SEALED SWITCH ARRANGEMENT

BACKGROUND OF THE INVENTION

This invention relates to electrical switches and more particularly to an improved electrical switch having a diaphragm dust and moisture seal.

Heretofore it has not been possible to completely seal off the contacts of small switches such as subminiature switches from atmospheric contaminates such as moisture and dust. Even in the best made switches, contaminates will eventually enter the switch housing from around the switch terminals, through openings in the switch housing and particularly from around the switch actuating button. Once contaminates enter the switch housing, the switch contacts may rapidly become corroded and pitted, thereby causing the switch to fail. Problems have particularly been encountered in attempting to seal the opening through the switch housing for the movable switch actuating button.

SUMMARY OF THE INVENTION

According to the instant invention, a switch is provided with a diaphragm seal for preventing dust and moisture from entering the switch housing around a movable switch actuating button. The switch housing comprises an upper and lower shell molded of a synthetic resinous material. The switch terminals are molded in and extend through the lower shell, while the upper shell is sealed to the lower shell, thereby forming an airtight switch housing. An annular groove is formed in the upper shell around the actuating button opening for receiving the diaphragm seal. The diaphragm seal, which is formed of an elastomeric material, has a generally toroidal or annular lip portion for sealably engaging the annular groove in the upper shell of the housing. An optional annular ring may be pressed into the annular groove in the housing to hold the annular lip portion of the seal within the annular groove. An integral flexible cup-shaped membrane extends completely across the annular lip portion of the seal. When the switch is in its normal unactuated position, a switch blade partially collapses the cup-shaped membrane, causing the button to project from the upper shell of the housing. When the switch actuating button is pushed, the membrane portion of the seal assumes either its normal or a slightly stretched position, thereby deflecting the switch blade to actuate the switch.

It is the primary object of this invention to provide an improved dust and moisture resistant switch.

It is a further object of this invention to provide a diaphragm seal for preventing dust and moisture from entering a switch around a switch actuating button.

Other objects and advantages of the invention will become apparent from the following detailed description, reference being made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially broken away top view of a switch embodying the instant invention;

FIG. 2 is a partially broken away side view of a switch embodying the invention and showing the switch in unactuated and actuated positions;

FIG. 3 is a bottom view of a diaphragm dust and moisture seal for use in a switch, according to the instant invention;

FIG. 4 is a cross-sectional view of a diaphragm seal taken along line 4–4 of FIG. 3;

FIG. 5 is a broken away side view of a portion of a switch, similar to FIG. 2, but showing a modified embodiment of the invention; and

FIG. 6 is a perspective view of an annular ring which may be used to hold the diaphragm seal in position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 2, sealed switch 10 is shown in detail according to the instant invention. The sealed switch 10 generally includes an upper housing 11, a lower housing 12, a switch actuating button 13, a diaphragm seal 14, and a switching mechanism 15. The upper and lower housings 11 and 12 and the switch actuating button 13 are preferably molded from a synthetic resinous material having a high dielectric strength. The upper housing 11 and the lower housing 12 have mating surfaces 16 and 17, respectively, which are sealed together. The mating surfaces 16 and 17 are preferably sealed by means of an epoxy resin, although other obvious types of seals may be used. A common terminal 18, a normally closed terminal 19 and a normally open terminal 20 extend through and are insert molded in and sealed to the lower housing 12. The terminals 18, 19 and 20 are electrically connected and disconnected by means of the switching mechanism 15.

The switch actuating button 13 has a generally cylindrical body portion 21 which is slidably mounted in a cooperating opening 22 through the upper housing 11. The body 21 of the button 13 and the cooperating opening 22 have matching flat key surfaces 23 which prevent the button 13 from rotating. The button 13 further includes a head 24 which engages the upper housing 11 when the switch 10 is in the unactuated position, thereby retaining the button 13 within the switch 10. A rounded hump portion 25 protruding from the head 24 engages and operates the switching mechanism 15 when the actuating button 13 is pushed.

Referring now to FIGS. 2—4, the diaphragm seal 14 is shown in detail. The diaphragm seal 14 includes an annular lip portion 26 which is generally toroidal and which sealably engages an annular groove 27 formed in the upper housing 11 about the opening 22. A cup-shaped membrane 28 extends completely across the opening through the annular lip portion 26 of the seal 14. The diaphragm seal 14 is preferably formed from a single piece of elastomeric material such as silicone rubber or neophrene. The lip portion 26 of the seal 14 should be of sufficient diameter to form a tight seal in the annular groove 27 in the upper housing 11 while the cup-shaped membrane 28 should be sufficiently thin as to be flexible and easily collapsed by the switching mechanism 15. A small indentation 29 may be formed in the center of the membrane 28 for conforming to the rounded hump portion 25 on the head 24 of the switch actuating button 13.

As shown in FIG. 2, when the lip portion 26 of the seal 14 sealably engages the annular groove 27 in the upper housing 11, the cup-shaped membrane 28 completely covers the head 24 of the switch actuating button 13. Thus, it can be seen that although contaminates may enter the upper switch housing 11 around the switch actuating button 13, they are retained by the diaphragm seal 14.

Referring again to FIG. 2, one form of switch mechanism 15 is shown in detail. The switch mechanism 15 generally includes a contact retainer 30, an upper fixed contact 31, a lower fixed contact 32, a floating blade 33 having upper and lower contacts 34 and 35, and a C-spring 36. The upper fixed contact 31 is electrically connected to the normally closed terminal 19, while the lower fixed contact 32 is electrically connected to the normally open terminal 20 and the contact retainer 30 is electrically connected to the common terminal 18. The floating blade 33 includes a pair of wing portions 37 at one end 38 which pivotally engage the V-shaped grooves 39 in a pair of parallel wing portions 40 which project from the contact retainer 30. The C-spring 36 is compressed between an opening 41 in the floating blade 33 and a detent 42 in a flange 43 which projects vertically from the contact retainer 30. The C-spring 36 is positioned such that it tends to force the floating blade 33 upwards until the contact 34 electrically connects with the upper fixed contact 31. Thus, when the switch 10 is in the unactuated position, the floating blade 33 is forced upward until electrical and mechanical contact is made between the contact 34 and the upper fixed contact 31, thereby shorting the common terminal 18 to the normally closed terminal 19. The cup-shaped membrane 28 of the seal 14 is slightly collapsed when the floating blade 33 is in the unactuated position. When the actuating button 13 is pushed, the cup-shaped membrane 28 assumes either its normal shape or a slightly

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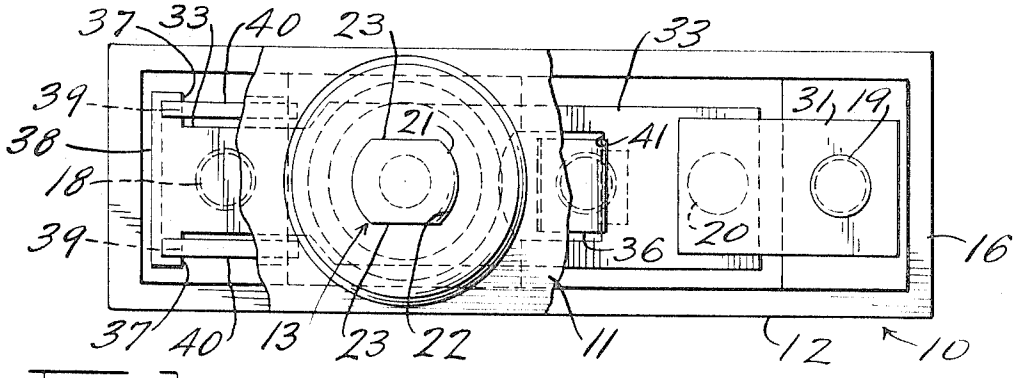
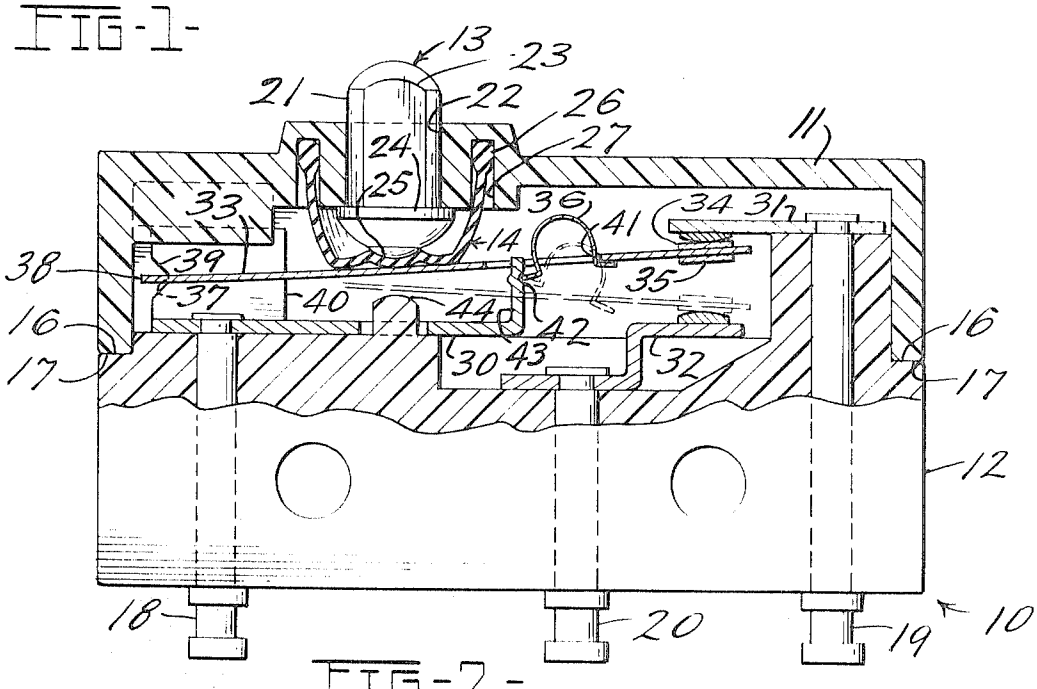


FIG-1-



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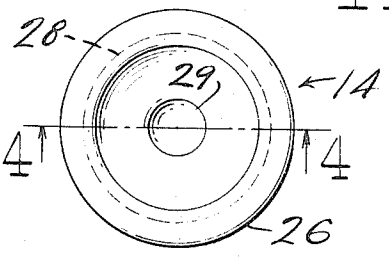

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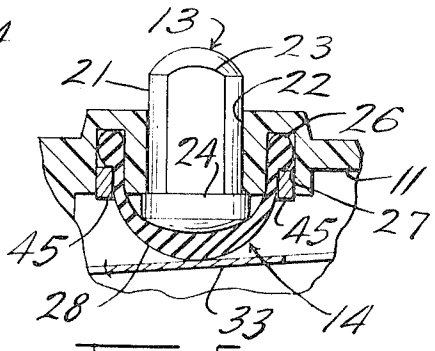

FIG-5-

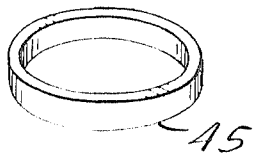

FIG-6-

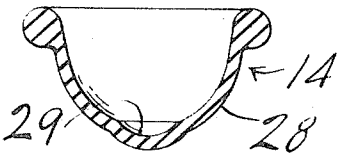

FIG-4-

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FIG. 5 is a broken away side view of a portion of a switch, similar to FIG. 2, but showing a modified embodiment of the invention; and

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As shown in FIG. 2, when the lip portion 26 of the seal 14 sealably engages the annular groove 27 in the upper housing 11, the cup-shaped membrane 28 completely covers the head 24 of the switch actuating button 13. Thus, it can be seen that although contaminates may enter the upper switch housing 11 around the switch actuating button 13, they are retained by the diaphragm seal 14.

Referring again to FIG. 2, one form of switch mechanism 15 is shown in detail. The switch mechanism 15 generally includes a contact retainer 30, an upper fixed contact 31, a lower fixed contact 32, a floating blade 33 having upper and lower contacts 34 and 35, and a C-spring 36. The upper fixed contact 31 is electrically connected to the normally closed terminal 19, while the lower fixed contact 32 is electrically connected to the normally open terminal 20 and the contact retainer 30 is electrically connected to the common terminal 18. The floating blade 33 includes a pair of wing portions 37 at one end 38 which pivotally engage the V-shaped grooves 39 in a pair of parallel wing portions 40 which project from the contact retainer 30. The C-spring 36 is compressed between an opening 41 in the floating blade 33 and a detent 42 in a flange 43 which projects vertically from the contact retainer 30. The C-spring 36 is positioned such that it tends to force the floating blade 33 upwards until the contact 34 electrically connects with the upper fixed contact 31. Thus, when the switch 10 is in the unactuated position, the floating blade 33 is forced upward until electrical and mechanical contact is made between the contact 34 and the upper fixed contact 31, thereby shorting the common terminal 18 to the normally closed terminal 19. The cup-shaped membrane 28 of the seal 14 is slightly collapsed when the floating blade 33 is in the unactuated position. When the actuating button 13 is pushed, the cup-shaped membrane 28 assumes either its normal shape or a slightly

stretched shape. As the floating blade **33** is deflected downward, it is suddenly snapped downward by the C-spring **36** into a position where the contact **35** is electrically connected to the lower fixed contact **32**. A stop **44** limits the downward movement of the blade **33**. Thus, electrical contact will be made between the common terminal **18** and the normally open terminal **20** and broken between the common terminal **18** and the normally closed terminal **19**. It will be appreciated that applicant's improved diaphragm seal for switches may be used with switches having other types of switching mechanisms.

Referring now to FIG. **5**, various modifications of the invention are shown in a portion of the switch **10** of FIG. **2**. The switch actuating button **13** has been modified by the elimination of the rounded hump portion **25** which protrudes from the button head **24** in FIG. **2**. The button **13** is shown in FIG. **5** as having a generally rounded head portion **24** for engaging and operating the switching mechanism. The diaphragm seal **14** has been similarly modified by eliminating the small indentation **29** which conforms to the eliminated hump portion **25**.

An optional annular ring **45**, as shown in perspective in FIG. **6**, may be used to increase the effective air and moisture seal between the annular lip portion **26** of the diaphragm seal **14** and the annular groove **27** in the upper housing **11**. The ring **45**, which is preferably formed from a relatively soft material such as soft aluminum, is pressed into the annular groove **27** after the diaphragm seal **14** is positioned in the groove **27**, as shown in FIG. **5**. The ring **45** will hold the annular lip portion **26** of the diaphragm seal **14** within the groove **27** even after repeated stretching and flexing of the cup-shaped membrane **28** and even when the switch **10** is used under increased atmospheric pressure conditions.

I claim:

1. A sealed switch comprising, in combination, an enclosed electrically insulated switch housing, a switching mechanism positioned within said housing, electrical terminals extending from said switching mechanism through said housing, said terminals sealed in said housing, a button extending through a cooperating opening in said housing for actuating said switching mechanism, and a diaphragm seal having an annular lip portion sealably engaging an annular groove formed in said housing about said opening, said seal further having an integral cup-shaped elastic membrane enclosing the opening through the annular lip portion, said membrane positioned between said button and said switching mechanism.

2. A sealed switch, as defined in claim **1**, wherein said membrane has an indentation formed therein for conforming to said button.

3. A sealed switch, as defined in claim **1**, wherein said button has an enlarged head positioned within said housing for retaining said button in said housing and for actuating said switching mechanism, and said membrane is shaped to conform to at least a portion of said enlarged head on said button.

4. A sealed switch, as defined in claim **1**, and including an annular ring, said ring frictionally engaging said annular groove formed in said housing for holding said annular lip portion of said seal within said annular groove.

5. A sealed switch, as defined in claim **1**, and including an annular ring, said ring frictionally engaging the portion of said seal within said annular groove for holding said seal against a wall of said annular groove.