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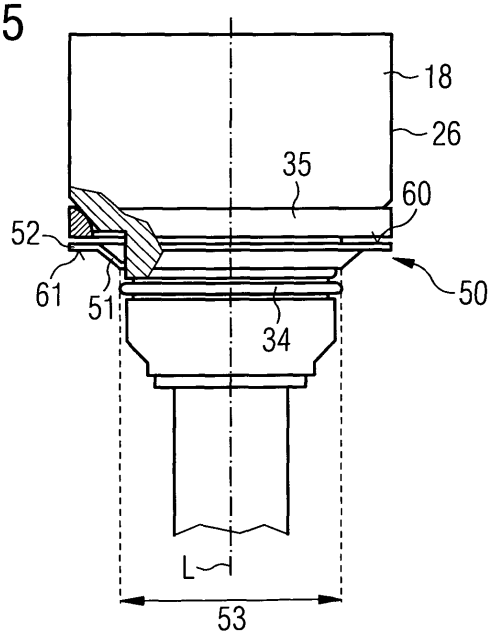
(54) Fuel injector

(57) Fuel injector (18) of a combustion engine (22) comprising a fuel injector housing (26) and a spacer-ring (35). The injector housing (26) is applicable to be mounted in a cylinder head (14) of the combustion engine (22). The spacer-ring (35) being applicable to allow planar and rotational movements of the fuel injector (18) within the cylinder head (14) of the combustion engine (22). The fuel injector (18) further comprises a fixing device (50). The fixing device (50) comprises a discoidal portion (52) with a central opening and a conic portion (51). The discoidal portion (52) comprises an inner diameter (54), representing the diameter of the central opening, and an outer diameter (55). The outer diameter (55) is larger than the inner diameter (54), whereas the inner diameter (54) is larger than the diameter of the injector housing (26), where the fixing device (50) is arranged. The discoidal portion (52) comprises an upper planar surface (60) and a bottom planar surface (61). The bottom planar surface (61) is in contact with the cylinder head (14). The upper planar surface (60) is in contact with the spacer-ring (35), if the fuel injector (18) is mounted in the cylinder head (14). The conic portion (51) comprises a first diameter (56) and a second diameter (53). The first diameter (56) is larger than the second diameter (53) and is in the range of the inner diameter (54) of the discoidal portion (52). The second diameter (53) being larger than the diameter of the injector housing (26), where the fixing device (50) is arranged. The end of the first diameter (56) of the conic portion (51) is rigidly coupled to the discoidal portion (52).

FIG 5



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Description

[0001] The invention relates to a fuel injector of a combustion engine.

[0002] Fuel injectors are in wide spread use, in particular for internal combustion engines where they may be arranged in order to dose fuel into an intake manifold of the internal combustion engine or directly into the combustion chamber of a cylinder of the internal combustion engine. Fuel can be supplied to the internal combustion engine by the fuel injector. The fuel injectors can be coupled to the cylinder head of the internal combustion engine in different manners.

[0003] The coupling of the fuel injectors to the cylinder heads needs to be very precise to get a correct injection angle.

[0004] The object of the invention is to create a fuel injector of a combustion engine which ensures a simple and reliable coupling to a cylinder head of the combustion engine.

[0005] The objects are achieved by the features of the independent claim. Advantageous embodiments of the invention are given in the sub-claims.

[0006] According to a first aspect the invention is distinguished by a fuel injector of a combustion engine, comprising an injector housing and a spacer-ring. The injector housing is applicable to be mounted in a cylinder head of the combustion engine. The spacer ring is applicable to allow planar and rotational movements of the fuel injector within the cylinder head of the combustion engine. The fuel injector further comprises a fixing device. The fixing device comprises a discoidal portion with a central opening and a conic portion. The discoidal portion comprises an inner diameter, representing the diameter of the central opening, and an outer diameter. The outer diameter is larger than the inner diameter and the inner diameter is larger than the diameter of the injector housing, where the fixing device is fixed to. The discoidal portion further comprises an upper planar surface and a bottom planar surface. The bottom planar surface is in contact with the cylinder head and the upper planar surface is in contact with the spacer-ring, if the fuel injector is mounted in the cylinder head. The conic portion comprises a first diameter and a second diameter. The first diameter is larger than the second diameter and is in the range of the inner diameter of the discoidal portion. The second diameter is larger than the diameter of the injector housing, where the fixing device is fixed to. The end of the first diameter of the conic portion is rigidly coupled to the discoidal portion.

[0007] The spacer-ring is coupled with the upper surface of the fixing device, when the fuel injector is mounted in the cylinder head of the combustion engine. This has the advantage that the spacer-ring in correlation with the fixing device offers a simple and reliable coupling of the injector housing of the fuel injector with the cylinder head, in particular by allowing planar and rotational movements of the fuel injector. By this the fuel injector can compensate tolerances of parts coupled to it.

[0008] In an advantageous embodiment of the invention the discoidal portion is formed in one piece with the conic portion.

[0009] This has the advantage that the fixing device can be simply constructed with a small amount of material. Furthermore, a compact construction is possible.

[0010] In a further advantageous embodiment of the invention the outer diameter of the discoidal portion is in the range of the outer diameter of the spacer-ring.

[0011] By this a reliable coupling between the spacer-ring and the fixing device can be achieved. Additionally, planar movements of the spacer-ring can be ensured.

[0012] In a further advantageous embodiment of the invention the fuel injector comprises a snap-ring, which is arranged underneath the fixing device. The second diameter of the conic portion of the fixing device is smaller than an outer diameter of the snap-ring to keep the spacer-ring and the fixing device packaged to the injector housing.

[0013] By this the spacer-ring and the fixing device can be packaged to the fuel injector. This has the advantage that an assembly of the fuel injector into the cylinder head of the combustion engine can be processed in a single step, saving assembly time and reducing manufacturing costs for assembly in the combustion engine.

[0014] In a further advantageous embodiment of the invention the injector housing, the spacer-ring, the discoidal portion and the conic portion are made of stainless steel.

[0015] Preferably the injector housing, the spacer-ring, the discoidal portion and the conic portion are made of the same material. This has the advantage that a reliable coupling between the fixing device and the spacer-ring can be ensured, as well as a reliable coupling between the fixing device and the injector housing of the fuel injector.

[0016] In a further advantageous embodiment of the invention the fixing device is applicable to allow planar movements of the spacer-ring of the fuel injector.

[0017] By this the planar movements of the fuel injector are ensured by the coupling of the upper surface of the fixing device with the bottom planar surface of the spacer-ring. This has the advantage that tolerances, in particular tolerances within the arrangements of parts coupled to the fuel injector, can be compensated reliably.

[0018] In a further advantageous embodiment of the invention the fixing device is arranged in the area of the injector housing, where it is fixed to the cylinder head of the combustion engine.

[0019] This ensures that the spacer-ring is generally not directly in contact with the cylinder head of the combustion engine, in particular if the cylinder head of the combustion engine is made of a material different to the material of the spacer-ring. By this planar movements can be ensured and tolerances of parts coupled to the fuel injector can be compensated reliably.

[0020] Exemplary embodiments of the invention are

explained in the following with the aid of schematic drawings. These are as follows:

Figure 1 an internal combustion engine in a schematic view,

figure 2a a fuel injector in a cylinder head of the combustion engine in a side view,

figure 2b the fuel injector in the cylinder head of the combustion engine in a enhanced view,

figure 3 the fuel injector with different degrees of freedom,

figure 4 a fixing device with discoidal portion and conic protion in a plan view,

figure 5 the fuel injector with a spacer-ring and the fixing device.

[0021] Elements of the same design and function that occur in different illustrations are identified by the same reference character.

[0022] Figure 1 shows an internal combustion engine 22, with an intake manifold 10, a motor block 12, a cylinder head 14 and an exhaust manifold 16. A combustion chamber 20 is arranged within the motor block 12.

[0023] The cylinder head 14 comprises a fuel injector 18 and a sparking plug 19. A spring and/or a clamp 30 enable the fixing of the fuel injector 18 to the cylinder head 14 of the combustion engine 22.

[0024] The fuel injector 18 (in figure 2a) comprises an injector coupling portion 24 and a valve assembly 27. The injector coupling portion 24 is designed to be coupled to a high-pressure fuel rail of the internal combustion engine 22, the fuel is stored under high pressure, for example, under the pressure of about 200 bar in the case of a gasoline engine or of about 2,000 bar in the case of a diesel engine.

[0025] Furthermore, the injector coupling portion 24 is designed to be coupled to an electrical supply to actuate a not shown actuator unit of the fuel injector 18.

[0026] The valve assembly 27 comprises an injector housing 26 with a central longitudinal axis L and a not shown cavity which is axially led through the injector housing 26. The valve assembly 27 further comprises a not shown valve needle taken in the cavity of the injector housing 26. On a free end of the valve assembly 27 an injection nozzle 28 is formed which is closed or opened by an axial movement of the valve needle. In a closing position a fuel flow through the injection nozzle 28 is prevented. In an opening position fuel can flow through the injection nozzle 28 into the combustion chamber 20 of the internal combustion engine 22.

[0027] Figur 2a illustrates the fuel injector 18 mounted in the cylinder head 14 of the combustion engine 22. The recess 15 in the cylinder head 14, where the fuel injector 18 is mounted in, can be called a cylinder head pocket for the fuel injector 18.

[0028] The fuel injector 18 comprises a spacer-ring 35. A cross section of the spacer-ring 35 is shown in figure 2b.

[0029] The upper surface 31 of the spacer-ring 35 is preferably toroidal and in contact with a contact area 37 of the injector housing 26, whereas the contact area 37 is preferably conic. The contact area 37 of the injector housing 26 represents a transition area from a larger diameter of the injector housing 26 to a lower diameter. The bottom surface 32 of the spacer-ring 35 is preferably planar and in contact with a projection 36 of the cylinder head 14 of the combustion engine 22. Furthermore the fuel injector 18 comprises a snap-ring 34 which is arranged underneath the conic contact area 37 and the spacer-ring 35 of the fuel injector 18.

[0030] The spacer-ring 35 is applicable to allow predetermined movements of the fuel injector 18 within its cylinder head pocket in the combustion engine 22. As indicated in figure 3, the spacer-ring 35 preferably allows fuel injector 18 movements in up to five different degrees of freedom within its cylinder head pocket of the combustion engine 22. Three degrees of freedom represent typically rotational movements 40 of the fuel injector 18, while two remaining degrees of freedom represent planar movements 41 of the fuel injector 18 within its cylinder head pocket. The reason for allowing different degrees of freedom is, that the fuel injector 18 has to compensate tolerances of other parts coupled with it, as for example compensate the arrangement of the high-pressure fuel rail, which can vary in its arrangement by +/- 1 mm. Furthermore the fuel injector 18 has to compensate thermal changes of dimensions of the cylinder head 14 and/or the cylinder head pocket, while the combustion engine 22 is in operation. As indicated in figure 2b, there is typically a predetermined clearance 39 between the inner vertical surface of the cylinder head pocket and the vertical surface of the injector housing 26. The clearance 39 is for example in the range between 0.5 mm to 1 mm. Beside the clearance 39 between the inner cylinder head surface and the surface of the injector housing 26, there is also a clearance between the vertical surface of the spacer-ring 35 and the inner vertical surface of the cylinder head 14, that means, the outer diameter of the spacer-ring 35 is preferable smaller than the diameter of the inner vertical cylinder head surface in the area, where the spacer-ring 35 is arranged.

[0031] When the upper surface 31 of the spacer-ring 35 is coupled with the conic contact area 37 of the fuel injector 18, the rotational movements 40 of the fuel injector 18 are possible.

[0032] The coupling of the upper surface 31 of the spacer-ring 35 with the conic contact area of the injector housing 26 of the fuel injector 18 allows preferably three rotational movements 40 of the fuel injector 18.

[0033] In addition the fuel injector 18 comprises a sealing ring 33, whose vertical surface is preferably in contact with the inner vertical surface of the cylinder head 14 of

the combustion engine 22. The sealing ring 33 is for example made of rubber and is applicable to separate the area of the combustion chamber 20 from the cylinder head pocket above the sealing ring 33, where the fuel injector 18 is fixed. By this the sealing ring 33 ensures that high temperature gases and/or fuel particles dosed into the combustion chamber 20 cannot intrude into the cylinder head pocket.

[0034] If predetermined tolerances, for example due to a slightly shifted high-pressure fuel rail coupled with the fuel injector 18, have to be compensated, the spacer-ring 35 typically allows planar movements 41 (figure 3) of the fuel injector 18 through its bottom surface 32, which is preferably in contact with the surface of the cylinder head projection 36.

[0035] The injector housing 26, the spacer-ring 35 and the snap-ring 34 are preferably made of stainless steel, while the cylinder head 14 of the combustion engine 22 is preferably made of aluminium or magnesium.

[0036] Due to the coupling of the cylinder head surface made of aluminium with the spacer-ring 35 made of stainless steel, chemical processes can occur, keeping the cylinder head 14 and the spacer-ring 35 stick together, so that planar movements 41 of the fuel injector 18 are no longer possible. The lost planar movements 41 of the fuel injector 18 can cause damages of the cylinder head 14 of the combustion engine 22 and/or the fuel injector 18, due to thermal changes of dimension and/or mechanical stresses within the particular part.

[0037] Figur 4 depicts a first embodiment of the fixing device 50 in a plan view. The fixing device 50 comprises a discoidal portion 52 and a conic portion 51. The discoidal portion 52 comprises an inner diameter 54 representing a central opening and an outer diameter 55. The outer diameter 55 is for example 22 mm and is preferably larger than the inner diameter 54, which is for example 18 mm. The area between the inner diameter 54 and the outer diameter 55 is preferably made of stainless steel, with a thickness of less than 1 mm.

[0038] Furthermore, figure 4 depicts the conic portion 51 (shaded) in a plan view. The conic portion 51 comprises a first diameter 56 and a second diameter 53. The first diameter 56 is preferably larger than the second diameter 53. Preferably the first diameter 56 is identical to the inner diameter 54 of the discoidal portion 52 of the fixing device 50. The second diameter 53 of the conic portion 51 is typically larger than the diameter of the injector housing 26 in the area, where the fixing device 50 is arranged. The conic portion 51 of the fixing device 50 is preferably made of stainless steel. The end of the first diameter 56 of the conic portion 51 is rigidly coupled to the discoidal portion 52 of the fixing device 50.

[0039] In a further preferred embodiment of the fixing device 50, the discoidal portion 52 is formed in one piece with the conic portion 51.

Figur 5 illustrates a side view of the fixing device 50 in package with the fuel injector 18. The fixing device 50 is arranged underneath the spacer-ring 35. An upper surface 60 of the fixing device 50 is associated to the bottom surface of the spacer-ring 35. If the fuel injector 18 with fixing device 50 is mounted into the cylinder head pocket of the combustion engine 22, the upper surface 60 of the fixing device 50 is in contact with the bottom surface 32 of the spacer-ring 35. Because the spacer-ring 35 and the fixing device 50 are made of stainless steel, a chemical process, keeping both parts stick together, can typically not occur. This ensures planar movements 41 of the fuel injector 18 through the spacer-ring 35 for the lifetime of the combustion engine 22 and/or the fuel injector 18.

[0040] The bottom surface 61 of the fixing device 50 is typically in contact with the projection 36 of the cylinder head 14 of the combustion engine 22, if the fuel injector 18 is mounted in the cylinder head 14 adequately. Because the cylinder head 14 of the combustion engine 22 is preferably made of aluminium and the fixing device 50 is made of stainless steel, a chemical process can occur keeping both parts stick together. The outer diameter 55 of the discoidal portion 52 of the fixing device 50 is for example 22 mm and the outer diameter of the spacer-ring 35 is for example 22 mm. The outer diameter 55 of the discoidal portion 52 is therefore in the range of the outer diameter of the spacer-ring 35. Due to the ensured planar movement 41 upon the upper surface 60 of the discoidal portion 52 of the fixing device 50, the coupling of the bottom surface 61 of the fixing device 50 with the cylinder head 14 is necessarily not needed for planar movements 41 of the fuel injector 18.

[0041] If the bottom surface 61 of the fixing device 50 sticks together with the cylinder head projection 36 of the combustion engine 22 due to chemical processes, the fixing device 50 is preferably applicable to allow planar movements of the fuel injector 18. This is achieved by making the second diameter 53 of the conic portion 51 of the fixing device 50 larger than the diameter of the injector housing 26 of the fuel injector 18 in the area, where the fixing device 50 is arranged. For example is the second diameter 53 of the conic portion 51 0.4 mm to 0.6 mm larger than the diameter of the fuel injector 18 in the area, where the fixing device 50 is arranged.

[0042] The fuel injector 18 comprises the snap-ring 34, which is associated to the fixing device 50; more precisely the conic portion 51 is associated to the snap-ring 34. The snap-ring 34 comprises an outer diameter, which is larger than the second diameter 53 of the conic portion 51 of the fixing device 50. As a result, the spacer-ring 35 stays packaged to the fuel injector 18 through fixing device 50 and the fixing device 50 stays packaged to the fuel injector 18 through the snap-ring 34, even if the fuel injector 18 is pulled out of its cylinder head pocket. This is in particular practical if the inner diameter of the spacer-ring 35 is larger than the outer-diameter of the snap-ring 34. This allows a complete package of a fuel injector 18 with its associated spacer-ring 35 and its associated fixing device 50. Furthermore the steps for mounting the fuel injector 18 into the cylinder head 14 of the combus-

tion engine 22 can be reduced to a single step, because all necessary components are already packaged to the fuel injector 18.

Claims

1. Fuel injector (18) of a combustion engine (22) comprising

   - a fuel injector housing (26) being applicable to be mounted in a cylinder head (14) of the combustion engine (22),
   - a spacer-ring (35) being applicable to allow planar and rotational movements of the fuel injector (18) within the cylinder head (14) of the combustion engine (22),
   - a fixing device (50) comprising a discoidal portion (52) with a central opening and a conic portion (51), the discoidal portion (52) comprising an inner diameter (54), representing the diameter of the central opening, and an outer diameter (55), the outer diameter (55) being larger than the inner diameter (54), the inner diameter (54) being larger than the diameter of the injector housing (26), where the fixing device (50) is arranged, the discoidal portion (52) comprising an upper planar surface (60) and a bottom planar surface (61), the bottom planar surface (61) being in contact with the cylinder head (14) and the upper planar surface (60) being in contact with the spacer-ring (35), if the fuel injector (18) is mounted in the cylinder head (14), the conic portion (51) comprising a first diameter (56) and a second diameter (53), the first diameter (56) being larger than the second diameter (53) and being in the range of the inner diameter (54) of the discoidal portion (52), the second diameter (53) being larger than the diameter of the injector housing (26), where the fixing device (50) is arranged, the end of the first diameter (56) of the conic portion (51) being rigidly coupled to the discoidal portion (52).

2. Fuel injector (18) in accordance with claim 1, with the discoidal portion (52) being formed in one piece with the conic portion (51).

3. Fuel injector (18) in accordance with claim 1 or 2, with the outer diameter (55) of the discoidal portion (52) being in the range of the outer diameter of the spacer-ring (35).

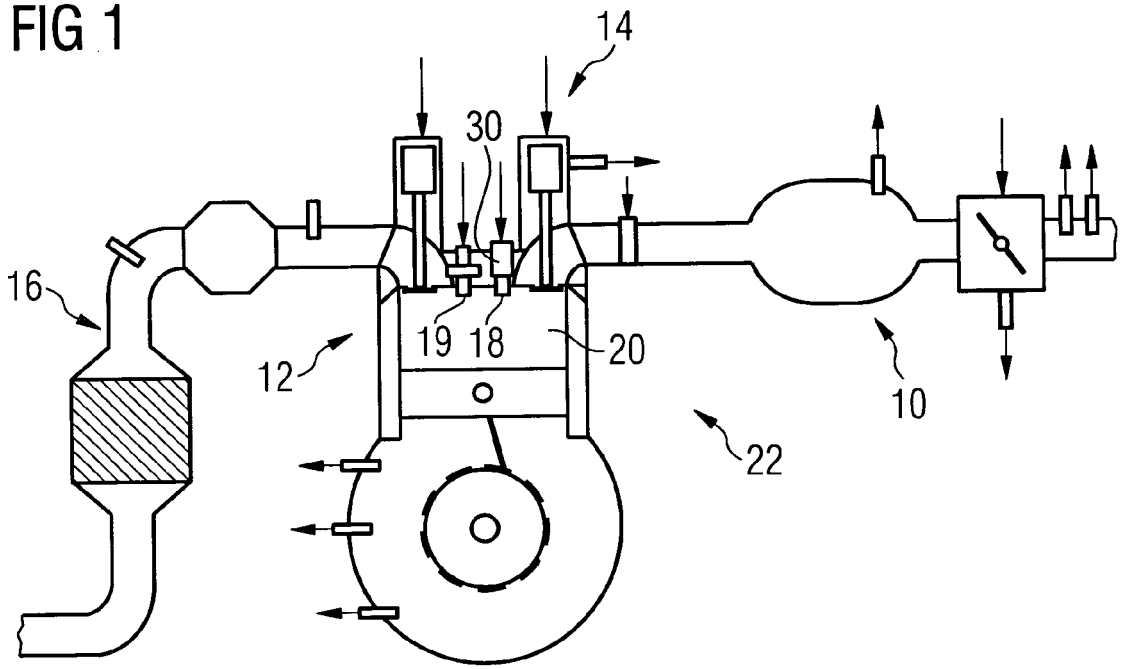
4. Fuel injector (18) in accordance with one of the preceding claims, comprising a snap-ring (34), which is arranged underneath the fixing device (50), with the second diameter (53) of the conic portion (51) of the fixing device (50) being smaller than an outer diameter of the snap-ring (34) to keep the spacer-ring (35) and the fixing device (50) packaged to the injector housing (26).

5. Fuel injector (18) in accordance with one of the preceding claims, with the injector housing (26), the spacer-ring (35), the discoidal portion (52) and the conic portion (51) being made of stainless steel.

6. Fuel injector (18) in accordance with one of the preceding claims, with the fixing device (50) being applicable to allow planar movements of the spacer-ring (35) of the fuel injector (18).

7. Fuel injector (18) in accordance with one of the preceding claims, with the fixing device (50) being arranged in the area of the injector housing (26), where it is fixed to the cylinder head (14) of the combustion engine (22).

FIG 1



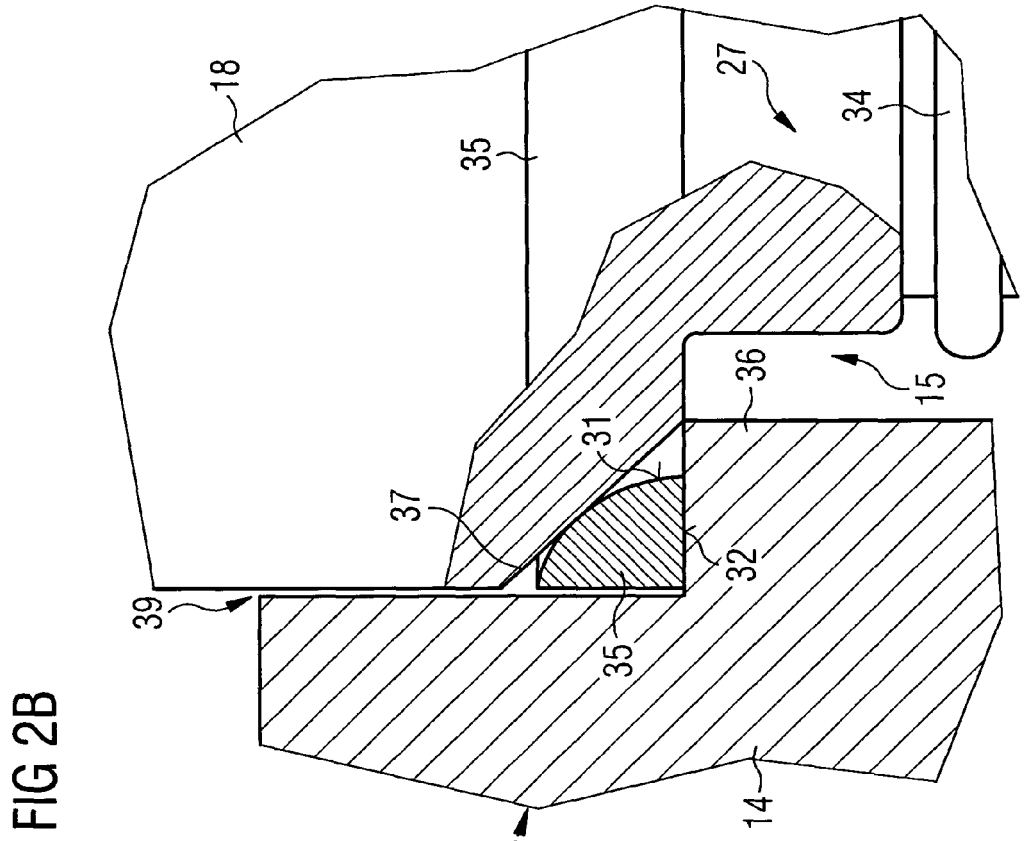

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FIG 2B

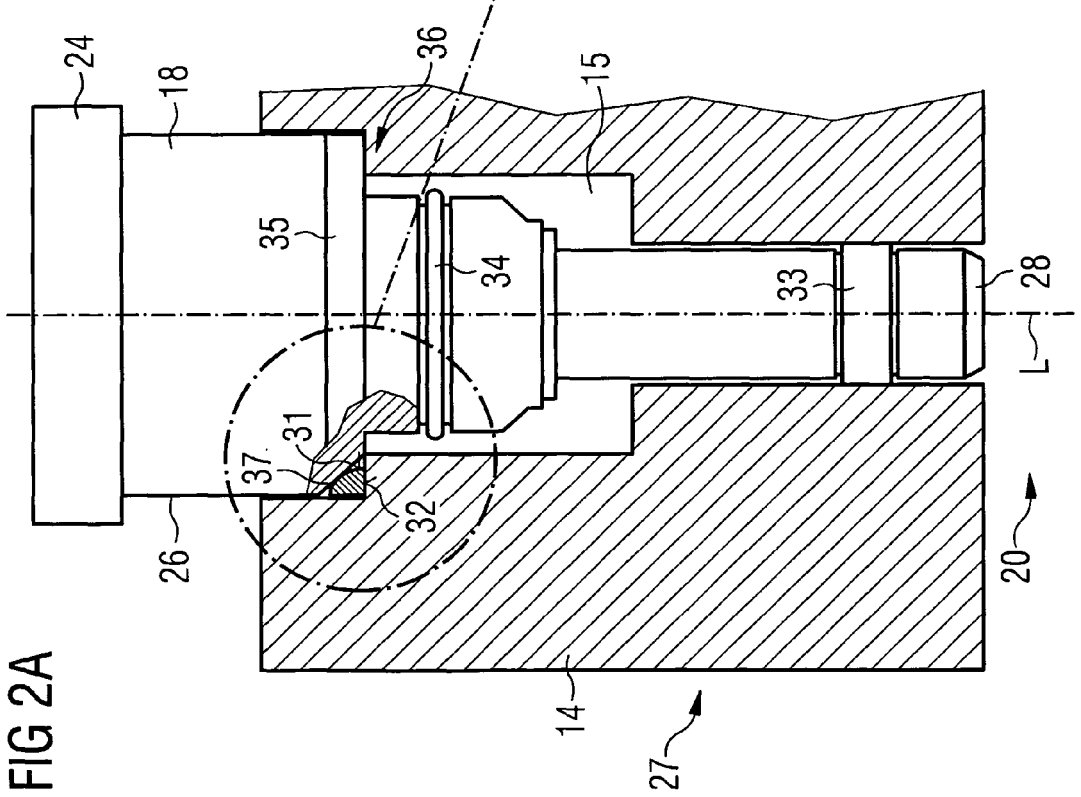
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FIG 2A

FIG 3

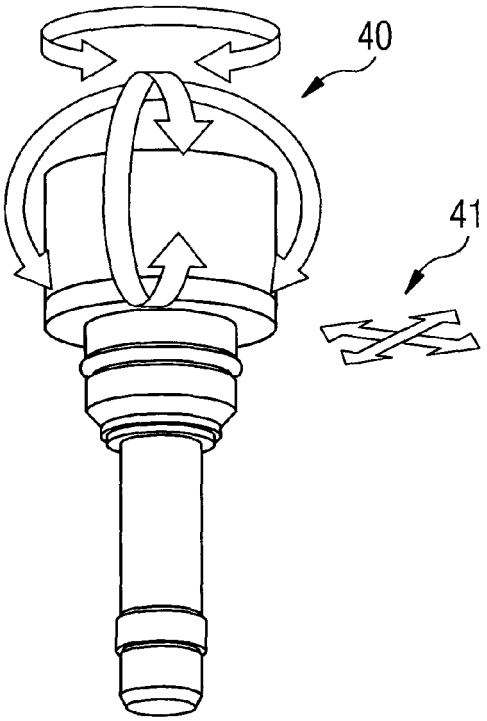


FIG 4

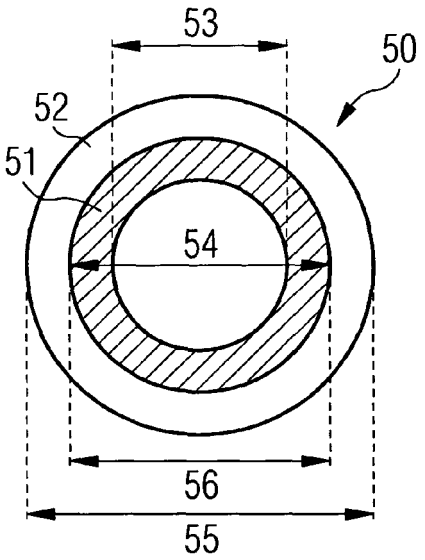
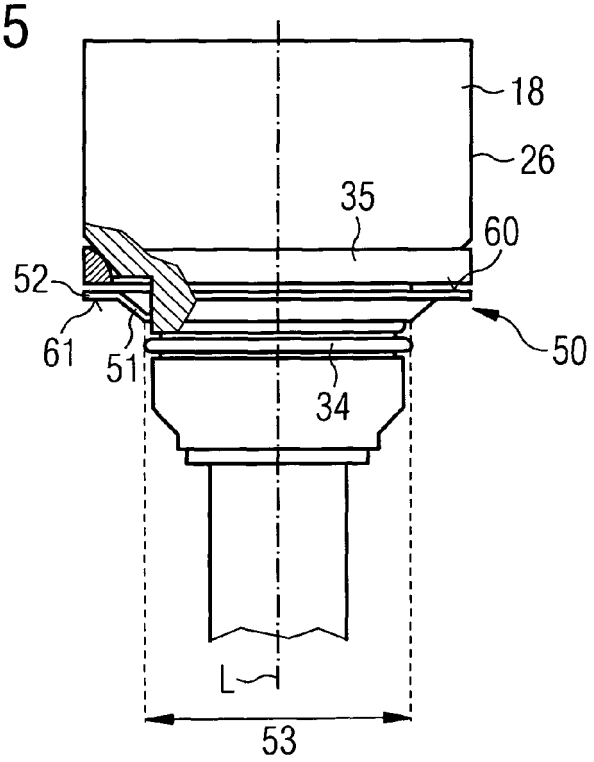


FIG 5



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EUROPEAN SEARCH REPORT

Application Number
EP 08 00 2856

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 July 2008	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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