 between the index finger 602 and thumb 604 with the index finger 602 placed at the undercut 406 of the flap 404. The undercut 404 provides a good anchoring point for the index finger 602 and together with the assistance from the thumb 604 placed on the outer side of flap 404, a firm positive grip can be established. In this way, the locking sleeve 206 (Figures 3a-d) can be pulled away from the base portion 204, disengaging

the stump 316 from the stopper 314 and allowing the user to switch confidently to mode 3 without error.

5 Embodiments of the present invention are designed to make it possible for the operator to flip easily between Mode 1 and Mode 2 in a biased configuration, and vice versa, with a simple movement of the index finger.

10 At the same time, the embodiments are designed to make it difficult or even impossible for the operator to accidentally flip from Mode 2 to Mode 3, while allowing easier intended mode switching with the positive action of pulling the switch lever, using the thumb and index finger. As will be appreciated by a person skilled in the art, pull to activate type switches will normally comprise rough surfaces on the lever cap/locking sleeve to introduce friction which allows the operator to easily grip and pull the switch. In sharp contrast, the embodiments of the present invention seek to smoothen the surface and reduce the friction on the lever cap/locking sleeve such that accidental brushing of the lever cap/locking sleeve will not result in accidental mode switching from Mode 2 to Mode 3. On the other hand, should intentional mode switching be required, the presence of the flap and its undercut provides support to allow easier intentional pulling of the lever locking sleeve away from the base portion to switch the lever from mode 2 to mode 3.

20 3.

 It will be appreciated by a person skilled in the art that alternate embodiments may provide for other mode variations, without departing from the spirit or scope of the invention as described in the described embodiments. For example the toggle switch could provide for two groups of operation, each group comprising modes of operation, giving a total of six modes of operation. The toggle switch could then provide for quick switching within each group i.e. between modes 1-3 and between modes 4-6, but providing the safety mechanism to prevent accidental switching between the two groups.

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 Further, embodiments of the present invention illustrate the use of an cap to produce a shape that is beneficial to the "pulling" of the attachment away from the base portion to facilitate the switching into the protected mode 3. It will be appreciated by a person skilled in the art that the attachment could be fabricated in the shape of the cap

to achieve similar effect without the need for the additional cap. Alternatively, the mechanical lever could comprise the elements of the attachment and cap, e.g. the stump and curved flap.

5 Figure 7 shows a flow chart 700 illustrating a method of fabricating a toggle switch according to an example embodiment. At step 702, a base portion is provided. At step 704, a stoppered lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration is provided. At step 706, a
10 surface slanted towards the second switching position is formed on the lever structure.

 Figure 8 shows a flow chart illustrating 800 another method of fabricating a toggle switch according to an example embodiment. At step 802, a base portion is
15 provided. At step 804, a lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration, and for toggling between at least a third switching position and the first or second switching in a biased configuration is provided.

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 It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to
25 be illustrative and not restrictive.

CLAIMS

1. A toggle switch comprising
a base portion; and
5 a stoppered lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration;
wherein said lever structure comprises a surface slanted towards the second switching position.
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2. The toggle switch as claimed in claim 1, wherein the slanted surface is formed at a top portion of the lever structure, and has an increasing gradient as the top portion extends from the base portion of the stoppered lever structure.
- 15 3. The toggle switch as claimed in claim 2, wherein another side of the slanted surface at the tip end provides an undercut surface to allow the stoppered lever structure to be pulled away from the base portion.
4. The toggle switch as claimed in any one of the preceding claims,
20 wherein the stoppered lever structure comprises
a lever attached to the base portion;
a sleeve for providing a means for locking the lever in the at least respective first and second switching positions; and
a cap for providing an exterior shape to the stoppered lever structure;
25 wherein the slanted surface is formed on the cap.
5. The toggle switch as claimed in any claim 4, wherein the sleeve further comprises a stump on the near end facing the base portion and the base portion further comprises a stopper; said stump capable of being engaged by the
30 stopper to lock the lever.
6. The toggle switch as claimed in any one of claims 4 or 5, further comprising means for attaching the cap onto the lever such that the cap is rotationally rigid on the lever.

7. The toggle switch as claimed in claim 6, wherein the means for attaching the cap onto the lever comprises first and second locking pins, wherein the first locking pin engages the lever and sleeve, and the second locking pin engages the cap and the sleeve.

8. The toggle switch as claimed in any one of the preceding claims wherein the lever structure is made of stainless steel.

9. The toggle switch as claimed in claim 8 wherein the lever structure is polished to mirror shine.

10. A method of fabricating a toggle switch, comprising the steps of providing a base portion; and providing a stoppered lever structure extending from the base portion of the toggle switch and adapted for toggling between at least a first and a second switching positions in a pull-to-activate configuration; and forming, on the lever structure, a surface slanted towards the second switching position.

11. The method as claimed in claim 10, wherein the slanted surface is formed at a top portion of the lever structure, and has an increasing gradient as the top portion extends from the base portion of the stoppered lever structure.

12. The method as claimed in claim 13, further comprising providing an undercut surface on an other side of the slanted surface at the tip end to allow the stoppered lever structure to be pulled away from the base portion.

13. The method as claimed in any one of claims 10 to 12, wherein the stoppered lever structure comprises a lever attached to the base portion; a sleeve for providing a means for locking the lever in the at least respective first and second switching positions; and

a cap for providing an exterior shape to the stoppered lever structure;
wherein the slanted surface is formed on the cap.

14. The method as claimed in claim 13, wherein the sleeve further
5 comprises a stump on the near end facing the base portion and the base portion
further comprises a stopper; the method further comprising engaging the stump with
the stopper to lock the lever.

15. The method as claimed in anyone of claims 13, further comprising
10 attaching the cap onto the lever such that the cap is rotationally rigid on the lever.

16. The method as claimed in claim 15, further comprising
engaging the lever and sleeve using a first locking pin; and
engaging the cap and the sleeve a second locking pin.

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17. The method as claimed in any one of the preceding claims wherein
the lever structure is made of stainless steel.

18. The method as claimed in claim 17 wherein the lever structure is
20 polished to mirror shine.

19. A toggle switch comprising
a base portion; and
a lever structure extending from the base portion of the toggle switch and
25 adapted for toggling between at least a first and a second switching positions in a
pull-to-activate configuration, and for toggling between at least a third switching
position and the first or second switching in a biased configuration.

20. A method of fabricating a toggle switch, comprising the steps of:
30 providing a base portion; and
providing a lever structure extending from the base portion of the toggle
switch and adapted for toggling between at least a first and a second switching
positions in a pull-to-activate configuration, and for toggling between at least a third
switching position and the first or second switching in a biased configuration.

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