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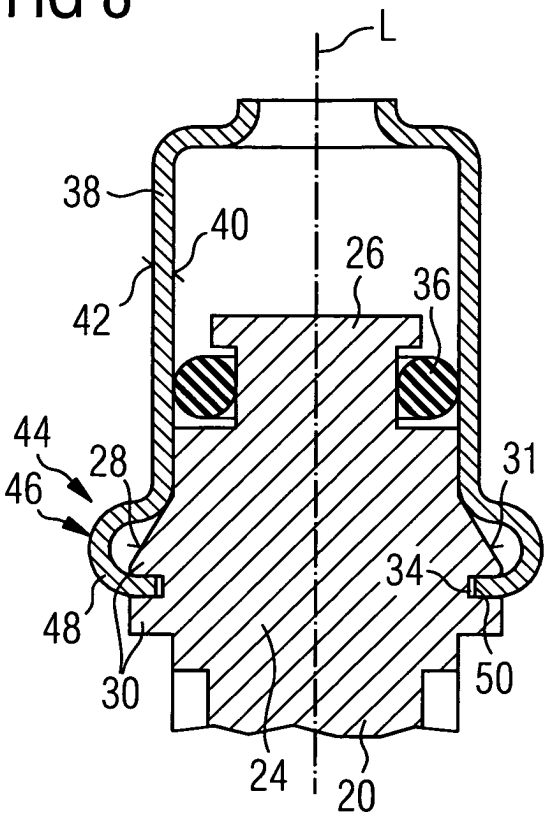
(54) Fuel injector assembly

(57) Fuel injector assembly including a central longitudinal axis (L) comprising a fuel injector (20) with a fuel inlet portion (26) and an outer surface (28), and a fuel injector cup (38) with an inner surface (40), an outer surface (42) and an end section (44). The fuel inlet portion (26) of the fuel injector (20) is designed to interact with the end section (44) of the fuel injector cup (38). The inner surface (40) of the fuel injector cup (38) is designed to sealingly engage the outer surface (28) of the fuel injector (20). The outer surface (28) of the fuel injector (20) comprises a projection (30), the end section (44) of the fuel injector cup (38) comprises a protrusion (46), and the protrusion (46) engages the projection (30) of the fuel injector (20) for retaining the fuel injector (20) in the fuel injector cup (38) in direction of the central longitudinal axis (L).

FIG 8



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Description

[0001] The invention relates to a fuel injector assembly comprising a fuel injector and a fuel injector cup.

[0002] Fuel injector assemblies are in widespread use, in particular for internal combustion engines. Fuel can be supplied to an internal combustion engine by the fuel injector assembly that includes the fuel injector cup and the fuel injector. The fuel injectors can be coupled to the fuel injector cups in different manners.

[0003] In order to keep pressure fluctuations during the operation of the internal combustion engine at a very low level, internal combustion engines are supplied with a fuel accumulator to which the fuel injectors are connected and which has a relatively large volume. Such a fuel accumulator is often referred to as a fuel rail.

[0004] Known fuel rails comprise a hollow body with recesses in form of fuel injector cups, where the fuel injectors are arranged. The connection of the fuel injectors to the fuel injector cups that supply the fuel from a fuel tank via a low or highpressure fuel pump needs to be very precise to get a correct injection angle.

[0005] The object of the invention is to create a fuel injector assembly which is simply to be manufactured and which facilitates a reliable and precise connection between the fuel injector and the fuel injector cup.

[0006] It is furthermore the object of the invention to create a fuel injector assembly that ensures a precise dosing of fuel.

[0007] The objects are achieved by the features of the independent claims. Advantageous embodiments of the invention are given in the sub-claims.

[0008] The invention is distinguished by a fuel injector assembly including a central longitudinal axis comprising a fuel injector with a fuel inlet portion and an outer surface, and a fuel injector cup with an inner surface, an outer surface and an end section. The fuel inlet portion of the fuel injector is designed to interact with the end section of the fuel injector cup. The inner surface of the fuel injector cup is designed to sealingly engage the outer surface of the fuel injector. The outer surface of the fuel injector comprises a projection, the end section of the fuel injector comprises a protrusion, and the protrusion engages the projection of the fuel injector for retaining the fuel injector and the fuel injector cup in direction of the central longitudinal axis.

[0009] This has the advantage that the fuel injector assembly may have a very high stability in view of avoiding translative movement of the fuel injector relative to the fuel injector cup. Furthermore, no extra parts for the connection of the fuel injector and the fuel injector cup has to be manufactured and the construction of the fuel injector assembly can be simplified. In addition, the assembly process may be accelerated as only two parts have to be coupled with each other.

[0010] In an advantageous embodiment of the invention the outer surface of the fuel injector comprises a stop element, and the protrusion engages the stop element of the fuel injector for retaining the fuel injector against rotation relative to the fuel injector cup.

[0011] This may allow an accurate angular positioning of the fuel injector in the fuel injector cup and therefore an improved fuel spray targeting. Furthermore, the stability of the assembly in view of avoiding rotative movement of the fuel injector relative to the fuel injector cup can be improved.

[0012] In a further advantageous embodiment of the invention the projection comprises a groove and the groove receives the protrusion.

[0013] By this a particular high engagement of the protrusion in the projection is possible and therefore an exact positioning of the fuel injector in direction of the central longitudinal axis is obtainable.

[0014] In a further embodiment of the invention the projection comprises an inclined plane section forming an inclined plane on the outer surface of the fuel injector and the inclined plane extends in direction of the central longitudinal axis.

[0015] This allows an easy axial movement of the fuel injector relative to the fuel injector cup over the inclined plane while assembling the fuel injector with the fuel injector cup.

[0016] In a further advantageous embodiment of the invention the stop element extends in radial direction from the outer surface of the fuel injector and is arranged relative to the protrusion for retaining the protrusion in the groove against rotation of the fuel injector relative to the fuel injector cup.

[0017] By this a rotational movement of the protrusion in the groove of the projection and therefore a rotational movement of the fuel injector relative to the fuel injector cup can be avoided.

[0018] In a further advantageous embodiment the protrusion comprises a final section with an edge and the longitudinal section of the final section is of the shape of a semi-circular arc with the edge orientated in direction to the central longitudinal axis.

[0019] This has the advantage that the end section of the protrusion may be in a simple way elastic in direction of the central longitudinal axis as the final section in the shape of a semi-circular arc has the function of a spring element. Therefore, a particular high stability of the end section of the protrusion against distortion may be obtained.

[0020] In an further advantageous embodiment the fuel injector comprises a plurality of projections circumferentially distributed over the outer surface of the fuel injector and the fuel injector cup comprises a plurality of protrusions circumferentially distributed over the end section of the fuel injector cup.

[0021] This has the advantage that a good distribution of the forces between the fuel injector and the fuel injector cup may be obtained.

[0022] In a further advantageous embodiment of the invention the outer surface of the fuel injector comprises two opposing projections and the fuel injector cup com-

prises two opposing protrusions in radial direction with respect to the central longitudinal axis.

[0023] This is advantageous because with two opposing projections and two opposing protrusions the assembling of the fuel injector assembly can be very simple. Furthermore, a favourable force distribution in the connection between the fuel injector and the fuel injector cup with the two opposing projections and the two opposing protrusions can be obtained.

[0024] In a further embodiment of the invention the projections and the protrusions extend angularly less than 90°.

[0025] By this it is very simple to couple and to uncouple the fuel injector with the fuel injector cup by the combination of a rotational movement of the fuel injector relative to the fuel injector cup of about 90° and an movement of the fuel injector relative to the fuel injector cup in axial direction.

[0026] In a further embodiment of the invention the protrusion is designed as a fork with two prongs and a gap between the two prongs and the fork receives the projection in the gap.

[0027] This allows a fast connection of the fuel injector on the fuel injector cup. Therefore, the assembly process of the fuel injector assembly may be improved.

[0028] In a further advantageous embodiment of the invention the projection is of a trapezoidal cross section and the gap having an inner gap section is of a trapezoidal cross section to receive the projection.

[0029] This makes it possible to obtain a high stability of the connection between the fuel injector and the fuel injector cup.

[0030] In a further advantageous embodiment the gap is designed such that it is possible to push the projection into the gap by elastic deformation of the prongs.

[0031] This allows an easy and quick connection of the fuel injector with the fuel injector cup.

[0032] In a further advantageous embodiment the projection and the stop element are a one-piece-element.

[0033] By this, the number of elements of the fuel injector assembly may be reduced and consequently a reduction of costs may be obtained.

[0034] In a further advantageous embodiment the fuel injector cup is made out of stainless steel.

[0035] By this the corrosion of the fuel injector assembly may be reduced.

[0036] 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 with a fuel rail in a schematic view,

Figure 2 a first embodiment of a fuel injectior in a perspective view,

Figure 3 a fuel injector cup of the first embodiment of the fuel injector assembly in a perspective view,

Figure 4 the first embodiment of the fuel injector assembly in a perspective view,

Figure 5 the first embodiment of the fuel injector assembly in a perspective view during disassembling,

Figure 6 the first embodiment of the fuel injector assembly in a side view,

Figure 7 a cross section of the first embodiment of the fuel injector assembly along line VII-VII of figure 6,

Figure 8 a longitudinal section through the first embodiment of the fuel injector assembly along line VIII-VIII of figure 6,

Figure 9 a further embodiment of the fuel injector assembly in a perspective view,

Figure 10 a perspective view of the further embodiment of the fuel injector assembly,

Figure 11 a side view of the further embodiment of the fuel injector assembly,and

Figure 12 a longitudinal section through the further embodiment of the fuel injector assembly.

[0037] Elements of the same design and function that occur in different illustrations are identified by the same reference character.

[0038] A fuel feed device 10 is assigned to an internal combustion engine 22 (figure 1). It includes a fuel tank 12 that is connected via a first fuel line to a low-pressure pump 14. The output of the low-pressure pump 14 is connected to a fuel inlet 16 of a fuel rail 18. Fuel injectors 20 are connected to the fuel rail 18. The fuel is fed to the fuel injectors 20 via the fuel rail 18. The fuel injectors 20 have a sealed connection to the fuel rail 18.

[0039] Figure 2 to 8 show a first embodiment of the fuel injector assembly.

[0040] The fuel injector 20 has a fuel injector body 24 and is suitable for injecting fuel into a gasoline engine. The fuel injector body 24 has a fuel inlet portion 26, a not shown fuel outlet portion and an outer surface 28. The outer surface 28 of the fuel injector body 24 comprises two opposing projections 30 in radial direction with respect to the central longitudinal axis L. Each of the projections 30 has a groove 34. As can be best seen in figure 7 four stop elements 32 are arranged on the outer surface 28 of the fuel injector body 24, two of the stop elements 32 are related to one of the grooves 34, one of each stop element 32 positioned at each side of each groove 34.

[0041] Figure 3 shows a fuel injector cup 38 with an inner surface 40 and an outer surface 42. An end section 44 of the fuel injector cup 38 comprises two opposing protrusions 46 in radial direction with respect to the cen-

tral longitudinal axis L. Each of the protrusions 46 has a final section 48 with an edge 50. As can be seen best in figure 8 the final section 48 of the protrusion 46 is formed in the shape of a semi-circular arc and the edge 50 is orientated in direction to the central longitudinal axis L.

[0042] The groove 34 of the projection 30 of the fuel injector body 24 receives the final section 48 of the protrusion 46 of the fuel injector cup 38. Due to the semi-circular arc shape of the final section 48 of the protrusion 46 the fuel injector cup 38 has a particular high stability against distortion.

[0043] The extension of the edges 50 in direction to the central longitudinal axis L of the fuel injector assembly results in a high stability of the fuel injector assembly against forces in axial direction between the fuel injector 20 and the fuel injector cup 38.

[0044] As can be best seen in figure 7 the stop elements 32 extend in radial direction from the outer surface 28 of the fuel injector body 24 of the fuel injector 20. By this rotational movement of the protrusions 46 which are received in the grooves 34 of the projections 30 can be avoided unless a given torque is applied to the fuel injector 20.

[0045] The fuel injector 20 comprises a sealing ring 36 which is arranged between the fuel injector body 24 and the fuel injector cup 38 to obtain a good sealing between the fuel injector 20 and the fuel injector cup 38. The surface of the sealing ring 36 is forming a part of the outer surface 28 of the fuel injector 20.

[0046] The fuel injector cup 38 is preferably made out of stainless steel. This allows an elastic deformation of the protrusions 46 formed in the shape of a semi-circular arc and can reduce the corrosion of the fuel injector assembly.

[0047] In the following, the assembly and disassembly of the fuel injector assembly according to the first embodiment will be described in detail (see figures 4 and 5):

[0048] For assembling the fuel injector assembly the fuel injector 20 is pushed into the fuel injector cup 38 by shifting the fuel inlet portion 26 of the fuel injector 20 into the end section 44 of the fuel injector cup 38. The protrusions 46 of the fuel injector cup 38 have to be positioned in a way that they can engage the grooves 34 of the fuel injector 20. By further shifting the fuel injector 20 in axial direction to the fuel injector cup 38 the protrusions 46 engage with the inclined planes 31 of the fuel injector body 24. By this the final sections 48 of the protrusions 46 are shifted radially outward until they engage the grooves 34. Consequently, a snap-fit connection is established. As to be seen best in figure 8 the inner surface 40 of the fuel injector cup 38 sealingly engages the outer surface 28 of the fuel injector 20 in the section of the sealing ring 36. After the assembling fuel can flow through the fuel injector cup 38 into the fuel inlet portion 26 of the fuel injector 20 without fuel leakage.

[0049] To disassemble the fuel injector assembly a rotational force has to be applied on the fuel injector 20 thereby using a torque which is high enough that the final sections 48 of the protrusions 46 can overcome the stop elements 32 of the fuel injector 20 (arrow A). After the fuel injector 20 has been rotated 90° the protrusions 46 are to be in disengagement with the projections 30 of the fuel injector 20. Now the fuel injector 20 can be shifted away from the fuel injector cup 38 in axial direction (arrow B) and the fuel injector 24 and the fuel injector cup 38 can be separated from each other.

[0050] Figures 9 to 12 show a further embodiment of the fuel injector assembly.

[0051] The end section 44 of the fuel injector cup 38 comprises two protrusions 46. Each of the protrusions 46 is formed as a fork with two prongs 52 and a gap 54 between the two prongs 52. The gap 54 receives the projection 30. The projection 30 is of a rectangular cross section and the gap 54 has an inner gap section 56 which has a trapezoidal cross section to receive the projection 30. The prongs 52 are of a material which allows an elastic deformation of the prongs 52. By this it is possible to push the projection 30 into the gap 54 by elastic deformation of the prongs 52. This construction allows to avoid axial movement of the fuel injector 20 against the fuel injector cup 38 as well as to avoid rotational movement of the fuel injector 20 relative to the injector cup 38 as the projection 30 and the stop element 32 are a one-piece-element.

[0052] The fuel injector cup 38 is preferably made out of stainless steel. This allows an elastic deformation of the protrusions 46 and can reduce the corrosion of the fuel injector assembly.

[0053] In the following, the assembly and disassembly of the fuel injector assembly according to the further embodiment will be described in detail:

[0054] For assembling the fuel injector assembly the fuel injector 20 is pushed into the fuel injector cup 38 by shifting the fuel inlet portion 26 into the end section 44 of the fuel injector cup 38. The projections 30 of the fuel projector 20 and the protrusions 46 of the fuel injector cup 38 have to be positioned in a way that one of each of the gaps 54 between the prongs 52 and one of each of the projections 30 of the fuel projector 20 are on one axis parallel to the central longitudinal axis L. By further shifting the fuel injector 20 in axial direction to the fuel injector cup 38 each of the projections 30 of the fuel projector 20 is pushed into one of the inner gap sections 56 of the gaps 54 by elastic deformation of the prongs 52 of the protrusions 46. By this each two of the prongs 52 of the protrusions 46 engage with one of the projections 30 of the fuel projector 20. Consequently, a snap-fit connection is established. As to be seen best in figure 12 the inner surface 40 of the fuel injector cup 38 sealingly engages the outer surface 28 of the fuel injector 20 in the section of the sealing ring 36. After the assembling fuel can flow through the fuel injector cup 38 into the fuel inlet portion 26 of the fuel injector 20 without fuel leakage.

[0055] For disassembling the fuel injector assembly a axial force has to be applied on the fuel injector 20 which is high enough that the projections 30 can overcome the

prongs 32 of the fuel injector 20 by elastic deformation of the prongs 52 and the projections 30 can leave the inner gap sections 56. Consequently, the projections 30 of the fuel injector 20 are in disengagement with the protrusions 46 of the fuel injector cup 38. Now the fuel injector 20 can be completely shifted away from the fuel injector cup 38 in axial direction and the fuel injector 24 and the fuel injector cup 38 can be separated from each other.

Claims

1. Fuel injector assembly including a central longitudinal axis (L) comprising

- a fuel injector (20) with a fuel inlet portion (26) and an outer surface (28), and
- a fuel injector cup (38) with an inner surface (40), an outer surface (42) and an end section (44),

the fuel inlet portion (26) of the fuel injector (20) being designed to interact with the end section (44) of the fuel injector cup (38),
the inner surface (40) of the fuel injector cup (38) being designed to sealingly engage the outer surface (28) of the fuel injector (20),
the outer surface (28) of the fuel injector (20) comprising a projection (30), the end section (44) of the fuel injector cup (38) comprising a protrusion (46), and the protrusion (46) engaging the projection (30) of the fuel injector (20) for retaining the fuel injector (20) in the fuel injector cup (38) in direction of the central longitudinal axis (L).

2. Fuel injector assembly in accordance with claim 1, with the outer surface (28) of the fuel injector (20) comprising a stop element (32), and the protrusion (46) engaging the stop element (32) of the fuel injector (20) for retaining the fuel injector (20) against rotation relative to the fuel injector cup (38).

3. Fuel injector assembly in accordance with claim 1 or claim 2, with the projection (30) comprising a groove (34) and the groove (34) receiving the protrusion (46).

4. Fuel injector assembly in accordance with one of the preceding claims, with the projection (30) comprising an inclined plane section forming an inclined plane on the outer surface (28) of the fuel injector (20), the inclined plane extending in direction of the central longitudinal axis (L).

5. Fuel injector assembly in accordance with one of the claims 3 and 4, with the stop element (32) extending in radial direction from the outer surface (28) of the fuel injector (20), being arranged relative to the protrusion (46) for retaining the protrusion (46) in the groove (34) against rotation of the fuel injector (20) relative to the fuel injector cup (38).

6. Fuel injector assembly in accordance with one of the preceding claims, with the protrusion (46) comprising a final section (48) with an edge (50) and the longitudinal section of the final section (48) being of the shape of a semi circular arc with the edge (50) orientated in direction to the central longitudinal axis (L).

7. Fuel injector assembly in accordance with one of the preceding claims, with the fuel injector (20) comprising a plurality of projections (30) circumferentially distributed over the outer surface (28) of the fuel injector (20) and the fuel injector cup (38) comprising a plurality of protrusions (46) circumferentially distributed over the end section (44) of the fuel injector cup (38).

8. Fuel injector assembly in accordance with one of the preceding claims, with the outer surface (28) of the fuel injector (20) comprising two opposing projections (30) and the fuel injector cup (38) comprising two opposing protrusions (46) in radial direction with respect to the central longitudinal axis (L).

9. Fuel injector assembly in accordance with claim 8, with the projections (30) and the protrusions (46) extending angularly less than 90°.

10. Fuel injector assembly in accordance with claim 1, with the protrusion (46) being designed as a fork with two prongs (52) and a gap (54) between the two prongs (52), the fork receiving the projection (30) in the gap (54).

11. Fuel injector assembly in accordance with claim 10, with the projection (30) being of a trapezoidal cross section and the gap (54) having an inner gap section (56) being of a trapezoidal cross section to receive the projection (30).

12. Fuel injector assembly in accordance with one of the claims 10 and 11, with the gap (54) being designed such that it is possible to push the projection (30) into the gap (54) by elastic deformation of the prongs (52).

13. Fuel injector assembly in accordance with one of the preceding claims, with the projection (30) and the stop element (32) being a one-piece-element.

14. Fuel injector assembly in accordance with one of the preceding claims, with the fuel injector cup (38) being made out of stainless steel.

FIG 1

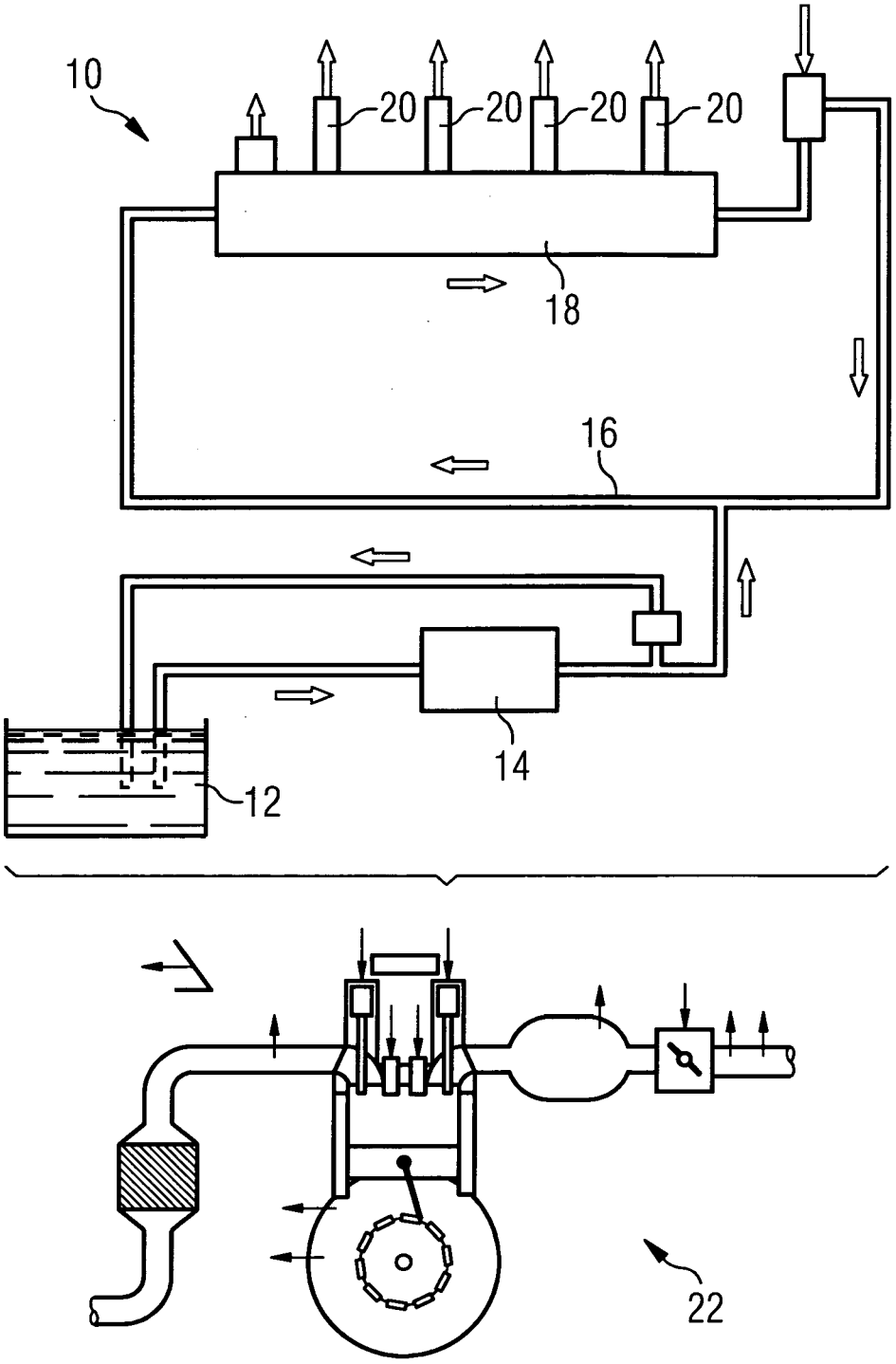

FIG 2

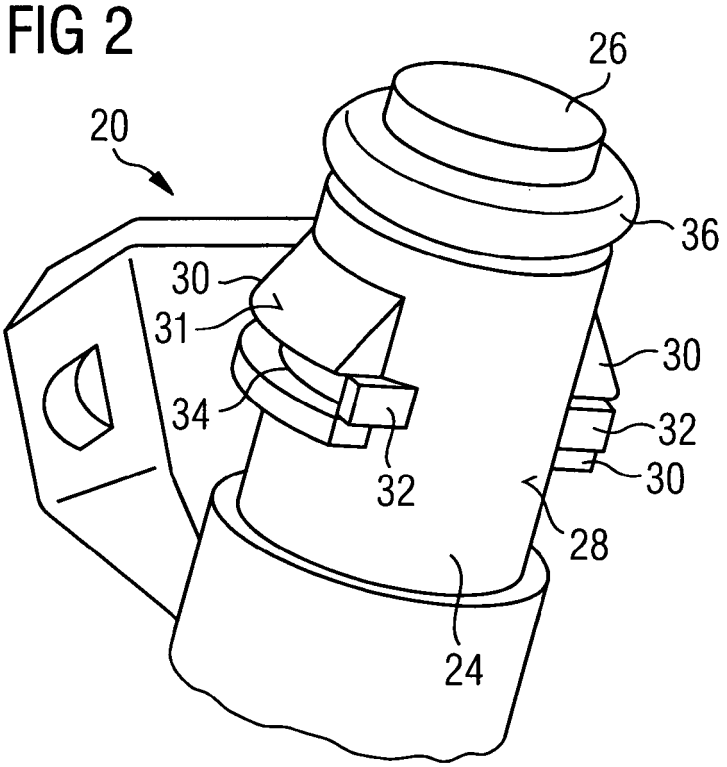

FIG 3

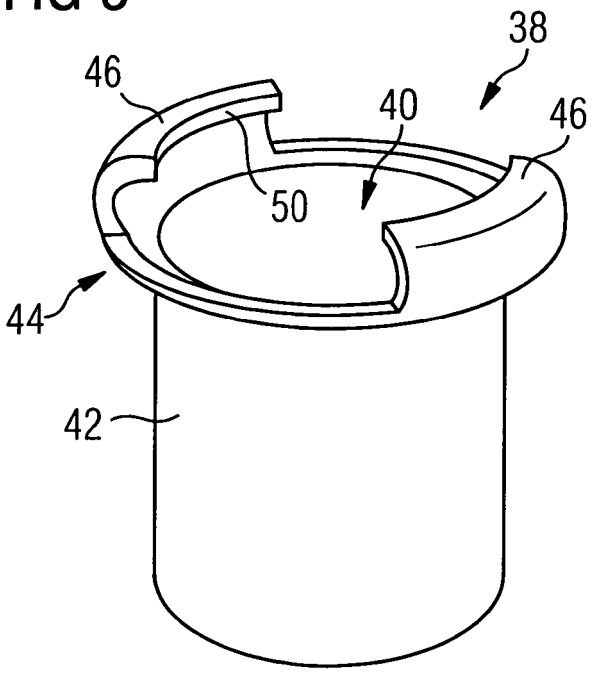

FIG 4

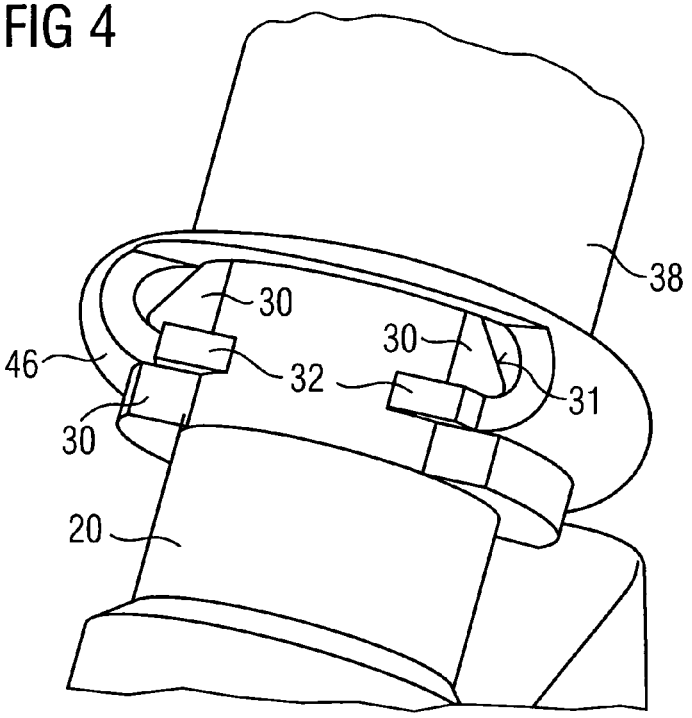

FIG 5

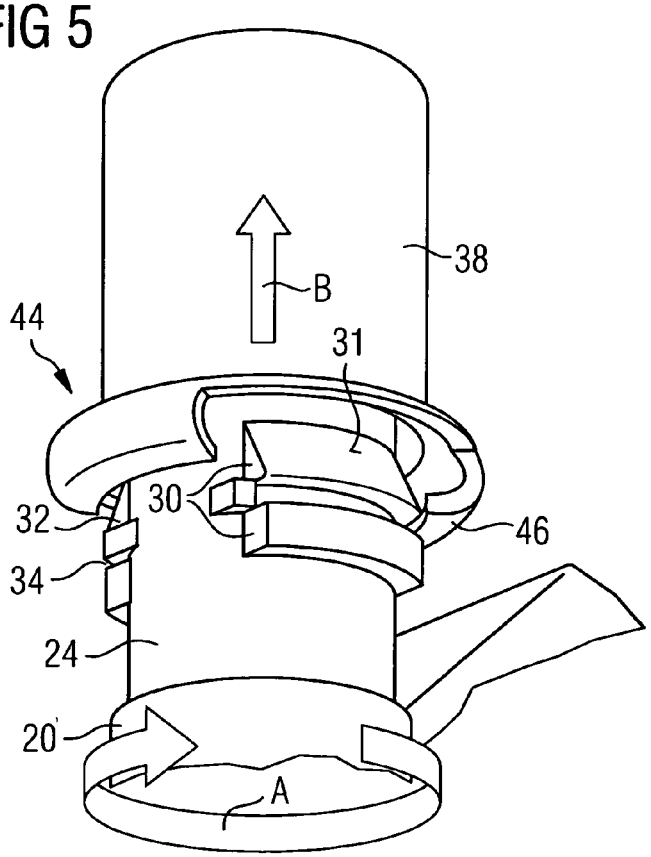

FIG 6

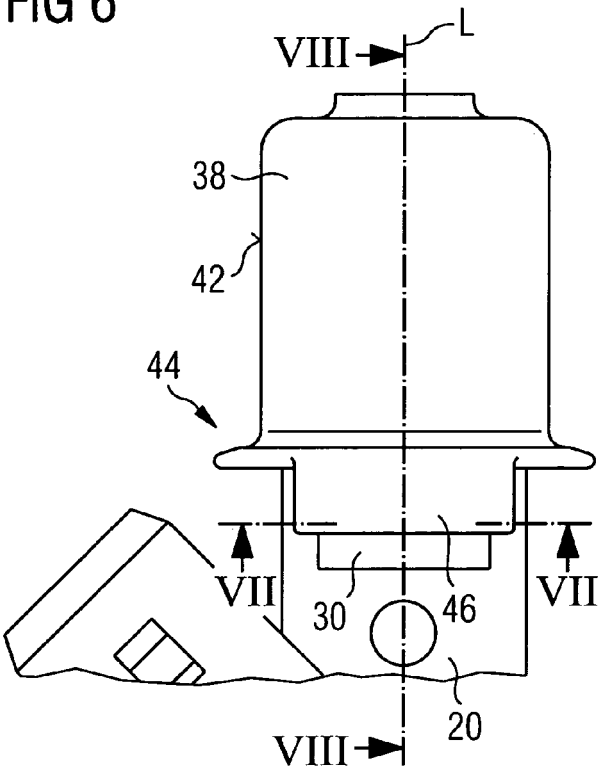

FIG 8

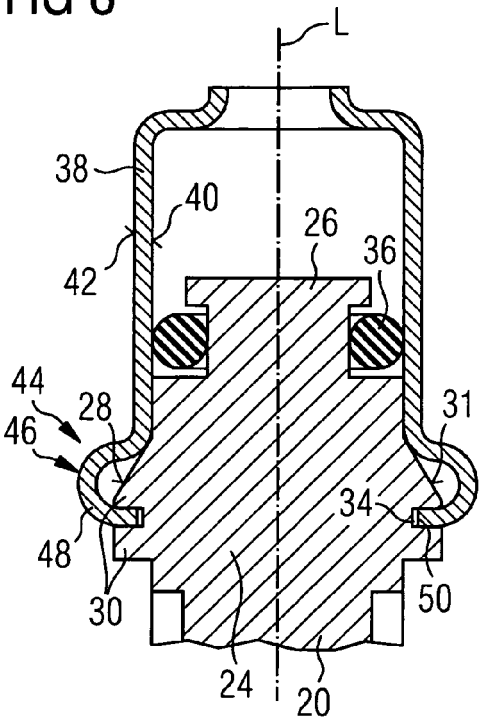

FIG 7

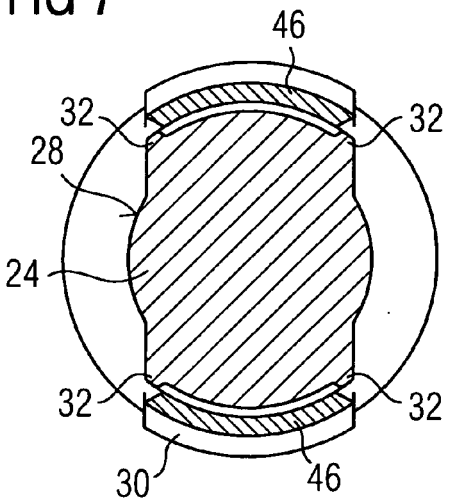

FIG 9

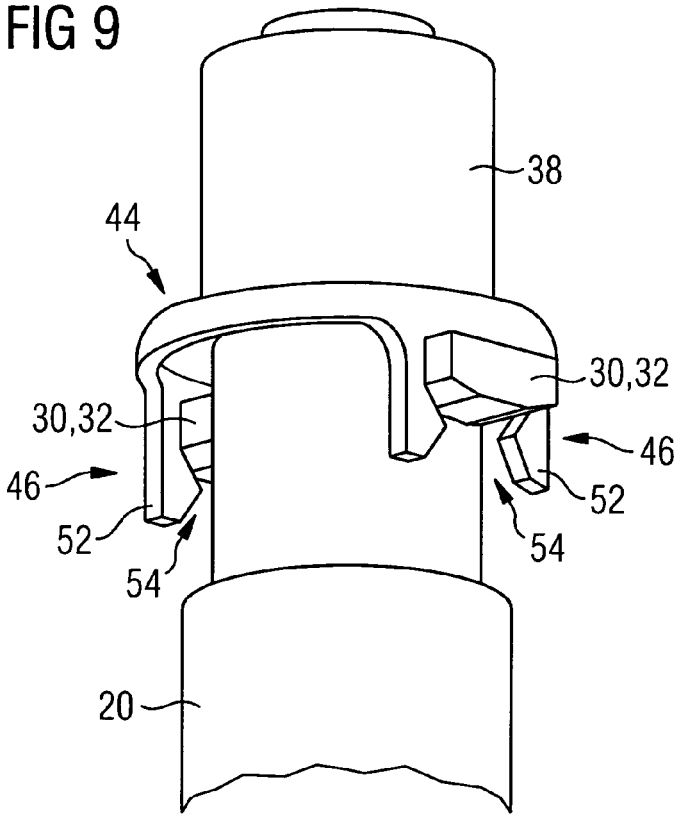
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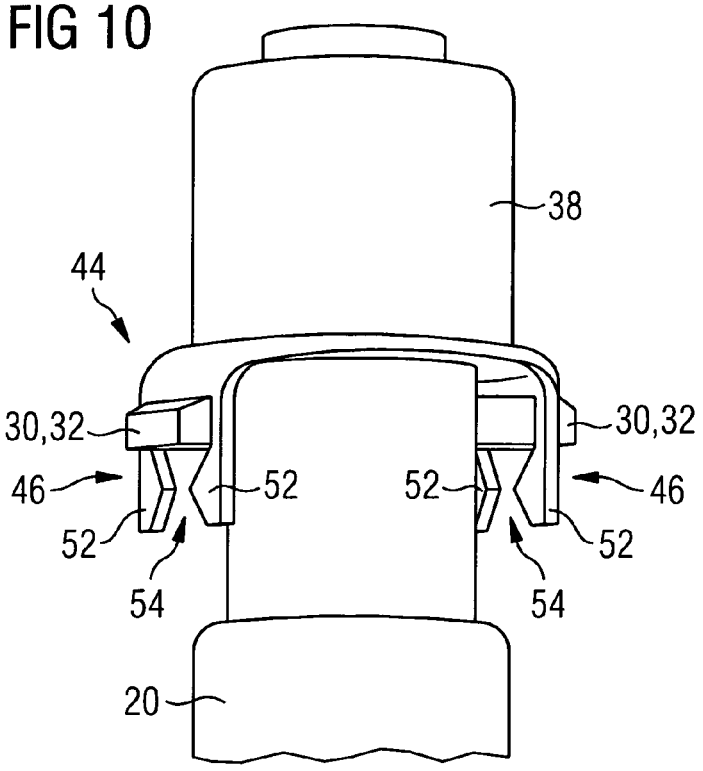
FIG 10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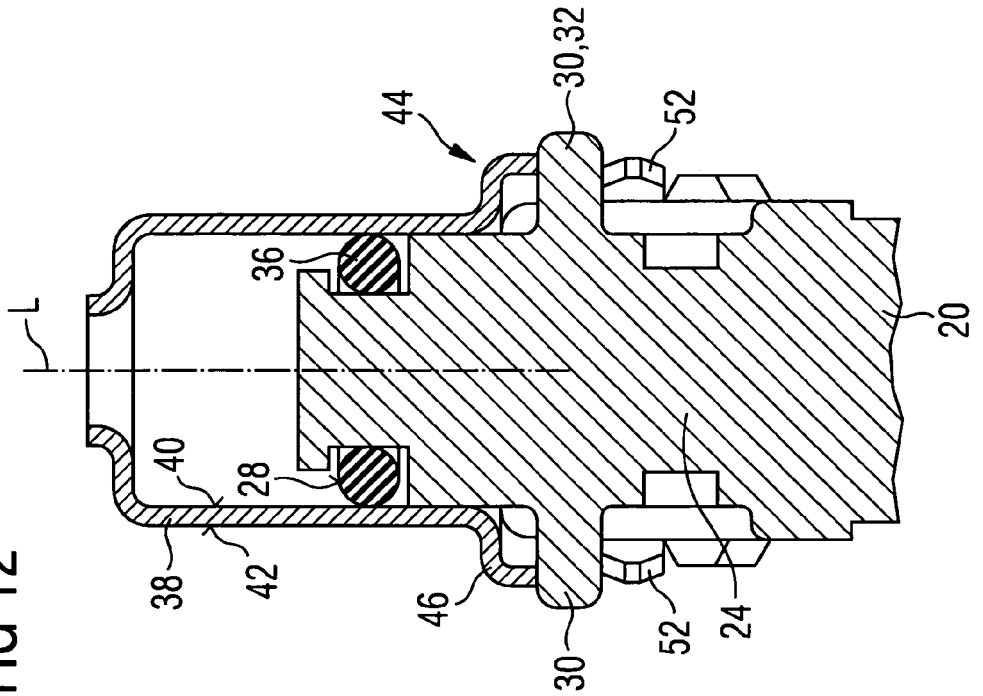
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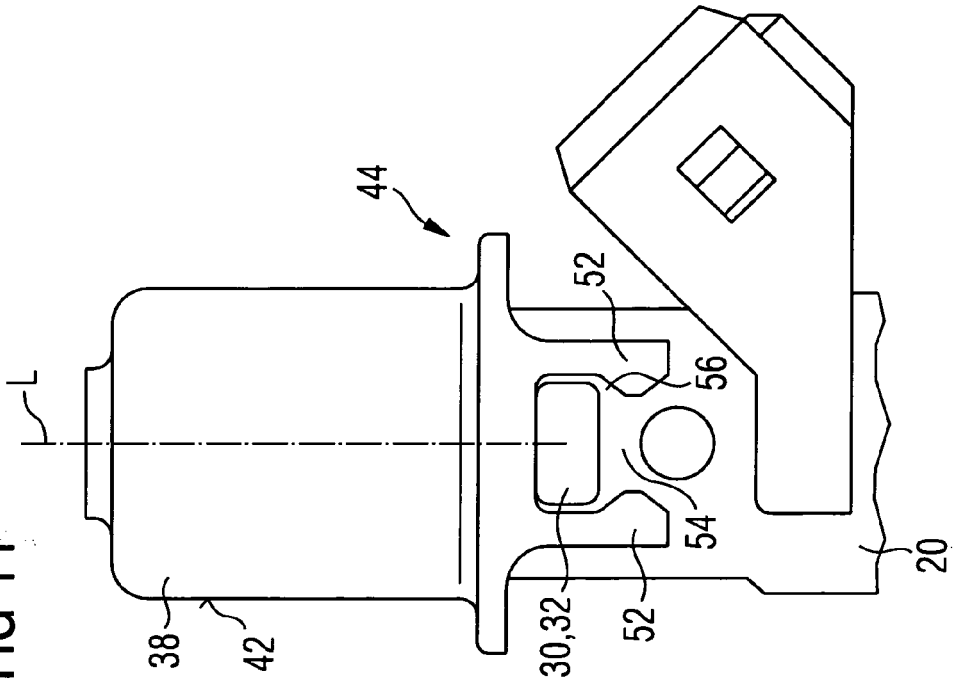
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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 6379

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 5 724 946 A (FRANCHITTO ET AL) 10 March 1998 (1998-03-10) * column 2, line 32 - line 60; figures 1-3 * * column 2, line 64 - column 3, line 11; figures 4-6 * -----	1-4,6, 10,12-14 5,7-9	INV. F02M69/46 F02M55/00
Y	US 6 491 026 B1 (ANDORFER MARTIN) 10 December 2002 (2002-12-10) * the whole document * -----	5,7-9	
A	DE 195 46 441 A1 (ROBERT BOSCH GMBH, 70469 STUTTGART, DE) 19 June 1997 (1997-06-19) * column 4, line 4 - line 18; figures 1,2 * -----	1,2,4, 7-9,13	

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
The Hague	18 April 2006	Nobre, S

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 02 6379

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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18-04-2006

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82