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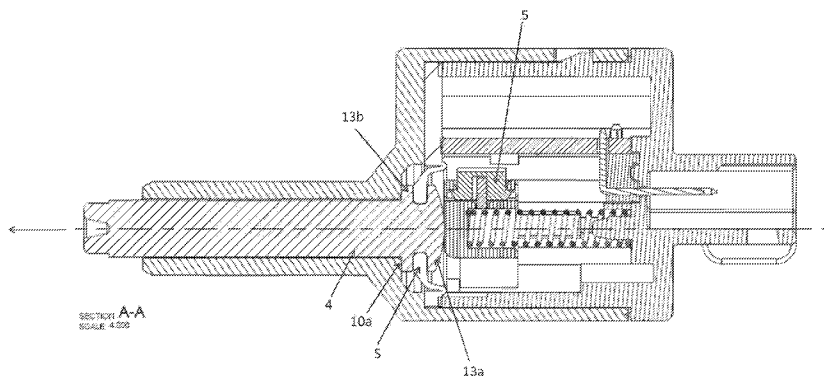
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(54) Title: ELECTROMECHANICAL SWITCH ASSEMBLY

**Figure 8**

(57) **Abstract:** The present invention describes an electromechanical switch assembly of a vehicle. Particularly, the present invention relates to a contactless electromechanical switch assembly for switching of ON/OFF functions like stop lamp, cruise control, etc., The electromechanical switch assembly comprising a housing and a casing, a magnet sub- assembly accommodating a magnet disposed in the housing and an actuating shaft. The Switch assembly comprises a sealing unit mounted on the actuating shaft and adapted to provide sealing between the casing and the interior of the housing. A PCB assembly accommodated in the housing and the PCB assembly comprises one or more Hall sensors adapted to detect change in magnetic flux due to movement of the magnet sub-assembly and to provide signal indicative of activation of brake light.



ELECTROMECHANICAL SWITCH ASSEMBLY

FIELD OF THE INVENTION

The present invention relates to an electromechanical switch assembly of a vehicle, particularly, the present invention relates to a contactless electromechanical switch assembly for switching of ON/OFF functions like stop lamp, cruise control, etc., more particularly, the present invention relates to sealing of a contactless electromechanical switch assembly.

BACKGROUND OF THE INVENTION

Generally, electromechanical switch assemblies are widely being used in automobiles for a long time for switching on and off any one or all the various functions like stop lamp, cruise control, electronic stability function, engine start stop function, etc. An existing vehicle switch similar to this invention is depicted in Figure 1 and 2. The main problem with the prior art switches was that it becomes electrically non-operable or failing to meet prime function of switching on and off of above said various functions. Water entrapment in the switch may result in short circuiting of moving and fixed contact and which may even lead to burning of contacts. This results into failure of switch or reduction in switching life. Entrapment of water is shown in Figure 1. Referring to Figure 1, fine dust entrapment in the switch occurs through the paths indicated by arrows. This ingress of dust results in building up of a layer of dust on the moving contact and/or fixed contact. Due to the layer of dust between contacts introduces a friction between the contacts which results in slower contact separation and leads to switch failure or reduction in switching life of the switch assembly..

Referring to Figure 2, a contactless stop lamp switch assembly is depicted wherein due to water entrapment in the switch, sensor or other electronic components (which are mounted on the printed circuit board) becomes wet and un-operable which leads to switch failure or reduction in switching life of the switch assembly. Furthermore, fine dust entrapment in the switch occurs through the paths indicated by arrows results in accumulation of dust on sensor element. Due to the accumulated dust, sensor's sensitivity gets affected resulting in reduction in switching point accuracy of switch assembly.

SUMMARY OF THE INVENTION

An electromechanical switch comprising a housing comprising an interior and an exterior, a casing comprising a hollow region adapted to receive the housing, a magnet sub-assembly accommodating a magnet disposed in the housing under a force of a spring, being slidably supported on one or more guiding tracks formed in the interior of the housing, an actuating shaft comprising a proximal end being disposed in the interior of the housing so as to remain in contact with the magnet sub-assembly, a distal end operatively coupled with brake pedal so that movement of the brake pedal causes actuation of the actuating shaft thereby allowing movement of the spring loaded magnet sub-assembly in longitudinal direction a sealing unit mounted on the actuating shaft and adapted to provide sealing between the casing and the interior of the housing a PCB assembly accommodated in the housing; the PCB assembly comprises one or more Hall sensors adapted to detect change in magnetic flux due to movement of the magnet sub-assembly and to provide signal indicative of activation of brake light.

BRIEF DESCRIPTION OF FIGURES

Further aspects and advantages of the present invention will be readily understood from the following detailed description with reference to the accompanying figures of the drawings. The figures together with a detailed description below, are incorporated in and form part of the specification, and serve to further illustrate the embodiments and explain various principles and advantages but not limiting the scope of the invention. In the accompanying drawings,

Figures 1 and 2 illustrate existing contact type and contactless switch assembly.

Figures 3 and 4 illustrate a housing of an electromechanical switch assembly according to an embodiment of the present invention.

Figures 5a-5d illustrate a sealing unit of the electromechanical switch assembly according to an embodiment of the present invention.

Figures 6a-6d illustrate an actuating shaft of the electromechanical assembly switch according to an embodiment of the present invention.

Figures 7a-7b illustrates the non-actuated condition electromechanical switch assembly of the present invention.

Figure 8 illustrates the actuation of electromechanical switch assembly of the present invention.

Figure 9 illustrates an electromechanical switch assembly according to an alternative embodiment of the present invention.

Figure 10 illustrates an electromechanical switch assembly according to an embodiment of the present invention.

Figure 11 illustrates details of connector and housing in an electromechanical switch assembly according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

While the invention is susceptible to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the figures and will be described in detail below. It should be understood, however that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the invention is to cover all modifications, equivalents, and alternative falling within the spirit and the scope of the invention as defined by the appended claims.

Before describing in detail the various embodiments of the present invention it may be observed that the novelty and inventive step that are in accordance with the present invention resides in the construction of electromechanical switch. It is to be noted that a person skilled in the art can be motivated from the present invention and modify the various constructions of electromechanical switch. However, such modification should be construed within the scope and spirit of the invention.

Accordingly, the drawings are showing only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

The terms “comprises”, “comprising”, “including” or any other variations thereof, are intended to cover a non-exclusive inclusion, such that an assembly, mechanism,

setup, that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such assembly, mechanism or setup. In other words, one or more elements in turn indicator control switch or assembly proceeded by “comprises” does not, without more constraints, preclude the existence of other elements or additional elements in the assembly or mechanism. The following paragraphs explain present invention and the same may be deduced accordingly.

Accordingly, it is an aim of the present invention to overcome at least one of the problem associated with the prior existing switches.

Accordingly, the present invention provides a electromechanical switch comprising:

- a housing comprising an interior and an exterior;

- a casing comprising a hollow region adapted to receive the housing;

- a magnet sub-assembly accommodating a magnet disposed in the housing under a force of a spring, being slidably supported on one or more guiding tracks formed in the interior of the housing

- an actuating shaft comprising:

 - a proximal end being disposed in the interior of the housing so as to remain in contact with the magnet sub-assembly,

 - a distal end operatively coupled with brake pedal so that movement of the brake pedal causes actuation of the actuating shaft thereby allowing movement of the spring loaded magnet sub-assembly in longitudinal direction;

- a sealing unit mounted on the actuating shaft and adapted to provide sealing between the casing and the interior of the housing;

- a PCB assembly accommodated in the housing; the PCB assembly comprises one or more Hall sensors adapted to detect change in magnetic flux due to movement of the magnet sub-assembly and to provide signal indicative of activation of brake light.

In an embodiment of the present invention, the sealing unit comprises a flat portion and a diaphragm portion formed on the flat surface.

In another embodiment of the present invention, the sealing unit is provided with pockets for accommodating pluralities of crushing ribs formed in the interior of the housing for securing the PCB sub assembly in a more accurate manner.

In still another embodiment of the present invention, the actuating shaft has an annular seat at the proximal end for locating the diaphragm portion of the sealing unit.

In yet another embodiment of the present invention, the diaphragm portion has a first annular end located at the flat portion and a second annular end opposite to the first annular end and having an annular flange extending radially inwardly.

In yet another embodiment of the present invention, the flange portion of the diaphragm is seated on the annular seat formed at the proximal end of the actuating shaft.

In a further embodiment of the present invention, the diaphragm portion has a variable thickness with thickness at the first annular end smaller than the thickness at the second annular end so that the diaphragm portion can deform easily to actuated condition and can return quickly to non-actuated condition.

In a further embodiment of the present invention, the sealing unit is positioned between the housing and the stopping face of the casing.

In a further more embodiment of the present invention, the proximal end of the actuating shaft has a curved surface which remains in contact with the magnet sub-assembly.

In a further more embodiment of the present invention, the actuating shaft has plurality of ribs extending in longitudinal direction.

In still another embodiment of the present invention, the sealing unit is made up of elastomeric material preferably rubber.

In one more embodiment of the present invention, the proximal end of the shaft comprises an annular rim and an annular seat formed on the shaft and contiguous to annular rim.

In still another embodiment of the present invention, the thickness of the flange portion is higher than the thickness of the diaphragm portion of the sealing unit.

In one more embodiment of the present invention, the housing is provided with a locating pin extending for locating the spring and a cylindrical hole may be formed on the magnet sub assembly to accommodate the spring for resiliently mounting the magnet sub assembly.

In another embodiment of the present invention, the proximal end of the shaft comprises an annular rim and an annular seat formed on the shaft and contiguous to annular rim;

In yet another embodiment of the present invention, the sealing unit comprises a diaphragm portion having a flange portion which is seated on the annular seat.

In a further embodiment of the present invention, thickness of the flange portion is higher than the thickness of the diaphragm portion of the sealing unit.

In a further more embodiment of the present invention, the actuating shaft has plurality of ribs formed on the shaft extending in longitudinal direction.

In one more embodiment of the present invention, the said one or more ribs have converging section extending from distal end towards the second annular rim at the proximal end of the shaft.

Another embodiment of the present invention further comprising a connector disposed in the housing, and mating face of the housing and the connector are substantially flat in order to restrict dust and water ingress

In a further more embodiment of the present invention, a clearance between the housing and the connector is provided so that the mating face of the housing and the connector abut at butting face.

The following description describes the present invention with reference to Figures 1 to 10 according to an embodiment of the present invention.

Figures 3 and 4 illustrate an electromechanical switch assembly (1) according to an embodiment of the present invention. Referring to Figures 3 and 4, the electromechanical switch assembly (1) of the present invention comprises a casing (2) and a housing (3) forming an encapsulation for accommodating various components of the switch assembly such as a shaft (4), a sealing unit (S), a magnet sub assembly (5), a spring (6), a PCB sub assembly (7).

As shown in figure 4, the casing (2) has a box shaped geometry, formed by side walls (8), an open end (9) and a rear end wall (10). One or more locking grooves (11) are provided on the side walls (8) for securing the casing (2) to the housing for forming an encapsulation. The housing (3) and casing (2) can be made of any suitable material preferably a thermoplastic material. The rear end wall (10) is incorporated with a hollow cylindrical trough (12) extending perpendicularly and outwardly from the rear end wall of the casing (2). The hollow cylindrical trough (12) is adapted to receive the actuating shaft (4) in the longitudinal direction. The term 'longitudinal direction' herein refers to a direction perpendicular to the plane of the rear end wall (10). The actuating shaft (4) is a rigid structure having a proximal end (13) and a distal end (14) and is adapted to move longitudinally upon actuation of brake pedal (not shown in Figures).

A skilled artisan can envisage the construction of brake pedal and other components which transfers the actuation force from the brake pedal to the distal end (14) of the actuating shaft (4).

The distal end (14) is adapted to pass through the hollow cylindrical trough (12) of the casing (2). The distal end (14) of the actuating shaft (4) emerges from an open end

(12a) of the hollow cylindrical trough (12) for contacting the brake pedal. The proximal end (13) of the actuating shaft (4) is disposed in the interior of the housing and remains in contact with the magnet sub assembly (5).

The term 'proximal end (13)' herein refers to an end of the shaft which is nearer to the magnet sub-assembly (5). The term 'distal end (14)' herein refers to an end of the shaft which is located far from the magnet sub-assembly (5) as compared to the proximal end (13).

The magnet sub assembly (5) accommodates a magnet. The magnet sub assembly is resiliently disposed in the housing (3) and adapted to move in a longitudinal direction upon actuation by actuation shaft. For this purpose, the housing (3) is provided with plurality of guiding tracks for slidably supporting the magnet sub assembly. The housing (3) is provided with a locating pin (not shown in figure) extending towards the open end from the rear end wall of the housing (3) for locating the spring (6) and a cylindrical hole may be formed on the magnet sub assembly (5) to accommodate the spring (6) for resiliently mounting the magnet sub assembly (5).

The PCB sub assembly (7) is accommodated in the housing (3) so as to be located over the magnet sub assembly. For this purpose, the housing (3) is provided with slots extending longitudinally between the open end (20) and closed end wall (21) are formed on the side walls (18, 19). The slots are sized to accommodate the PCB sub assembly (7). A plurality of apertures is provided on the closed end wall for projecting there through the terminals of the PCB sub assembly (7) for electrical connections with the driving circuit. The PCB sub assembly (7) comprises one or more Hall sensors or Hall element and is configured to detect magnetic flux or change in magnetic flux due to the movement of the magnet sub assembly (5) and to provide signal indicative of activation of brake light, cruise control etc.

Exterior of the housing (3) is provided with one or more snaps adapted to cooperate with the locking grooves provided on the casing for securing the housing (3) with the casing to form an encapsulation.

Referring to Figure 4, the electromechanical switch assembly of the present invention comprises a sealing arrangement/unit for providing sealing between the casing and interior of the housing (3). Figures 5(a)-(c) illustrates a sealing arrangement/unit for the electromechanical switch assembly according an embodiment of the present invention.

The sealing unit (S) may be formed of any suitable elastomeric material such as rubber. Referring to Figures 4 and 5a-5c, the sealing unit (S) has a flat portion (S1) and a diaphragm portion (S2) formed on the flat portion (S1). The diaphragm portion (S2) is a bell shaped portion. The flat portion (S1) of the sealing unit has a same shape as the casing inner wall. The diaphragm portion (S2) of the rubber sealing has a first annular end (S3) and a second annular end (S4). The first annular end (S3) of the diaphragm portion (S2) is located at flat portion (S1) of the sealing unit (S). The second annular end (S4) of the diaphragm (S2) is located opposite to the first end (S3). The second annular end (S4) of the diaphragm portion (S2) having an annular flange (S6) extending radially inwardly.

In an embodiment, the sealing unit (S) is provided with a plurality of rectangular pockets (S5) formed on the flat portion (S2) of the sealing unit (S) for material removal to reduce sealing weight.

The sealing unit (S) may be mounted on the shaft (4) preferably at the proximal end (13) of the shaft (4). The shaft (4) may be made of any suitable plastic material. Figures 6(a)-(d) illustrate a construction of the shaft (4) of electromechanical switch assembly (1) according to an embodiment of the present invention.

Referring to Figures 4, 5(a)-(c) and 6(a)-(d), the proximal end (13) of the shaft has two annular rims/flanges formed on the circumference of the actuating shaft (4). The first annular rim/flange (13a) has a top curved surface which remains in contact with the magnet sub assembly (5). The second annular flange/rim (13b) is located on the shaft at spaced apart location in longitudinal direction from the first annular rim (13a). An annular seat (13c) is formed in-between the first annular rim (13a) and the second annular rim (13b) of the shaft (4) to accommodate the sealing unit (S). The flange

portion (S6) of the diaphragm (S2) of the sealing unit (S) rests on the annular seat (13c) formed on the proximal end (13) of the actuating shaft (4).

When diaphragm portion (S2) of the sealing unit (S) starts to actuate, the diaphragm portion (S2) will tend to easily bend first from thinner wall starting at the base wall of the sealing unit (S) and thicker wall section will exert opposite force and try to regain its unactuated condition. When actuation force increases to the opposition force exerted by the thicker wall, the diaphragm portion (S2) gets momentarily actuated. Restoring force will be more at the thicker wall and thus diaphragm portion (S2) will return to its initial condition quickly.

In top view (Figure 5b), outer profile is 0.1 to 0.2mm offset of the internal profile of the casing (2) part so that rubber diaphragm can easily rest in the casing (2).

Referring to Figure 5c, vertical thickness t_1 is kept to be 2~3mm so that it can be compressed around 10% of its thickness during assembly with housing with the intentional interference provided between the housing and casing part. Further, height t_2 is kept to be 4~7 mm depending upon the total compressed length of the rubber diaphragm when shaft is actuated completed to switch on all the functions. Also, section A-A has been disclosed to explain the constructional detail of flexible zone of the rubber diaphragm. Diameter d_1 has been kept as per the formula as $d_1 > d_2 + 4 \cdot t_5$ so that adequate sliding clearance remains for the movement of moving portion of the rubber diaphragm.

Referring to Figure 5d, it represents the wall thickness design of the flexible portion for expansion and contraction of during completion of switching stroke. Thickness t_6 has been kept intentionally of smaller value than the thickness t_7 . The relation between t_6 and t_7 has been established by conducting design of experiments and it is $t_7 > t_6 + 0.4\text{mm}$ so that diaphragm has been supposed to be bent from t_6 only. This bending helps to regain the diaphragm to its original position (expanded) by virtue of restoring force developed in the diaphragm as this restoring force is more at starting from t_7 due to more thickness and smaller at ending at t_6 thickness due to lesser thickness, t_6 has been kept 0.4 to 0.6mm and t_7 has been kept to be 0.7 to 0.9 mm. Detail A shown in Figure 5d is useful in accommodating crushing ribs formed in the housing.

Referring to Figures 6a-6d the actuating shaft (4) has plurality of ribs (16) formed on the shaft (4) extending in longitudinal direction. The ribs (16) are formed in between the second annular rim (13b) and the distal end (14) of the shaft. In an embodiment, the one or more ribs (16) have converging section extending from distal end towards the second annular rim (13b) at the proximal end (13) of the shaft. The converging section reduces the area available for dust and water entry in the switch assembly (1) which will reduce the possibility of dust and water entry to reach the face area of the shaft in the switch assembly (1). Each of the ribs (16) tapers at the proximal end (13) so as to form multiple inlets (or longitudinal grooves). In case of dust or water accumulation of any assumed quantity near the second annual rim (13b), a greater pressure head built up by the available trapezoidal volumes will expel the water and dust towards outside automatically. When the shaft is received in the cylindrical trough of the casing, the converging ribs forms diverging channels extending from the distal end towards the second annular rim (13b) at the proximal end (13) of the shaft. In other words, the size of the channel (i.e. the space between two ribs) increases as we move from the distal end of the shaft towards the proximal end when the shaft is received in the cylindrical trough of the casing. Therefore, the opening available for entry of dust and water in the casing is very small. The large opening near in the proximal end helps the accumulated water to exits from the casing through the said channel. In an embodiment, the shaft comprises two converging ribs whose cross section decreases as we move from distal end to the proximal end and two ribs extending between the distal end and the proximal end whose cross section remains constant.

Referring to Figures 7a and 7b, the sealing unit (S) can be positioned between casing (2) and the housing (3). As shown in figure 7(a), the sealing unit (S) is positioned between peripheral edges of side walls (18, 19) of the housing (3) and stopping face (10a) of the rear end wall of the casing (2).

As can be observed from Figures 7(a) and 7(b), the annular seal formed on the shaft acts as a holding groove for gripping the flange portion (S6) of the elastomeric sealing unit. The said elastomeric sealing part is gripped in shaft holding groove or annular seal due to the intentional interference provided between the both part diametrically.

The flat portion of the sealing unit is disposed between the peripheral edges of the housing (3) and the stopping face (10a) of the rear end wall of the casing. Thus, the said elastomeric sealing unit is guided in all around the housing periphery. In order to firmly restrict the movement of the sealing unit in longitudinal direction, side walls (18, 19) of the housing (3) comprise an intentional interference between the side walls (18, 19) and the sealing unit (S) guided or disposed in the casing (2). This construction protects the switching parts for example magnet sub assembly (5), PCB sub assembly (7) from water and dust.

Figure 8 illustrates actuation of electromechanical switch (1) of the present invention. As depicted in figures 7(a) and 7(b), the electromechanical switch (1) is in non-actuated or no switching condition. In the non-actuated condition, the brake pedal remains in released state i.e. no force is applied on the brake pedal. The brake pedal is operatively coupled with the distal end (14) of the actuating shaft (4) so as to apply a force on the distal end (14) of the shaft (4) when the brake pedal is in released position. In this position, the second annular rim (13b) of the proximal end (13) of the actuation shaft (4) is not in contact with the stopping face (10a) of the rear end wall (10) of the casing (2). The first annular rim (13a) of the actuation shaft (4) is in point contact with the magnet sub assembly (5) due to its hemispherical geometry. The spring (6) which is resiliently in contact with the magnet sub assembly (5) is in compressed state in the non-actuated position of the switch (1).

When the brake pedal is pressed or an external force is applied on the brake pedal, the force applied on the distal end (14) of the shaft (4) by the brake pedal gets released. Referring to Figure 8, when the force of the brake pedal on the distal end (14) is removed, the spring (6) expands and pushes the magnet sub assembly (5) thereby resulting in a sliding movement of the magnet sub assembly (5) on the guiding tracks. Movement of the magnet sub assembly (5) pushes the actuation shaft (4) in longitudinal direction. In this position the second annular rim (13b) abuts with the stopping face (10a) of the rear end wall (10) of the casing (2) to restrict further movement of the actuation shaft (4). This is actuated or switching condition of the said electromechanical switch. Further, as shown in Figure 8, when the shaft (4) moves to the actuated position, the diaphragm portion (S2) of the sealing unit (S) deforms. Referring to Figures 8 and 5(c), the first annular end (S3) forms a hinge

about which the diaphragm (S2) deforms. As shown Figure 5(c), the diaphragm portion (S2) has a variable thickness ratio with thickness at the first annular end (S3) smaller than the thickness at the second annular end (S4) so that the diaphragm portion (S2) can deform easily. The variable thickness ratio of the diaphragm portion (S2) also provides quicker return of the diaphragm portion (S2) when the shaft (4) moves back to the non-actuated condition.

Due to sudden abutment of the second annular rim (13b) with the stopping face (10a) of the rear end wall (10) of the casing (2) generates noise. To avoid the same, in an embodiment of the present invention, the sealing unit (S) and the shaft (40) may be constructed to avoid contact between the second annular rim (13b) and the stopping face (10a).

Referring to Figure 9, in an alternative embodiment, the proximal end (130) of the shaft (40) comprises an annular rim (130a) and an annular seat (130c) formed on the shaft (40) and contiguous to annular rim (130a). As shown in Figure 9, the annular seat (130c) extends partially from the annular rim towards distal end (140) of the shaft (40). The flange portion (S6) of the diaphragm portion (S2) of the sealing unit (S) has been seated on the annular seat (130c). In an embodiment, thickness of the flange portion (S6) is higher than the thickness of the diaphragm portion (S2) of the sealing unit (S). It can be clearly understood from Figure 9, when the shaft (40) is actuated, the flange portion (S6) of the sealing unit (S) comes in contact with the stopping face (100a) and thus the noise which has been generated due to plastic to plastic contact is avoided and/or reduced significantly.

Referring to Figure 10, according to an embodiment of the present invention, intentional compression between PCB sub assembly (7) and sealing unit (S) is provided which helps in improved assembly of PCB sub assembly (7) in housing (3) in forms of firm assembly of PCB sub assembly (7) with casing (2) and housing (3). There is cushioning provided by the rubber compression achieved through intentional interference which is adding support to PCB assembly resting on crushing ribs. In case of manufacturing defect in crushing ribs, height is smaller, sealing will provide required support.

Referring to Figure 11, there is a possibility of dust and water ingress from connector (22) side through the entry formed by clearances provides for the terminals to come out from the housing (3). Therefore in an embodiment, mating faces (i.e. butting face) of the housing (3) and connector (22) has been kept substantially flat in order to restrict dust and water ingress. A clearance between the housing (3) and connector may be provided so that the mating face of the housing and the connector can abut at butting face (23).

Advantages of the present invention

(a) the main advantage of the present invention is that the it prevents the entry of dust and water in the housing at two locations. As can be clearly observed that the the dust and water can enter in the housing through the cylindrical trough and through the junction of the housing and casing. The sealing unit in the present invention prevents the entry of water and dust from these two locations. In other words, the sealing unit forms a seal between the inner side of the rear end wall of casing and forms a seal around the proximal end of the shaft which is received in a hollow cylindrical trough. The sealing unit provide dust and water protection even when the shaft is reciprocating or in motion. This protection increases the product life cycle.

(b) The present invention invention is much advantageous in case of vehicles which are frequently washed by water jet pressure from the bottom side of the vehicle since the possibility of water ingress inside the switch assembly is quite high during this kind of washing.

(c) Another advantage of the present invention is that the sealing unit is constructed so that the PCB assembly can be accommodated inside the housing and the actuation of the diaphragm portion does not interfere with the other components disposed in the housing.

(d) Yet another advantage is to dampen the operating noise generated due to plastic to plastic contact, significantly.

We claim:

1. An electromechanical switch comprising:
a housing comprising an interior and an exterior;
a casing comprising a hollow region adapted to receive the housing;
a magnet sub-assembly accommodating a magnet disposed in the housing under a force of a spring, being slidably supported on one or more guiding tracks formed in the interior of the housing
an actuating shaft comprising:
a proximal end being disposed in the interior of the housing so as to remain in contact with the magnet sub-assembly,
a distal end operatively coupled with brake pedal so that movement of the brake pedal causes actuation of the actuating shaft thereby allowing movement of the spring loaded magnet sub-assembly in longitudinal direction;
a sealing unit mounted on the actuating shaft and adapted to provide sealing between the casing and the interior of the housing;
a PCB assembly accommodated in the housing; the PCB assembly comprises one or more Hall sensors adapted to detect change in magnetic flux due to movement of the magnet sub-assembly and to provide signal indicative of activation of brake light.
2. The electromechanical switch as claimed in claim 1 wherein the sealing unit comprises a flat portion and a diaphragm portion formed on the flat surface.
3. The electromechanical switch as claimed in claim 1 wherein the sealing unit is provided with pockets for accommodating pluralities of crushing ribs formed in the interior of the housing for the securing PCB sub assembly in a more accurate manner.
4. The electromechanical switch as claimed in claim 1, wherein the actuating shaft has an annular seat at the proximal end for locating the diaphragm portion of the sealing unit.
5. The electromechanical switch as claimed in claim 2 wherein the diaphragm portion has a first annular end located at the flat portion and a second annular end

opposite to the first annular end and having an annular flange extending radially inwardly.

6. The electromechanical switch as claimed in claim 5 wherein the flange portion of the diaphragm is seated on the annular seat formed at the proximal end of the actuating shaft.

7. The electromechanical switch as claimed in claim 5, wherein the diaphragm portion has a variable thickness with thickness at the first annular end smaller than the thickness at the second annular end so that the diaphragm portion can deform easily to actuated condition and can return quickly to non-actuated condition.

8. The electromechanical switch as claimed in claim 1 wherein the sealing unit is positioned between the housing and the stopping face of the casing.

9. The electromechanical switch as claimed in claim 1 wherein the proximal end of the actuating shaft has a curved surface which remains in contact with the magnet sub-assembly.

10. The electromechanical switch as claimed in claim 1, wherein the actuating shaft has plurality of ribs extending in longitudinal direction.

11. The electromechanical switch as claimed in claim 1, wherein the sealing unit is made up of elastomeric material preferably rubber.

12. The electromechanical switch as claimed in claim 1, wherein the proximal end of the shaft comprises an annular rim and an annular seat formed on the shaft and contiguous to annular rim.

13. The electromechanical switch as claimed in claim 12, wherein the thickness of the flange portion is higher than the thickness of the diaphragm portion of the sealing unit.

14. The electromechanical switch as claimed in claim 1, wherein the housing is provided with a locating pin extending for locating the spring and a cylindrical hole may be formed on the magnet sub assembly to accommodate the spring for resiliently mounting the magnet sub assembly.

15. The electromechanical switch as claimed in claim 1, wherein the proximal end of the shaft comprises an annular rim and an annular seat formed on the shaft and contiguous to annular rim;

16. The electromechanical switch as claimed in claim 15, wherein the sealing unit comprises a diaphragm portion having a flange portion which is seated on the annular seat.

17. The electromechanical switch as claimed in claim 15, wherein thickness of the flange portion is higher than the thickness of the diaphragm portion of the sealing unit.

18. The electromechanical switch as claimed in claim 1, wherein the actuating shaft has plurality of ribs formed on the shaft extending in longitudinal direction.

19. The electromechanical switch as claimed in claim 1, wherein the said one or more ribs have converging section extending from distal end towards the second annular rim at the proximal end of the shaft.

20. The electromechanical switch as claimed in claim 1, further comprising a connector disposed in the housing, and mating face of the housing and the connector are substantially flat in order to restrict dust and water ingress

21. The electromechanical switch as claimed in claim 20, wherein a clearance between the housing and the connector is provided so that the mating face of the housing and the connector abut at butting face.

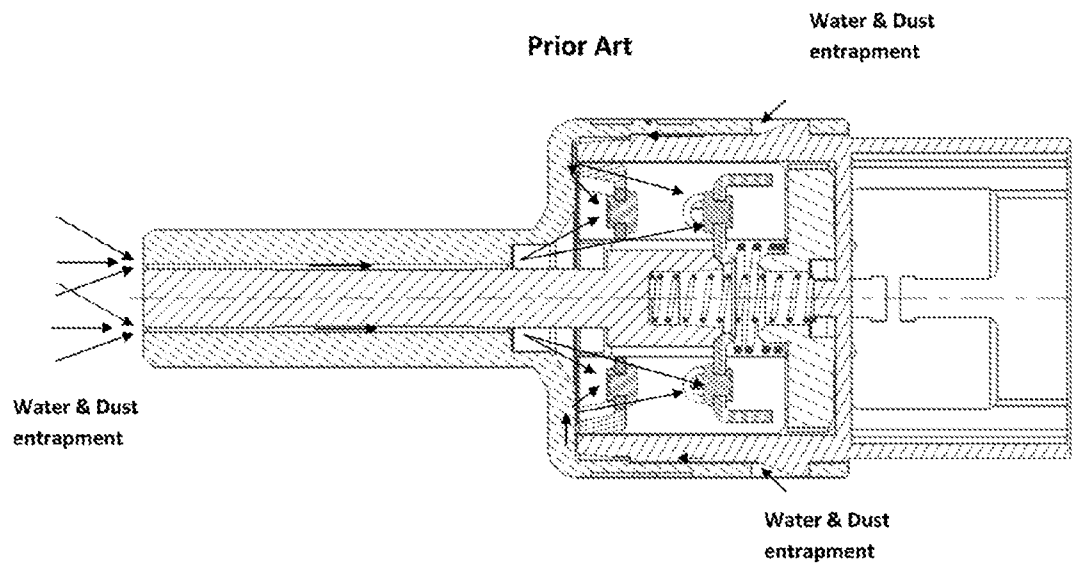


Figure-1

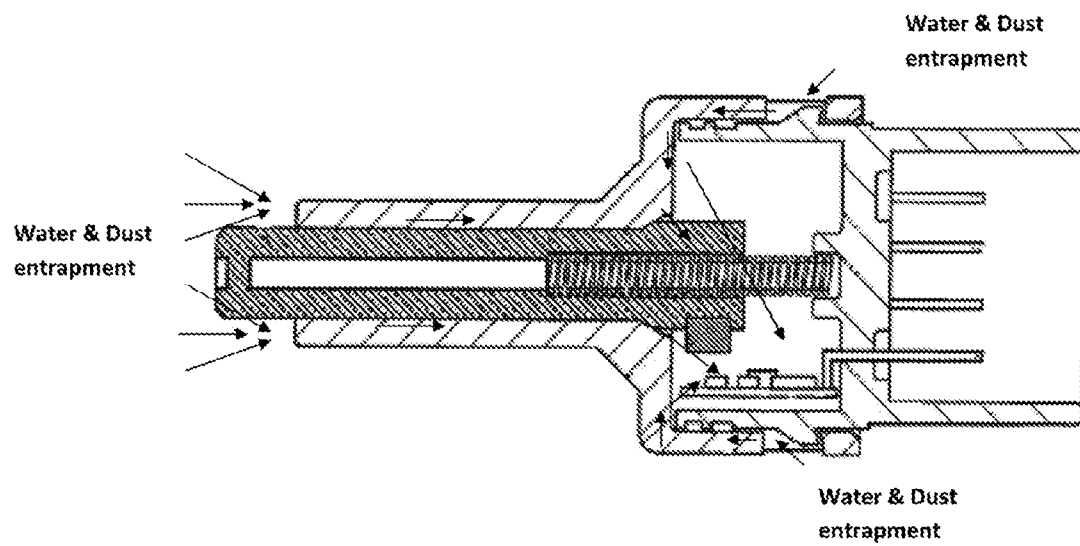


Figure-2

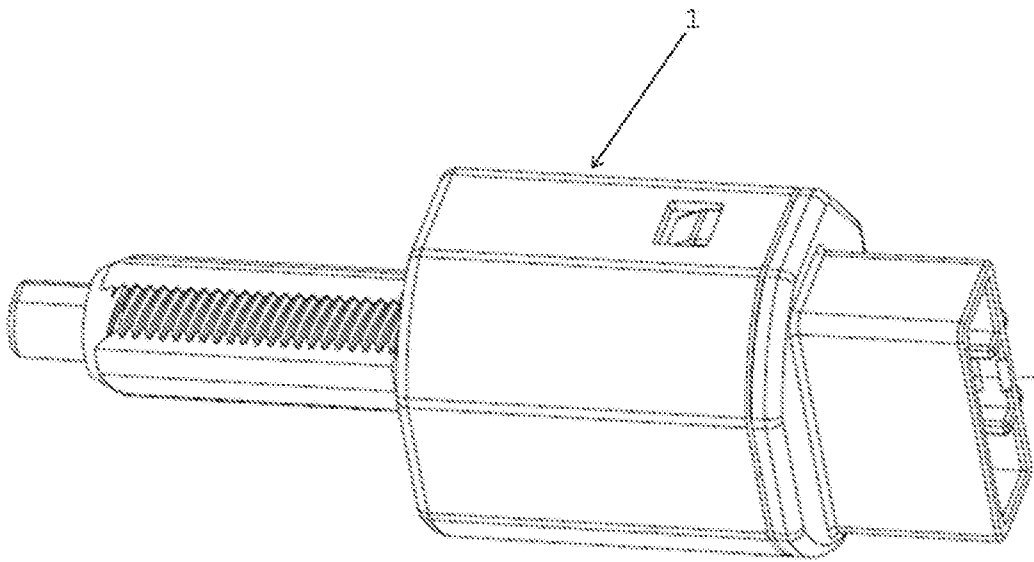


Figure 3

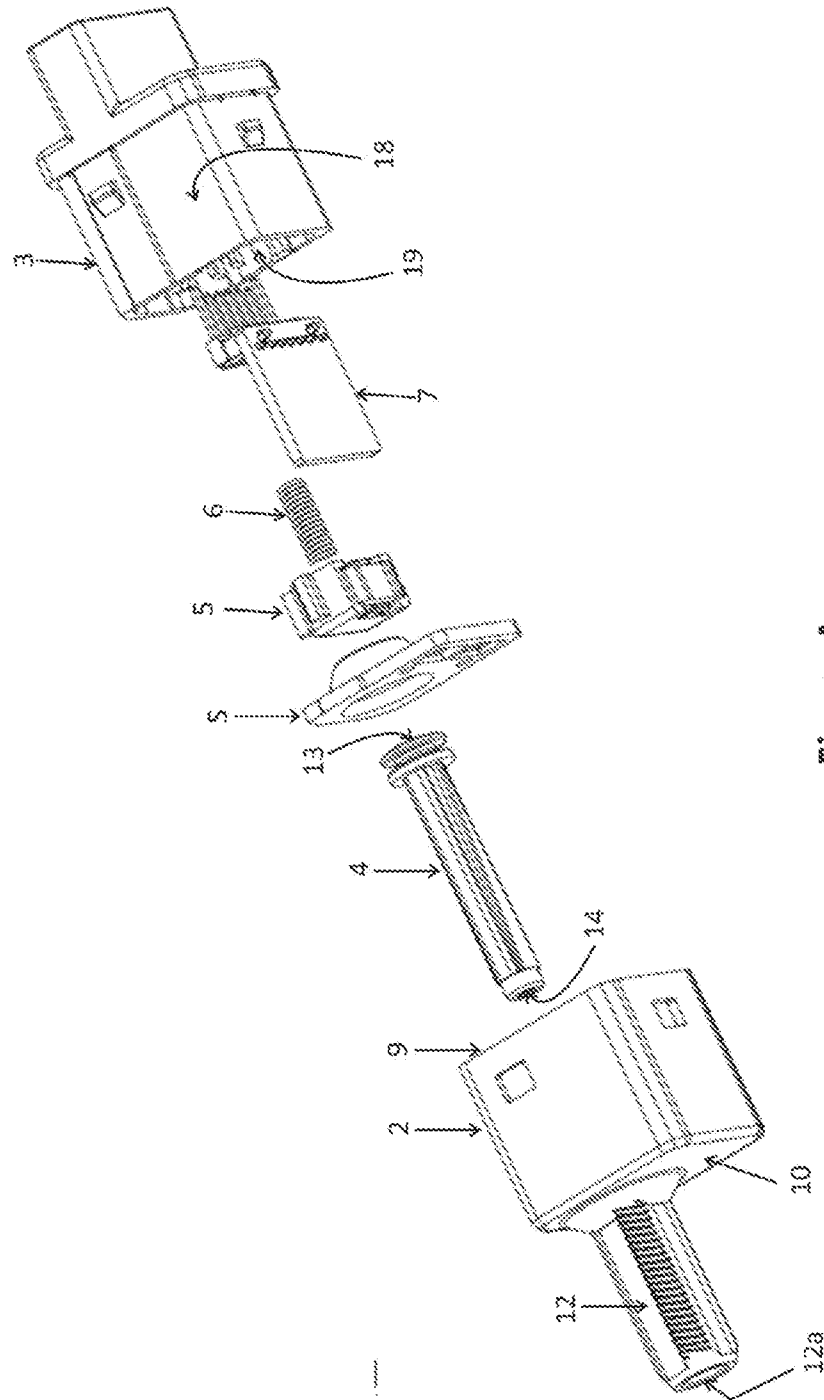


Figure 4

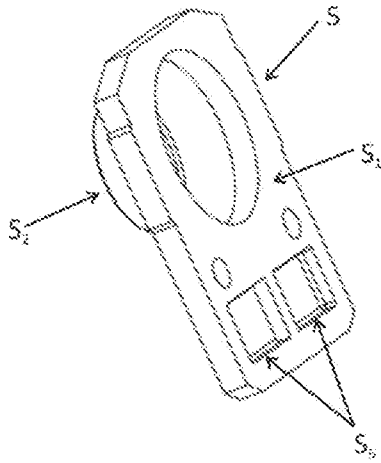


Figure 5a

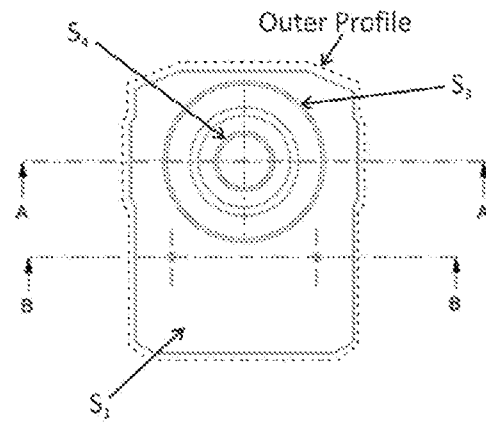


Figure 5b

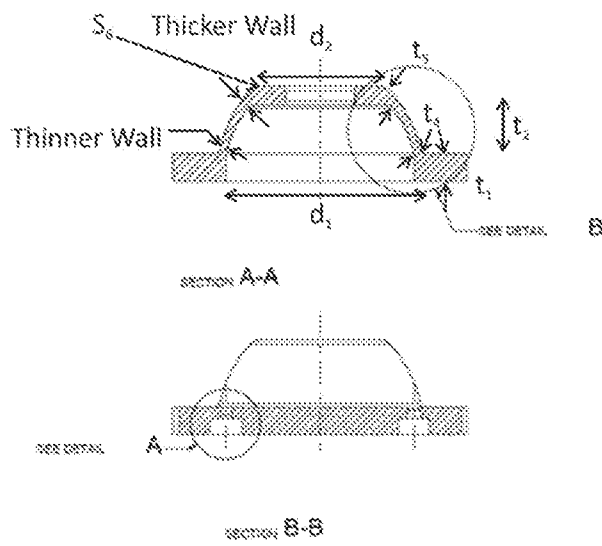


Figure 5c

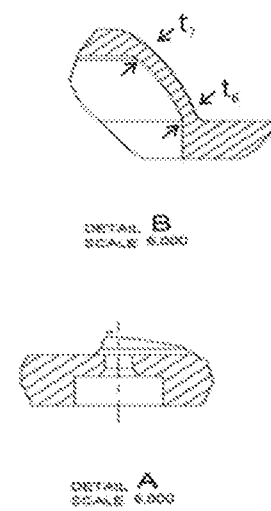


Figure 5d

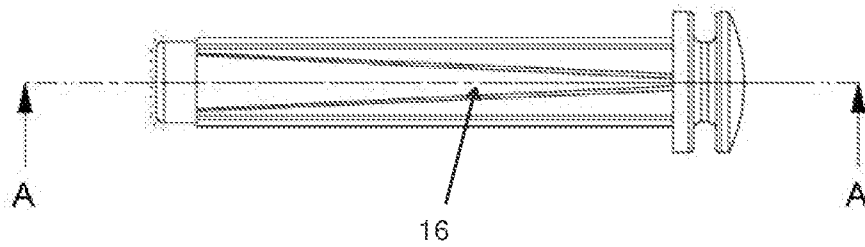


Figure 6a

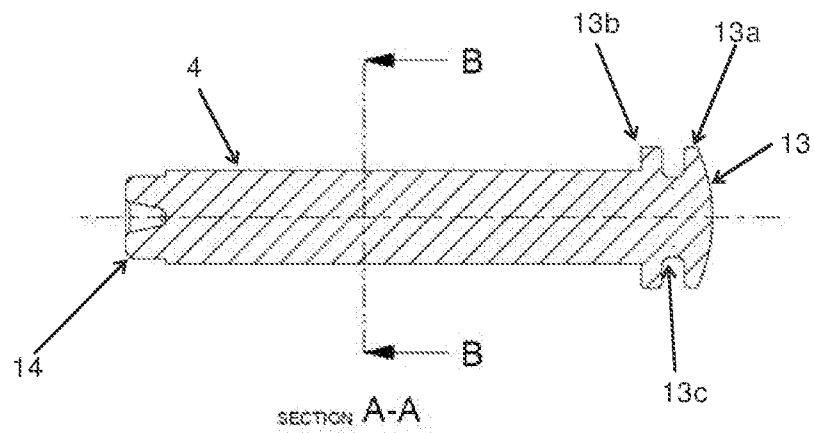


Figure 6b

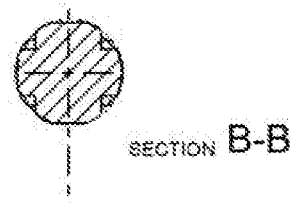


Figure 6c

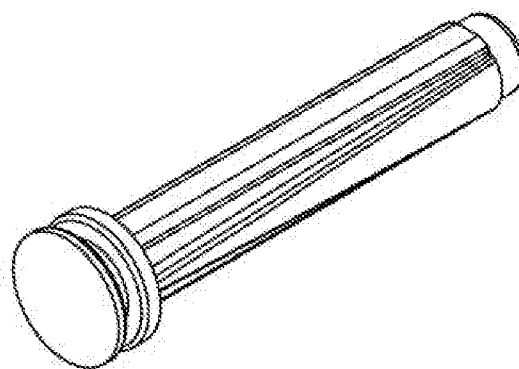


Figure 6d

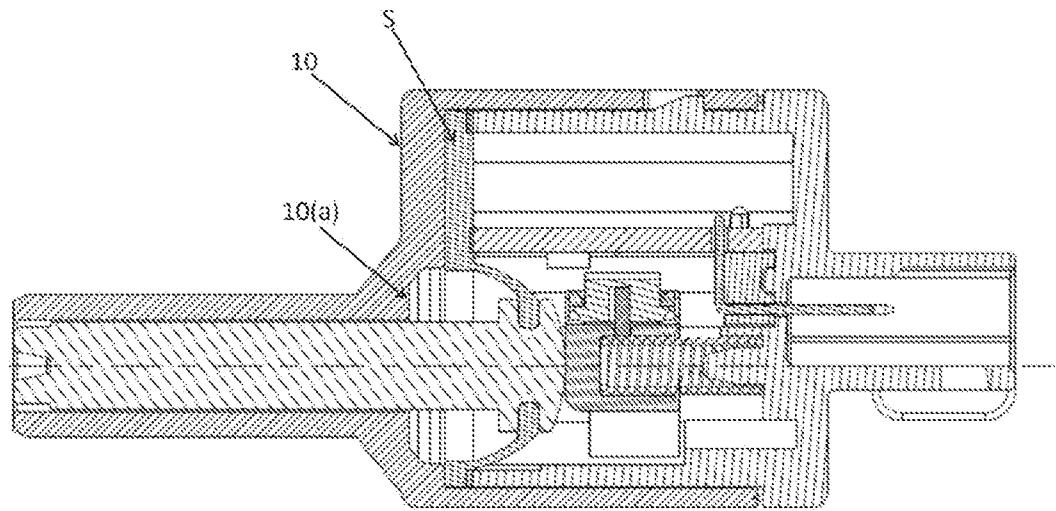


Figure 7a

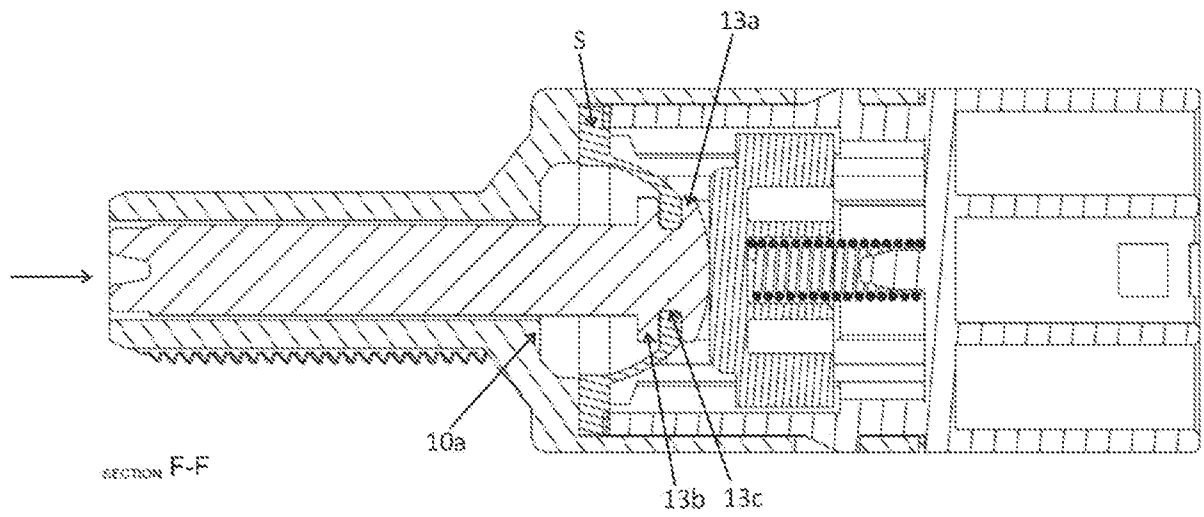


Figure 7b

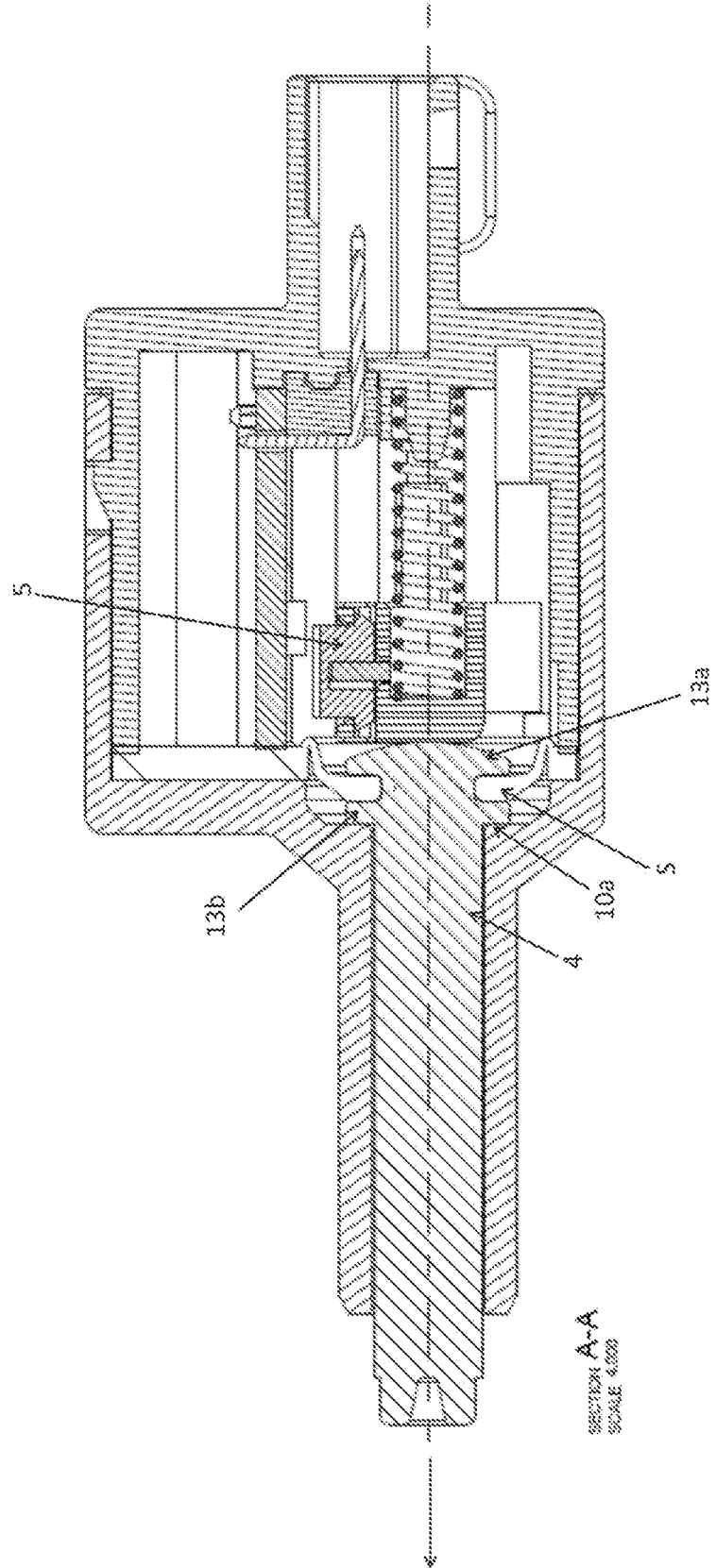


Figure 8

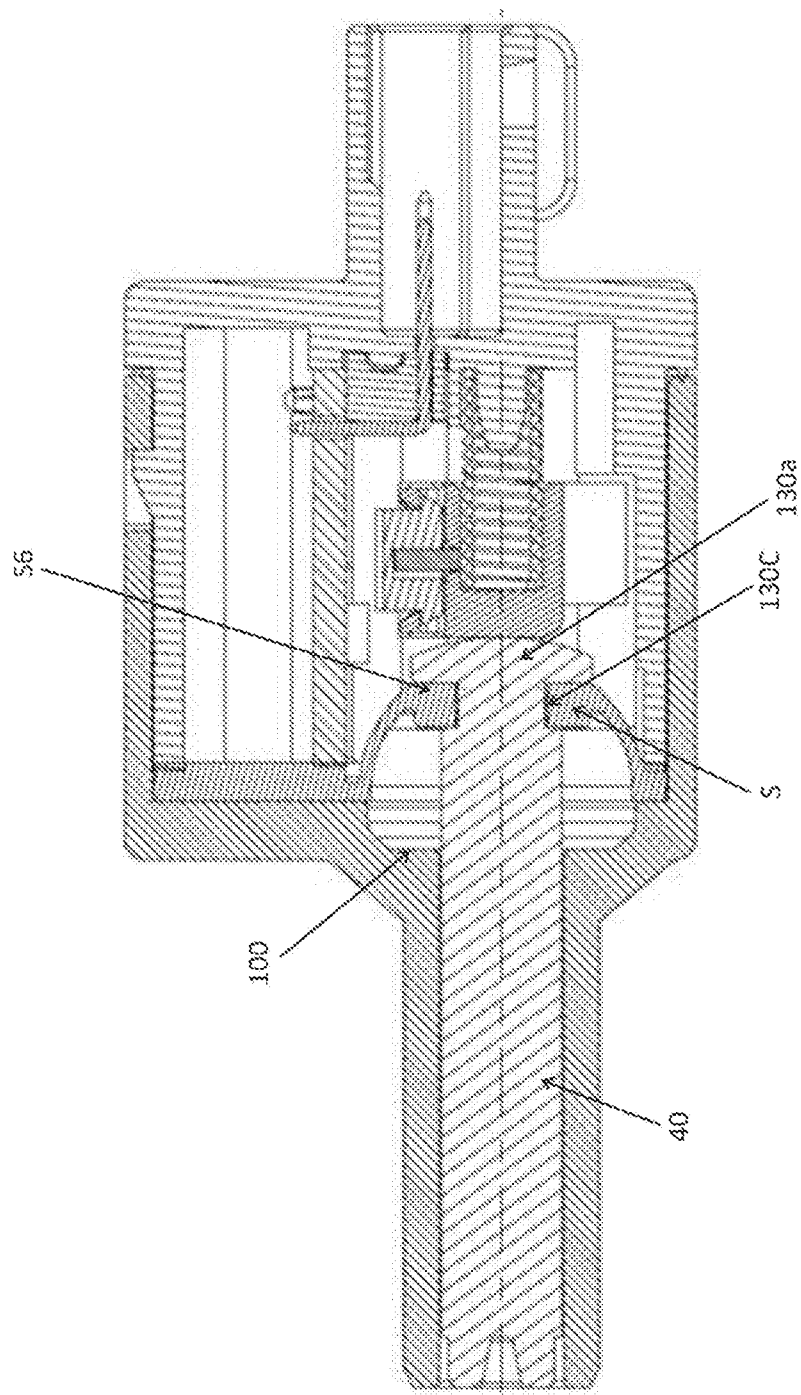


Figure 9

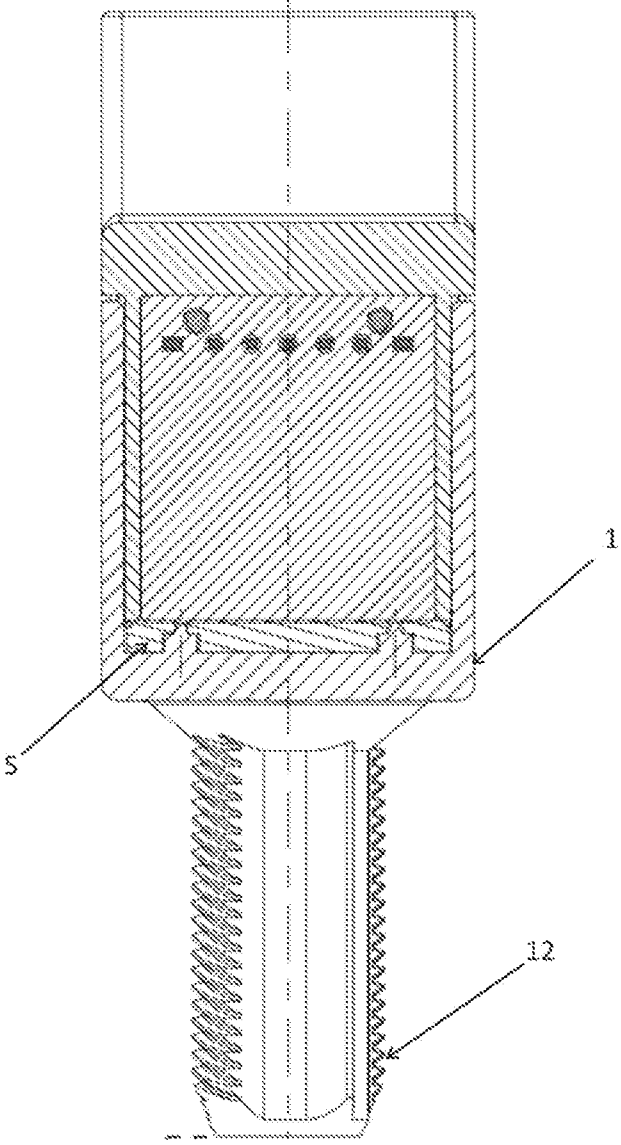
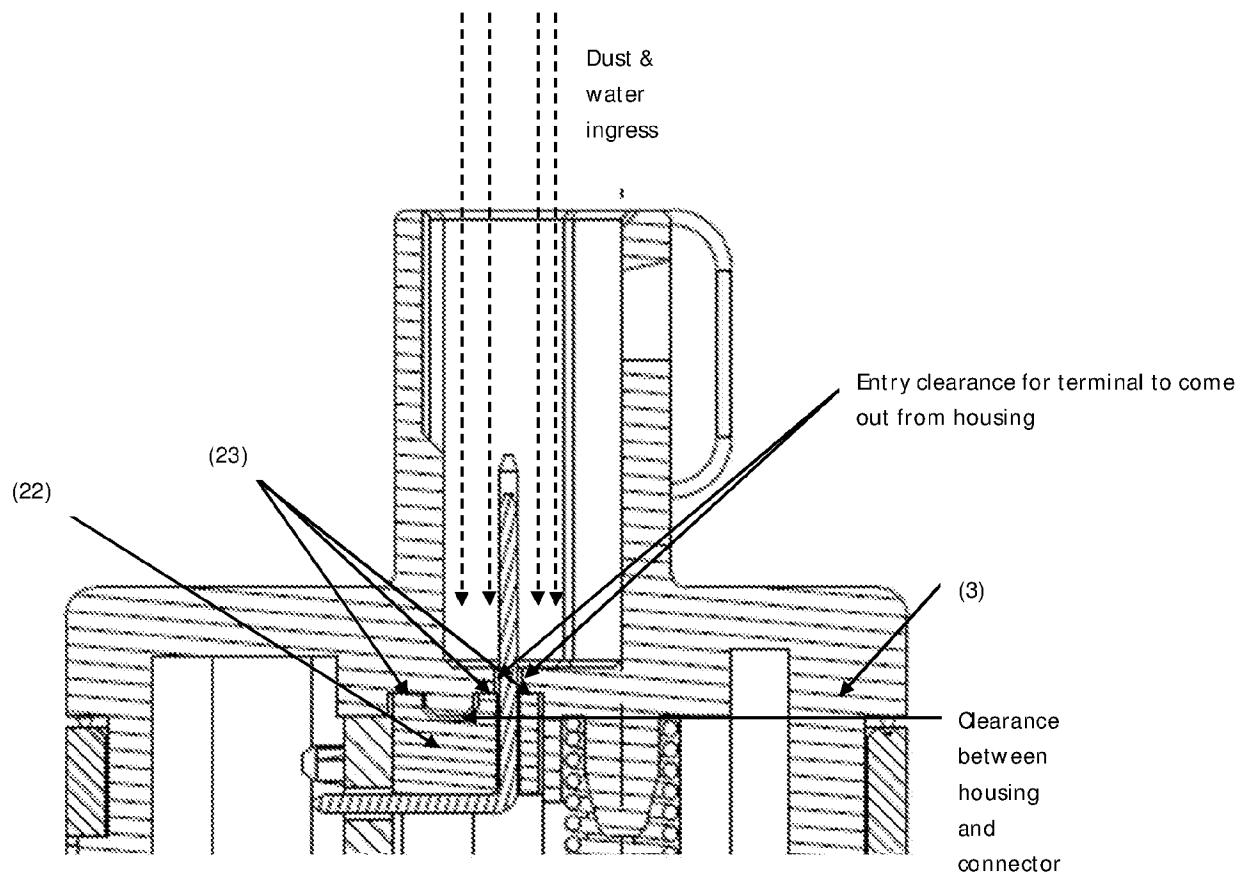


Figure 10

**Figure 11**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2015/056922

A. CLASSIFICATION OF SUBJECT MATTER
B60Q1/44, H01H9/00 Version=2016.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60Q1/44, H01H9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Ipo internal database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 2556346 A1 (SIEGFRIED SCHWAB) 23 June 1977 ABSTRACT, FIGURES-01-03	1-21
Y	US 7553205 B2 (MARTIN J. LOSCHIAVO, ANTHONY G. VIGGIANO) 30 June 2009 WHOLE DOCUMENT, ABSTRACT, FIGURES-01-012	1-21

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

05-02-2016

Date of mailing of the international search report

05-02-2016

Name and mailing address of the ISA/

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Authorized officer

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2015/056922

Citation	Pub.Date	Family	Pub.Date
DE 2556346 A1	23-06-1977	DE 7539899 U	01-06-1983
US 7553205 B2	30-06-2009	US 20070270051 A1	22-11-2007