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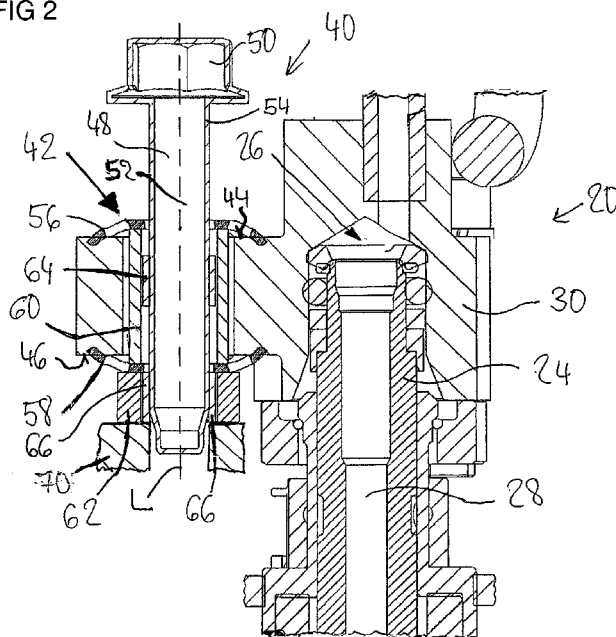
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[Continued on next page]

(54) Title: COUPLING DEVICE

FIG 2



(57) Abstract: The invention concerns a coupling device (40) for mechanically coupling a fuel rail (18) to a cylinder head (70) of a combustion engine (22). The coupling device (40) comprises a fuel injector cup (30) being designed to be hydraulically and mechanically coupled to the fuel rail (70) and comprising a through hole (42) extending between a first surface (44) and a second surface (46) of the fuel injector cup (30), the second surface (46) being arranged and designed to face the cylinder head (70), and a fastening element (48) being designed to be fixedly coupled to the cylinder head (70), the fastening element (48) comprising a head portion (50) and a shank portion (52), the head portion (50) facing the first surface (44) of the fuel injector cup (30), the shank portion (52) being partially arranged in the through hole (42) and being designed to be in engagement with the cylinder head (70). The coupling device (40) comprises a first spring element (56) being arranged axially between the head portion (50) and the first surface (44) of the fuel injector cup (30), and a second spring element (58) facing the second surface (46) of the fuel injector cup (30) and being arrangeable axially between the second surface (46) of the fuel injector cup (30) and the cylinder head (70).

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SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, **Published:**
GW, ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*

Description

Coupling device

- 5 The invention relates to a coupling device for hydraulically and mechanically coupling a fuel rail to a cylinder head of a combustion engine.

10 Coupling devices for hydraulically and mechanically coupling a fuel rail to a cylinder head of a combustion engine are in widespread use, in particular for internal combustion engines. Fuel can be supplied to an internal combustion engine by the fuel rail through a fuel injector. The fuel rail can be coupled to the cylinder head in different manners.

15 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 common rail. Known fuel rails comprise a hollow body with recesses in form of fuel injector cups, wherein the fuel injectors are arranged.

25 The object of the invention is to create a coupling device for hydraulically and mechanically coupling a fuel rail to a cylinder head of a combustion engine which is simply to be manufactured and which facilitates a reliable and precise coupling between the fuel rail and the cylinder head.

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

The invention is distinguished by a coupling device for mechanically coupling a fuel rail to a cylinder head of a combustion engine. The coupling device comprises a fuel injector cup being designed to be hydraulically and mechanically
5 coupled to the fuel rail and comprising a through hole extending between a first surface and a second surface of the fuel injector cup, the second surface opposing the first surface and being arranged and designed to face the cylinder head, and a fastening element being designed to be fixedly
10 coupled to the cylinder head. The fastening element comprises a head portion and a shank portion. The head portion faces the first surface of the fuel injector cup. The shank portion is partially arranged in the through hole and is designed to be in engagement with the cylinder head. The coupling device
15 comprises a first spring element which is arranged axially between the head portion and the first surface of the fuel injector cup, and a second spring element which faces the second surface of the fuel injector cup and is arrangeable axially between the second surface of the fuel injector cup
20 and the cylinder head.

This has the advantage that a fast and secure coupling of the fuel rail to the cylinder head is possible. Furthermore, the coupling of the fuel injector cup with the cylinder head al-
25 lows an assembly of the cylinder head and the fuel rail without a direct contact between the cylinder head and the fuel injector cup. Consequently, a noise transmission between the cylinder head and the fuel rail can be kept small. Additionally, the stiffness of the spring elements may be selected in
30 a simple manner in view of a favorable dynamic behavior of the fuel rail relative to the cylinder head.

In an advantageous embodiment a distance element is arranged axially between the first spring element and the second

spring element. By this a preset distance between the first spring element and the second spring element may be obtained. Consequently, a preset deformation of the spring elements may be obtained.

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In a further advantageous embodiment the distance element is shaped as a sleeve and is at least partially arranged inside the through hole. The shank portion is at least partially arranged inside the distance element. By this a compact construction of the coupling device may be obtained.

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In a further advantageous embodiment a first retaining element is arranged inside the distance element and is in engagement with the shank portion. By this the fastening element may be arranged in any desired position relative to the distance element. Consequently, an easy tightening of the fastening element may be obtained. Furthermore, a subassembly consisting of the fastening element, the first spring element, the sleeve and the first retaining element can be obtained which enables an easy construction of the coupling device.

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In a further advantageous embodiment the first retaining element consists of a plastic or comprises a plastic. This has the advantage that the first retaining element is in a secure engagement with the shank portion.

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In a further advantageous embodiment a bushing is arranged to face the second spring element. The bushing is arrangeable axially between the second spring element and the cylinder head. This has the advantage that a direct contact between the second spring element and the cylinder head may be avoided. The bushing may distribute the force from the coupling device to the cylinder head and the pressure between the

30

coupling device and the cylinder head may be kept small. Consequently, an imprinting of the second spring element in a surface of the cylinder head may be avoided.

5 In a further advantageous embodiment a second retaining element is arranged inside the bushing and is in engagement with the shank portion. This has the advantage that a second sub-assembly consisting of the second spring element, the bushing and the second retaining element can be obtained which is
10 enabled to be joined with the first subassembly. Consequently, this arrangement may make it very easy to mount the fuel injector cup to the cylinder head on the production line.

In a further advantageous embodiment the second retaining
15 element consists of a plastic or comprises a plastic. This has the advantage that the second retaining element is in a secure engagement with the shank portion.

In a further advantageous embodiment the fastening element is
20 a screw.

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

25 Figure 1 an internal combustion engine in a schematic view,
Figure 2 a coupling device in a longitudinal sectional view,
30 Figure 3 parts of the coupling device in a perspective view,
Figure 4 parts of the coupling device in a perspective view,

Figure 5 parts of the coupling device in a perspective view,
and

Figure 6 parts of the coupling device in a perspective view.

5

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

10 A fuel feed device 10 is assigned to an internal combustion engine 22 (Figure 1) which can be a diesel engine or a gasoline engine. It includes a fuel tank 12 that is hydraulically connected with a fuel pump 14. The output of the fuel pump 14 is connected to a fuel inlet 16 of a fuel rail 18. In the
15 fuel rail 18, the fuel is stored for example under a 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. Fuel injectors 20 are connected to the fuel rail 18 and the fuel is fed to the fuel injectors 20 via the fuel rail 18. The fuel injectors 20
20 are arranged in a cylinder head 70 of the internal combustion engine 22. Preferably, the fuel injectors 20 are not in direct contact with the cylinder head 70.

Figure 2 shows a part of the fuel injector 20. The fuel injector 20 has a fuel injector body 24. The fuel injector 20 is suitable for injecting fuel into a combustion chamber 25 of the internal combustion engine 22 (Figure 1). The fuel injector 20 comprises a fuel inlet portion 26. Furthermore, a cavity 28 is arranged in the fuel injector body 24. In an injection mode fuel can flow from the fuel inlet portion 26 to the cavity 28 and can be subsequently injected into the combustion chamber 25. In a non-injecting mode a fuel flow through the cavity 28 and an injection of fuel into the combustion chamber 25 is prevented.

The fuel feed device 10 comprises a fuel injector cup 30 which is part of a coupling device 40. The fuel injector cup 30 is mechanically and hydraulically coupled to the fuel rail 18. The fuel injector cup 30 is in engagement with the fuel inlet portion 26 of the fuel injector 20.

The fuel injector cup 30 has a through hole 42 with a central longitudinal axis L. The through hole 42 extends between a first surface 44 and a second surface 46 of the fuel injector cup 30. The first surface 44 is forming an outer surface of the fuel injector cup 30. The second surface 46 opposes the first surface 44 and faces the cylinder head 70.

The coupling device 40 further comprises a fastening element 48. The fastening element 48 has a head portion 50 and a shank portion 52. The head portion 50 has a larger radial extension than the shank portion 52. The head portion 50 faces the first surface 44 of the fuel injector cup 30. Preferably, the fastening element 48 is a screw with an outer thread 54. The shank portion 52 is extending through the through hole 42. The shank portion 52 can be in engagement with the cylinder head 70. If the fastening element 48 is a screw, the outer thread 54 is in engagement with an inner thread which is arranged in the cylinder head 70. By this the fastening element 48 can be fixedly coupled to the cylinder head 70.

The coupling device 40 further comprises a first spring element 56 and a second spring element 58. Preferably, the spring elements 56, 58 are shaped as open-worked disks with spokes as shown in Figures 3 and 4. In a further embodiment, the spring elements 56, 58 are star-shaped (Figure 5). Depending on the shape of the spring elements 56, 58 a desired stiffness of the spring elements 56, 58 can be selected. The

first spring element 56 is arranged axially between the head portion 50 and the first surface 44 of the fuel injector cup 30. The second spring element 58 faces the second surface 46 of the fuel injector cup 30. The second spring element 58 is
5 arranged axially between the second surface 46 of the fuel injector cup 30 and the cylinder head 70.

The coupling device 40 further comprises a distance element 60. The distance element 60 has the shape of a sleeve. The
10 distance element 60 is arranged axially between the first spring element 56 and the second spring element 58. The distance element 60 enables to maintain a desired distance between the first spring element 56 and the second spring element 58. The distance is selected in a way that the deformation of the spring elements 56, 58 is in a desired range.
15 Preferably, the distance element 60 is welded to the first spring element 56. Preferably, the distance element 60 is arranged inside the through hole 42. The shank portion 52 is arranged inside the distance element 60.

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The coupling device 40 further comprises a bushing 62 which is arranged axially between the second spring element 58 and the cylinder head 70. Preferably, the bushing 62 is welded to the second spring element 58. The bushing 62 prevents the
25 second spring element 58 to be in a direct contact with the cylinder head 70. The bushing 62 can distribute the force from the coupling device 40 to the cylinder head 70. As the bushing 62 can have a larger contact area than the second spring element 58 the pressure between the coupling device 40
30 and the cylinder head 70 is rather low. Therefore, it can be avoided that the second spring element 58 is imprinted into a surface of the cylinder head 70 which faces the coupling device 40.

The coupling device 40 further comprises a first retaining element 64 which is arranged inside the distance element 60. The first retaining element 64 is in engagement with the shank portion 52. Preferably, the first retaining element 64 consists of a plastic or comprises a plastic. In a further embodiment, the first retaining element 64 consists of a metal or comprises a metal. The first retaining element 64 enables to arrange the fastening element 48 in a position relative to the distance element 60 which allows an easy tightening of the fastening element 48.

The coupling device 40 further comprises a second retaining element 66 which is arranged inside the bushing 62. The second retaining element 66 is in engagement with the shank portion 52. Preferably, the second retaining element 66 consists of a plastic or comprises a plastic. In a further embodiment, the second retaining element 66 consists of a metal or comprises a metal. Preferably, the second retaining element 66 consists of a thin metal sheet (Figure 6).

As shown in Figure 3 the fastening element 48, the first spring element 56, the distance element 60 and the first retaining element 64 are composed in a manner that they form a first subassembly 80. As shown in Figure 4 a second subassembly 90 consists of the second spring element 58, the bushing 62 and the second retaining element 66. The second subassembly 90 can be mounted with the first subassembly 80. The pre-mounted subassemblies 80, 90 make it very easy to mount the fuel injector cup 30 to the cylinder head 70 on the production line.

The presented coupling of the fuel injector cup 30 with the cylinder head 70 enables to mount the fuel injector cup 30 on the cylinder head 70 without a direct contact between the

fuel injector cup 30 and the cylinder head 70. Consequently, a noise transmission between the cylinder head 70 and the fuel rail 18 can be kept small.

Claims

1. Coupling device (40) for mechanically coupling a fuel rail (18) to a cylinder head (70) of a combustion engine (22),
5 (22),
the coupling device (40) comprising
- a fuel injector cup (30) being designed to be hydraulically and mechanically coupled to the fuel rail (18) and comprising a through hole (42) extending between a first surface (44) and a second surface (46) of the fuel injector cup (30), the second surface (46) opposing the first surface (44) and being arranged and designed to face the cylinder head (70), and
10
 - a fastening element (48) being designed to be fixedly coupled to the cylinder head (70), the fastening element (48) comprising a head portion (50) and a shank portion (52), the head portion (50) facing the first surface (44) of the fuel injector cup (30), the shank portion (52) being partially arranged in the through hole (42) and being designed to be in engagement with the cylinder head (70),
15
- wherein the coupling device (40) comprises
- a first spring element (56) being arranged axially between the head portion (50) and the first surface (44) of the fuel injector cup (30), and
20
 - a second spring element (58) facing the second surface (46) of the fuel injector cup (30) and being arrangeable axially between the second surface (46) of the fuel injector cup (30) and the cylinder head (70).
25
- 30
2. Coupling device (40) in accordance with claim 1, wherein a distance element (60) is arranged axially between the first spring element (56) and the second spring element (58).

3. Coupling device (40) in accordance with claim 2, wherein
the distance element (60) is shaped as a sleeve and is
at least partially arranged inside the through hole
5 (42), and the shank portion (52) is at least partially
arranged inside the distance element (60).
4. Coupling device (40) in accordance with claim 3, wherein
a first retaining element (64) is arranged inside the
10 distance element (60) and is in engagement with the
shank portion (52).
5. Coupling device (40) in accordance with claim 4, wherein
the first retaining element (64) consists of a plastic
15 or comprises a plastic.
6. Coupling device (40) in accordance with one of the pre-
ceding claims, wherein a bushing (62) is arranged to
face the second spring element (56), the bushing (62)
20 being arrangeable axially between the second spring ele-
ment (56) and the cylinder head (70).
7. Coupling device (40) in accordance with claim 6, wherein
a second retaining element (66) is arranged inside the
25 bushing (62) and is in engagement with the shank portion
(52).
8. Coupling device (40) in accordance with claim 7, wherein
the second retaining element (66) consists of a plastic
30 or comprises a plastic.
9. Coupling device (40) in accordance with one of the pre-
ceding claims, wherein the fastening element (48) is a
screw.

FIG 1

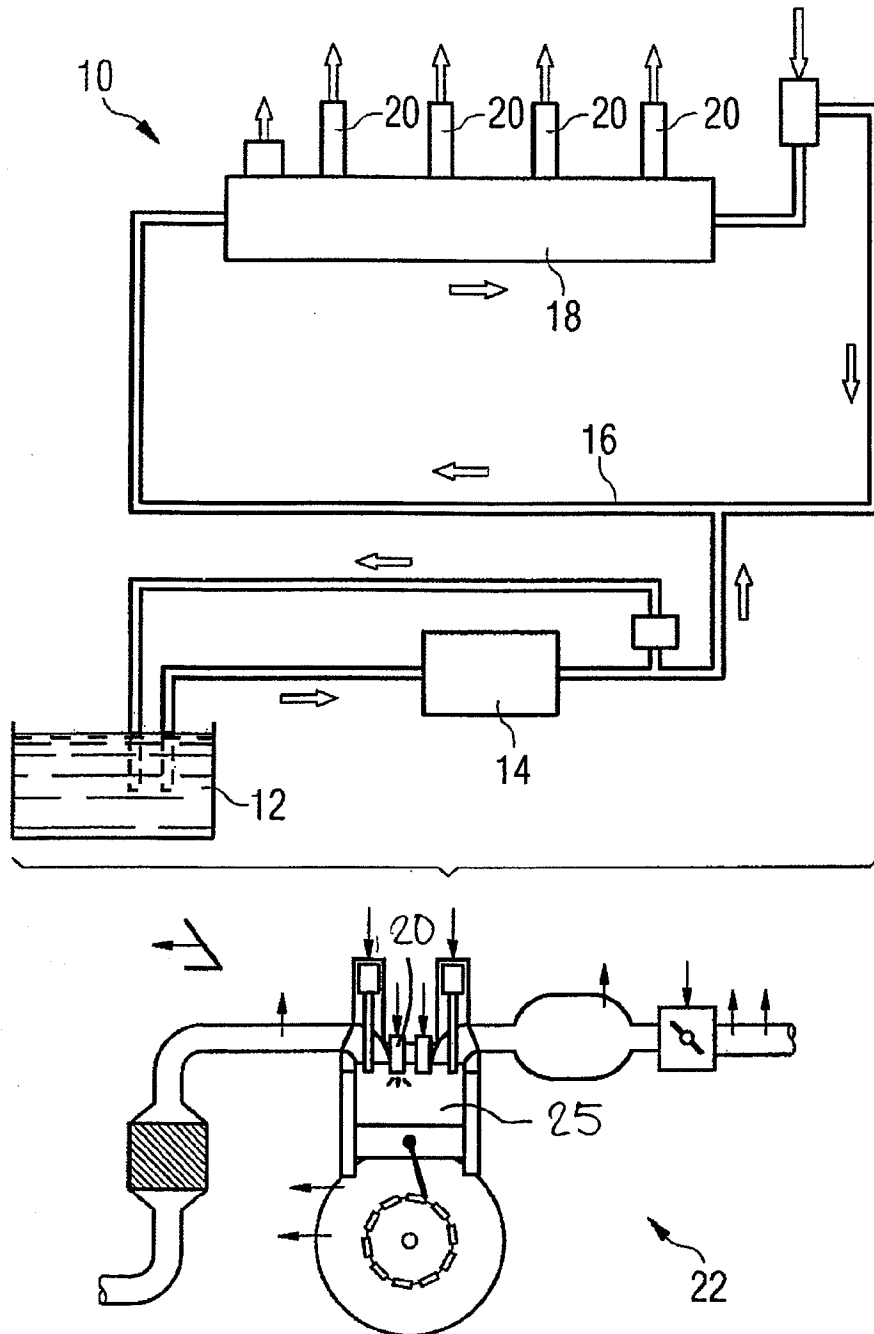


FIG 2

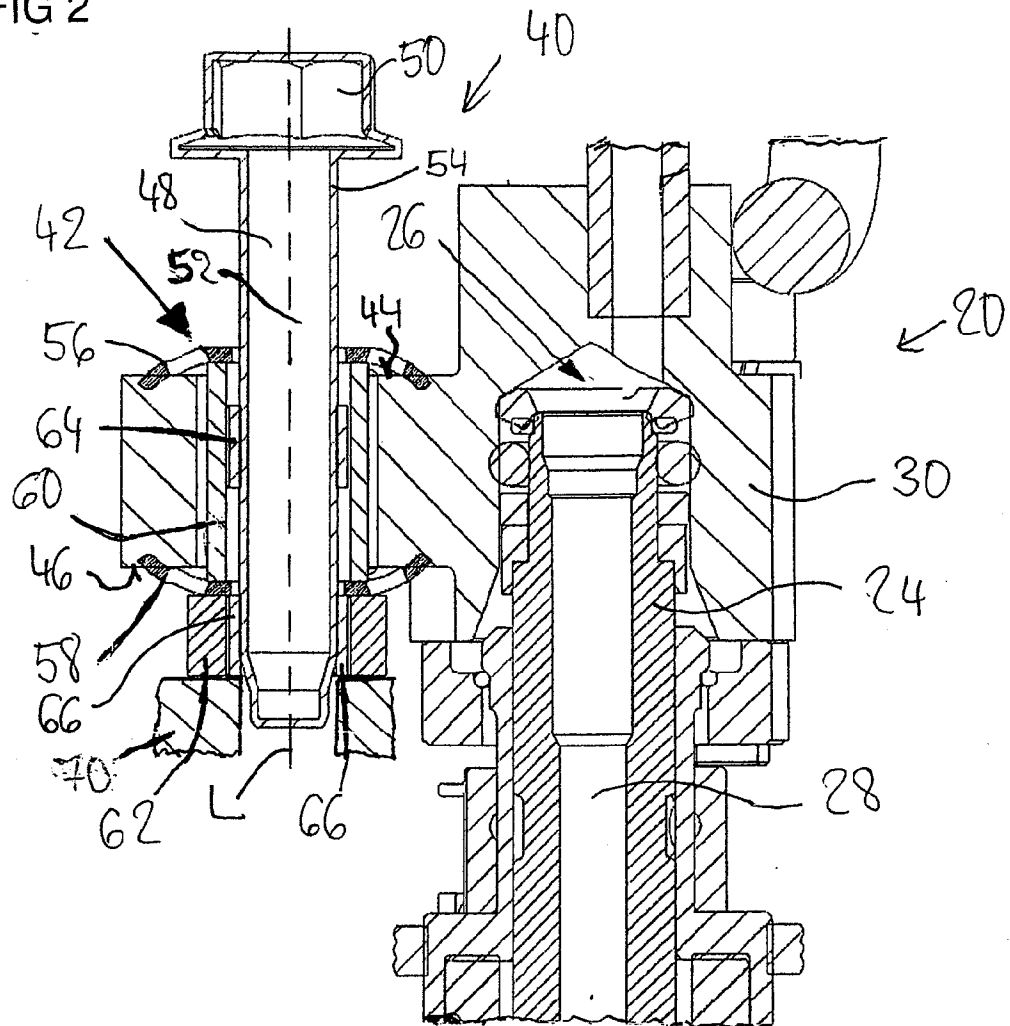


FIG 3

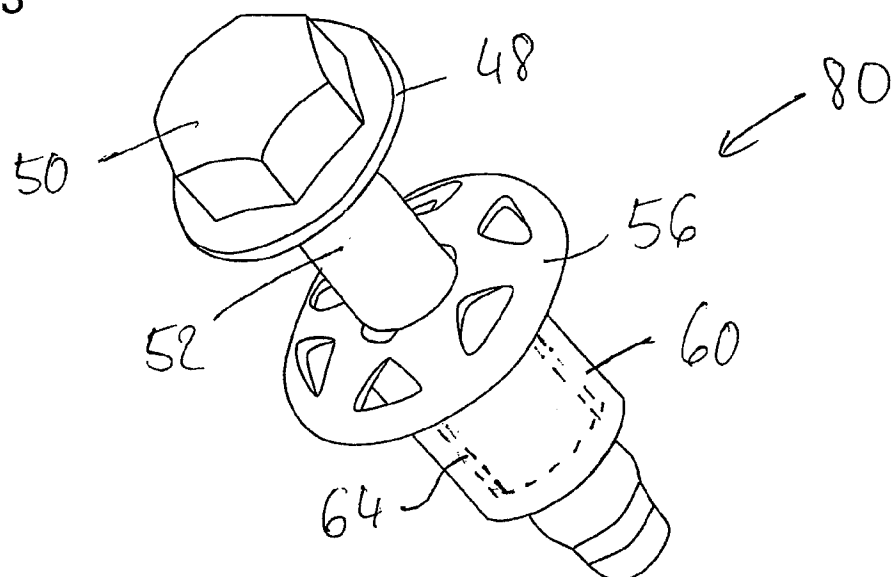


FIG 4

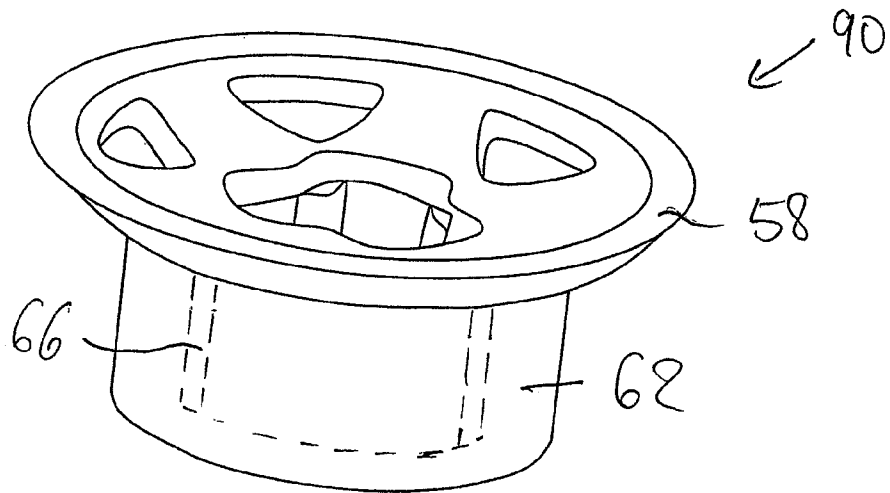


FIG 5

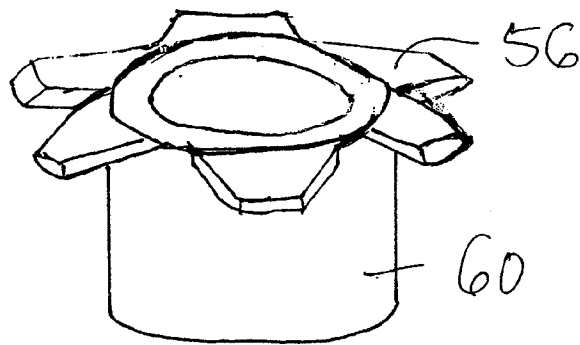
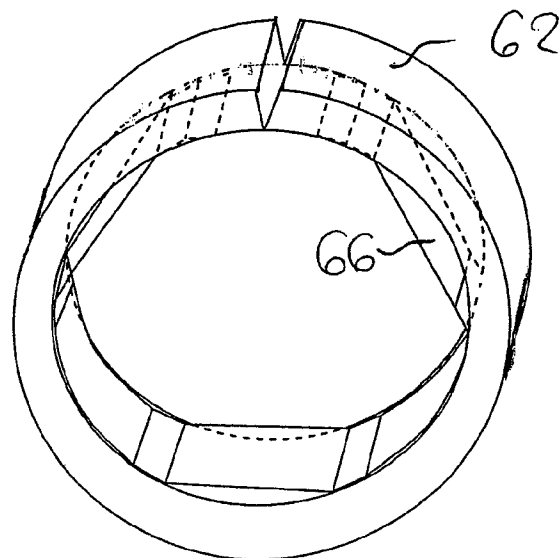


FIG 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/067690

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02M55/02 F02M61/14 F02M69/46 F02M55/04
ADD.

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)

F02M

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2005 008038 A1 (BOSCH GMBH ROBERT [DE]) 24 August 2006 (2006-08-24) paragraphs [0031] - [0035]; claims 8,9; figures 2-5	1-5,9
Y	US 2008/075403 A1 (HOLT JASON [US] ET AL) 27 March 2008 (2008-03-27) figure 1	1,2,9
Y	JP 2003 286928 A (KEIHIN CORP) 10 October 2003 (2003-10-10) * abstract; figure 2	1,2,9
A	US 2007/163545 A1 (BEARDMORE JOHN M [US] ET AL BEARDMORE JOHN M [US] ET AL) 19 July 2007 (2007-07-19) * abstract; figure 1	1-9
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

4 January 2011

Date of mailing of the international search report

12/01/2011

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/067690

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 575 114 A (CAMP JOHN W A [GB]) 11 March 1986 (1986-03-11) * abstract; figure 1 -----	2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/067690

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