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(54) STARTER AND SOLENOID SWITCH THEREOF

(57) A solenoid switch for a starter comprising: a switch cover (50) comprising a mounting hole (52, 54, 56) for mounting an exhaust assembly (20), and comprising a first side (50a) facing the inside of the solenoid switch and an opposite second side (50b), and an exhaust assembly (20) mounted in the mounting hole (52, 54, 56), the exhaust assembly comprising an air permeable element (40) and a plug (30) made of an elastic material, and the plug comprising an exhaust hole (35) through which air in the solenoid switch is discharged out in a direction from the first side (50a) to the second side (50b), and the air permeable element (40) covering the exhaust hole, wherein the plug (30) comprises a first por-

tion (32) proximate to the first side (50a) and a second portion (34) with a reduced cross-sectional dimension with a first step formed between the first portion and the second portion, and the mounting hole comprises a first hole segment (54) adapted to receive the second portion (34) and a first step at a first side of the first hole segment, and wherein the second portion (34) of the plug and the first hole segment (54) of the mounting hole form an interference fit therebetween, and the first step of the plug cooperates with the first step of the mounting hole at a first side of the first hole segment to form a stop for preventing the exhaust assembly from being pushed out of the mounting hole by the air in the solenoid switch.

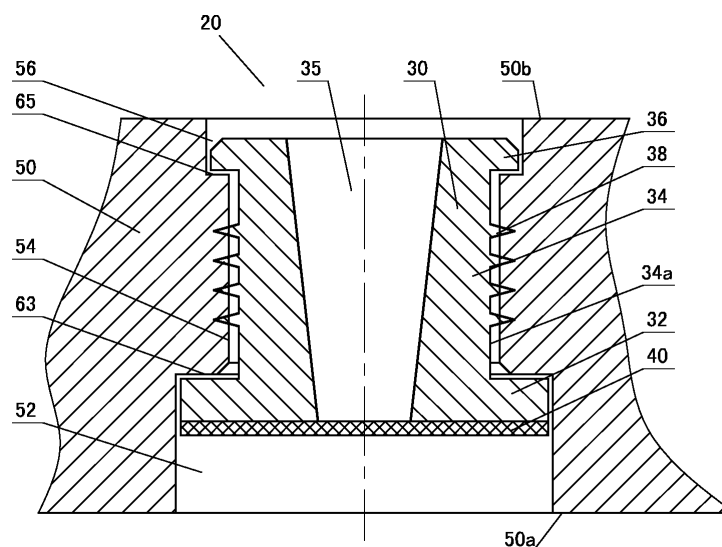


Figure 2

EP 3 016 121 A1

Description

Technical Field

[0001] The disclosure relates to a solenoid switch for a starter and the starter comprising the solenoid switch.

Background Art

[0002] In general, operation of a vehicle engine begins with the starting action of its starter. The starter mainly comprises a DC motor, a solenoid switch, and a one-way clutch. On one hand, the solenoid switch is configured for causing the one-way clutch to slide forward along a driving shaft to mesh with a disk wheel of the engine according to an instruction received from an ignition switch. On the other hand, the solenoid switch is configured for switching on/off power supply for the DC motor.

[0003] In some applications, it is required that the solenoid switch shall be completely closed. For the closed-type solenoid switch, the air pressure in the solenoid switch increases gradually because the air in the solenoid switch can not be discharged out, especially when the starter is located in a high temperature condition. The high air pressure in the solenoid switch may cause magnetic contact failure of the solenoid switch.

[0004] Providing an exhaust valve on a switch cover of the solenoid switch is common technical means currently to solve the above problem, and the provision of the exhaust valve achieves an object of allowing only air to permeate and prohibiting water and other materials to permeate.

[0005] Figure 1 shows an exhaust valve in the prior art. The exhaust valve 10 is assembled in a mounting hole 17 which is formed in a switch cover 15, and is assembled in a hole segment 17a of the mounting hole 17 which has a larger diameter, a hole segment 17b of the mounting hole 17 having a smaller diameter functioning to position the exhaust valve 10 axially.

[0006] The exhaust valve 10 comprises a rubber element 12 and an air permeable film 14. The rubber element 12 has a cylindrical shape and is provided at its outer circumferential surface with teeth 16 protruding outwards from the outer circumferential surface. Correspondingly, the hole segment 17a of the mounting hole 17 having the larger diameter is provided at its inner circumferential surface with teeth 19 protruding inwards. The teeth 19 have an innermost dimension "d" slightly larger than an outer diameter of the outer circumferential surface of the rubber element 12, and the teeth 16 have an outermost dimension "D" larger than an inner diameter of the hole segment 17a of the mounting hole 17 having the larger diameter. When the exhaust valve 10 is assembled into the hole segment 17a of the mounting hole 17 having the larger diameter, the teeth 16 on the outer circumferential surface of the rubber element 12 are positioned between the adjacent teeth 19 and are deformed elastically by an inner wall of the hole segment 17a of the

mounting hole 17 having the larger diameter, forming an interference fit.

[0007] The air permeable film 14 is glued to the rubber element 12, and is sandwiched between the rubber element 12 and a shoulder of the mounting hole 17 once the exhaust valve 10 has been assembled into position. Thus, air in the solenoid switch is discharged out of the solenoid switch through the air permeable film 14 and through an exhaust hole in the rubber element 12.

[0008] However, in the exhaust valve 10, the teeth 19 in the mounting hole 17 of the switch cover 15 are designed to protrude inwards from an inner surface of the mounting hole 17, which is difficult to machine and causes a high cost. More importantly, this can not be achieved by domestic manufacturers and suppliers. Moreover, the fixation of the exhaust valve in the mounting hole 17 is not reliable, especially after a long-time service. It is likely that the exhaust valve be pushed out of the switch cover due to the high air pressure in the solenoid switch, causing the solenoid switch to be disabled.

Summary of the Invention

[0009] An object of the application is to provide a solenoid switch for a starter with reliable operation and simple manufacturing process, in which the above problems are solved.

[0010] To this end, according to the invention, a solenoid switch for a starter is provided, which comprises: a switch cover comprising a mounting hole for mounting an exhaust assembly, and comprising a first side facing the inside of the solenoid switch and an opposite second side, and an exhaust assembly mounted in the mounting hole, the exhaust assembly comprising an air permeable element and a plug made of an elastic material, and the plug comprising an exhaust hole through which air in the solenoid switch is discharged out in a direction from the first side to the second side, and the air permeable element covering the exhaust hole, wherein the plug comprise a first portion proximate to the first side and a second portion with a reduced cross-sectional dimension with a first step formed between the first portion and the second portion, and the mounting hole comprise a first hole segment adapted to receive the second portion and a first step at the first side of the first hole segment, and wherein the second portion of the plug and the first hole segment of the mounting hole form an interference fit therebetween, and the first step of the plug cooperates with the first step of the switch cover to form a stop for preventing the exhaust assembly from being pushed out of the mounting hole by the air in the solenoid switch.

[0011] According to an alternative embodiment, one or both of the first portion and the second portion of the plug are cylindrical.

[0012] According to an alternative embodiment, the second portion is provided at its outer circumferential surface with teeth which protrude out from the outer circumferential surface, the teeth being deformed elastically by

an inner circumferential surface of the first hole segment to form or improve the interference fit when the exhaust assembly is being assembled into the mounting hole.

[0013] According to an alternative embodiment, the teeth extend along the entire circumference of the outer circumferential surface or along a portion of the circumference in a circumferential direction of the outer circumferential surface, or the teeth extend helically, continuously or discretely, on the outer circumferential surface.

[0014] According to an alternative embodiment, the first hole segment is a through hole.

[0015] According to an alternative embodiment, the solenoid switch further comprises a mounting and positioning portion for positioning the exhaust assembly in the mounting hole, wherein, in particular, the plug further comprises a third portion proximate to the second side which has a cross-sectional dimension larger than that of the second portion, with a second step of the plug formed between the second portion and the third portion, and the mounting hole further comprises a second step at the second side of the first hole segment, the second step of the plug and the second step of the switch cover cooperating to form the mounting and positioning portion, and wherein, preferably, the cross-sectional dimension of the third portion is smaller than or equal to the cross-sectional dimension of the first portion.

[0016] According to an alternative embodiment, the mounting hole further comprises a second hole segment adapted to receive the first portion of the plug, the first hole segment and the second hole segment of the mounting hole forming the first step of the switch cover, and/or the mounting hole further comprises a third hole segment adapted to receive the third portion of the plug, the first hole segment and the third hole segment of the mounting hole forming the second step of the switch cover.

[0017] According to an alternative embodiment, the air permeable element is attached to an end surface of the first portion of the plug which is proximate to the first side, for example, by gluing or by laser welding.

[0018] According to an alternative embodiment, the air permeable element is permeable to air and unpermeable to liquid, and preferably, the air permeable element is configured as an air permeable film or an air permeable plate.

[0019] The application also provides a starter comprising the solenoid switch.

[0020] With the solenoid switch for the starter according to the application, the exhaust assembly comprises a stop for preventing the exhaust assembly from being pushed out of the mounting hole in the air discharging direction by the air in the solenoid switch, in particular in the form of steps which abut against each other, which ensures that the exhaust assembly can be fixed securely in the switch cover of the solenoid switch even if the air pressure in the solenoid switch is overhigh. Moreover, the exhaust assembly of the solenoid switch comprises an air-tight interference fit portion, in particular in the form of the protruding teeth which are elastically deformable,

which improves the fixation of the exhaust assembly in the switch cover on one hand, and ensures the air-tight sealing between the exhaust assembly and the switch cover on the other hand. Further, the hole segments of the mounting hole in the switch cover for mounting the exhaust assembly are through holes, which contributes to a simple manufacturing process and a low manufacturing cost. Therefore, the solenoid switch according to the application has a simple manufacturing process and a low manufacturing cost, while the exhaust assembly is ensured not to be pushed out of the switch cover.

Brief Description of the Drawings

[0021] The above and other features, aspects and advantages of the application will be more apparent from the description of a preferred embodiment of the application in conjunction with the drawings, in which:

Figure 1 shows an exhaust valve of a solenoid switch for a starter according to prior art; and

Figure 2 shows an exhaust assembly of a solenoid switch for a starter according to a preferred embodiment of the application.

Detailed Description of Preferred Embodiments

[0022] An exhaust assembly according to a preferred embodiment of the application will now be described with reference to Figure 2. The exhaust assembly according to the application is used in a solenoid switch for a starter, especially in a solenoid switch for a vehicle starter.

[0023] In Figure 2, an exhaust assembly of a solenoid switch for a starter is denoted with a reference number 20, and a switch cover 50 of the solenoid switch is also shown in Figure 2. The switch cover 50 is formed with a mounting hole for mounting the exhaust assembly 20. The switch cover 50 comprises a first surface 50a, i.e., an inner surface, facing towards internal components of the solenoid switch, and an opposite second surface 50b, i.e., an outer surface, facing away from the internal components of the solenoid switch.

[0024] The mounting hole for mounting the exhaust assembly 20 comprises three portions: a first hole segment 52 proximate to the first surface 50a of the switch cover 50, a third hole segment 56 proximate to the second surface 50b of the switch cover 50, and a second hole segment 54 between the first hole segment 52 and the third hole segment 56, the second hole segment 54 having an inner diameter smaller than that of the first hole segment 52 and of the third hole segment 56. A first step 63 is formed between the first hole segment 52 and the second hole segment 54, and a second step 65 is formed between the third hole segment 56 and the second hole segment 54.

[0025] The exhaust assembly 20 mainly comprises a plug 30 and an air permeable element 40.

[0026] The plug 30 is made of an elastic material, such as soft rubber or any other suitable elastic material. The plug 30 is formed with a through hole 35 which functions as an exhaust hole of the solenoid switch for discharging air in the solenoid switch. For example, the through hole 35 is provided as a tapered hole outspreading from the first surface 50a of the switch cover 50 toward the second surface 50b of the switch cover 50, for improving the air discharging effect.

[0027] The air permeable element 40 is attached to an end surface of the plug 30 proximate to the first surface 50a, such as by gluing or by laser welding or the like. The air permeable element 40 is permeable to air and impermeable to water and other materials. The air permeable element 40 can be provided as a film-like member such as an air permeable film, or a platelike member such as an air permeable plate, or any other suitable element having an air permeable function.

[0028] Corresponding to the mounting hole in the switch cover 50 comprising the three hole segments, the plug 30 comprises three portions having three different diameters respectively: a first portion 32 proximate to the first surface 50a of the switch cover 50 having an outer diameter smaller than an inner diameter of the first hole segment 52, a third portion 36 proximate to the second surface 50b of the switch cover 50 having an outer diameter smaller than an inner diameter of the third hole segment 56, and a second portion 34 between the first portion 32 and the third portion 36. Likewise, the first portion 32 and the second portion 34 form a first step therebetween, and the third portion 36 and the second portion 34 form a second step therebetween.

[0029] The second portion 34 is provided at its outer circumferential surface 34a with a plurality of teeth 38 protruding outwards from the outer circumferential surface, the teeth 38 having a maximum outer diameter larger than the inner diameter of the second hole segment 54 of the switch cover 50. Preferably, each of the teeth 38 extends along the entire circumference of the second portion 34 in a circumferential direction of the second portion 34 of the plug 30, or each of the teeth 38 comprises a plurality of teeth segments which are spaced uniformly in the circumferential direction of the second portion 34 of the plug 30. Alternatively, each of the teeth 38 extends helically, continuously or discretely, on the outer circumferential surface 34a of the second portion 34 of the plug 30. The teeth 38 have a triangular cross-sectional shape as shown in Figure 2, or alternatively, have a square, trapezoid, or any other suitable cross-sectional shape.

[0030] When the plug 30 is to be assembled into the mounting hole in the switch cover 50, the plug 30 is pressed into the mounting hole from the side of the first surface 50a of the switch cover 50. The third portion 36 of the plug 30 passes through the first hole segment 52 and then enters the second hole segment 54 of the mounting hole in the switch cover 50. Due to the outer diameter of the third portion 36 of the plug 30 being larger

than the inner diameter of the second hole segment 54 and the maximum outer diameter of the teeth 38 being larger than the inner diameter of the second hole segment 54, the third portion 36 of the plug 30 and the teeth 38 on the second portion 34 are compressed while pushed through or pushed in the second hole segment 54. After passing through the second hole segment 54, the third portion 36 of the plug 30 recovers its original state under the elasticity of the material of the plug 30.

[0031] At this time, the second step between the third portion 36 and the second portion 34 of the plug 30 abuts the second step 65 of the switch cover 50, which indicates that the plug 30 has been assembled into position. In addition, the first step between the first portion 32 and the second portion 34 of the plug 30 abuts the first step 63 of the switch cover 50. During operation, the abutment of the corresponding first steps prevents the plug 30 and the air permeable element 40 attached to the plug 30 from being pushed out of the mounting hole in the switch cover 50 in an air discharging direction from the first surface 50a toward the second surface 50b under an air pressure in the solenoid switch, and thus avoids failure of the solenoid switch due to disengagement of the exhaust assembly 20.

[0032] With the exhaust assembly 20 according to the disclosure, the abutment between the second step of the plug 30 and the second step 65 of the switch cover 50 achieves the positioning of the plug 30 in the mounting hole in the switch cover 50, and the abutment between the first step of the plug 30 and the first step 63 of the switch cover 50 can ensure that the exhaust assembly 20 will not be pushed out of the through hole in the switch cover 50 because of the overhigh air pressure in the solenoid switch.

[0033] The fact that the plug 30 is provided on the second portion 34 with the teeth 38 which are compressible and deformable further ensures an interference fit between the second portion 34 of the plug 30 and the second hole segment 54 of the switch cover 50, which advantageously achieves an air-tight seal between the plug 30 and the switch cover 50, without needing to machine teeth on an inner surface of the second hole segment 54 of the switch cover 50 to be mated with the teeth 38 on the second portion 34 of the plug 30 as in the prior art. This substantially simplifies the manufacture of the switch cover 50 and accordingly causes a reduced manufacturing cost of the switch cover 50.

[0034] With the abutment of the corresponding first steps and the interference fit between the second portion and the second hole segment, it can be ensured that the exhaust assembly 20 can be assembled securely on the switch cover, and the design reliability can be improved.

[0035] By providing the above structure on the switch cover of the closed type solenoid switch, air in the solenoid switch can be discharged out timely, and therefore the risks that the exhaust assembly is pushed out of the switch cover and thus the solenoid switch is disabled, due to the air pressure rise in the solenoid switch, are

avoided.

[0036] It should be noted herein that, while the plug of the exhaust assembly in the illustrated embodiment of the invention is shown to comprise three substantially cylindrical portions, each portion of the plug does not have to be cylindrical as shown. Instead, a plug which is made of an elastic material and has other cross-sectional shape may also provide the same function.

[0037] The solenoid switch for the starter according to the disclosure provides at least the following advantages: first, the exhaust assembly comprises a stop for preventing the exhaust assembly from being pushed out of the mounting hole in the air discharging direction by the air in the solenoid switch, in particular in the form of steps which abut against each other, which ensures that the exhaust assembly can be fixed securely in the switch cover of the solenoid switch even if the air pressure in the solenoid switch is overhigh; second, the exhaust assembly of the solenoid switch comprises an air-tight interference fit portion, in particular in the form of the protruding teeth which are elastically deformable, which improves the fixation of the exhaust assembly in the switch cover on one hand, and ensures the air-tight sealing between the exhaust assembly and the switch cover on the other hand; and third, the hole segments of the mounting hole in the switch cover for mounting the exhaust assembly are the through holes, which causes a simple manufacturing process and a low manufacturing cost.

[0038] To sum up, the solenoid switch according to the disclosure has a simple manufacturing process and a low manufacturing cost, the fixation of the exhaust assembly in the switch cover is secure and reliable, and the exhaust assembly is ensured not to be pushed out of the switch cover.

[0039] Although only preferred embodiments according to the principle of the invention have been described, it should be understood for a skilled in the art that the invention is not limited to the embodiments described above and shown in the drawing. Instead, various modifications and variants can be made to the embodiments described above by the skilled in the art without departing from the spirit or scope of the invention.

Claims

1. A solenoid switch for a starter comprising:

a switch cover comprising a mounting hole for mounting an exhaust assembly, and comprising a first side facing the inside of the solenoid switch and an opposite second side, and an exhaust assembly mounted in the mounting hole, the exhaust assembly comprising an air permeable element and a plug made of an elastic material, and the plug comprising an exhaust hole through which air in the solenoid switch is discharged out in a direction from the first side

to the second side, and the air permeable element covering the exhaust hole, wherein the plug comprise a first portion proximate to the first side and a second portion with a reduced cross-sectional dimension with a first step formed between the first portion and the second portion, and the mounting hole comprise a first hole segment adapted to receive the second portion and a first step at the first side of the first hole segment, and wherein the second portion of the plug and the first hole segment of the mounting hole form an interference fit therebetween, and the first step of the plug cooperates with the first step of the switch cover to form a stop for preventing the exhaust assembly from being pushed out of the mounting hole by the air in the solenoid switch.

2. The solenoid switch of claim 1, wherein one or both of the first portion and the second portion of the plug are cylindrical.
3. The solenoid switch of claim 1 or 2, wherein the second portion is provided at its outer circumferential surface with teeth which protrude out from the outer circumferential surface, the teeth being deformed elastically by an inner circumferential surface of the first hole segment to form or improve the interference fit when the exhaust assembly is being assembled into the mounting hole.
4. The solenoid switch of claim 3, wherein the teeth extend along the entire circumference of the outer circumferential surface or along a portion of the circumference in a circumferential direction of the outer circumferential surface, or the teeth extend helically, continuously or discretely, on the outer circumferential surface.
5. The solenoid switch of any of claims 1-4, wherein the first hole segment is a through hole.
6. The solenoid switch of any of claims 1-5, further comprising a mounting and positioning portion for positioning the exhaust assembly in the mounting hole, wherein, in particular, the plug further comprises a third portion proximate to the second side which has a cross-sectional dimension larger than that of the second portion, with a second step of the plug formed between the second portion and the third portion, and the mounting hole further comprises a second step at the second side of the first hole segment, the second step of the plug and the second step of the switch cover cooperating to form the mounting and positioning portion, and wherein, preferably, the cross-sectional dimension of the third portion is smaller than or equal to the cross-sectional dimension of the first portion.

7. The solenoid switch of claim 6, wherein the mounting hole further comprises a second hole segment adapted to receive the first portion of the plug, the first hole segment and the second hole segment of the mounting hole forming the first step of the switch cover, and/or the mounting hole further comprises a third hole segment adapted to receive the third portion of the plug, the first hole segment and the third hole segment of the mounting hole forming the second step of the switch cover. 5 10
8. The solenoid switch of any of claims 1-7, wherein the air permeable element is attached to an end surface of the first portion of the plug which is proximate to the first side, for example, by gluing or by laser welding. 15
9. The solenoid switch of any of claims 1-8, wherein the air permeable element is permeable to air and unpermeable to liquid, and preferably, the air permeable element is configured as an air permeable film or an air permeable plate. 20
10. A starter comprising a solenoid switch according to any of claims 1-9. 25

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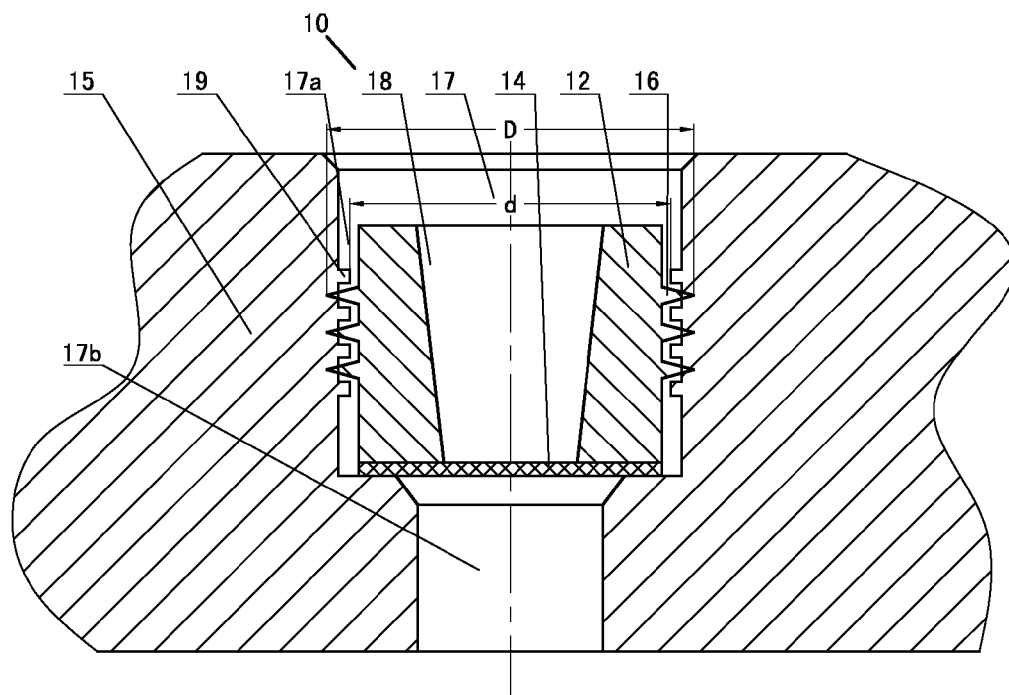


Figure 1

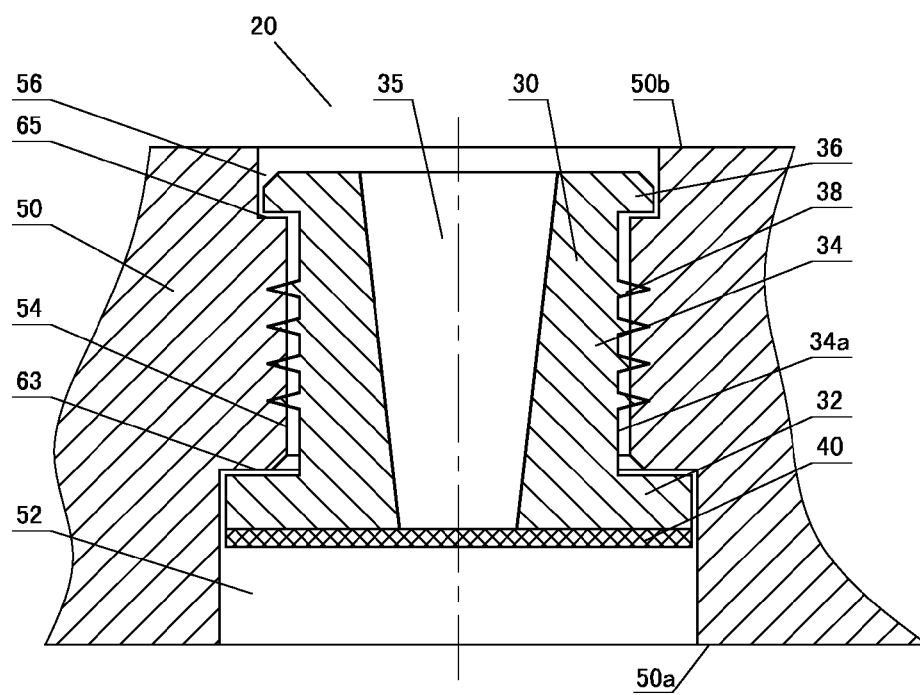


Figure 2



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Application Number
EP 15 19 1833

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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