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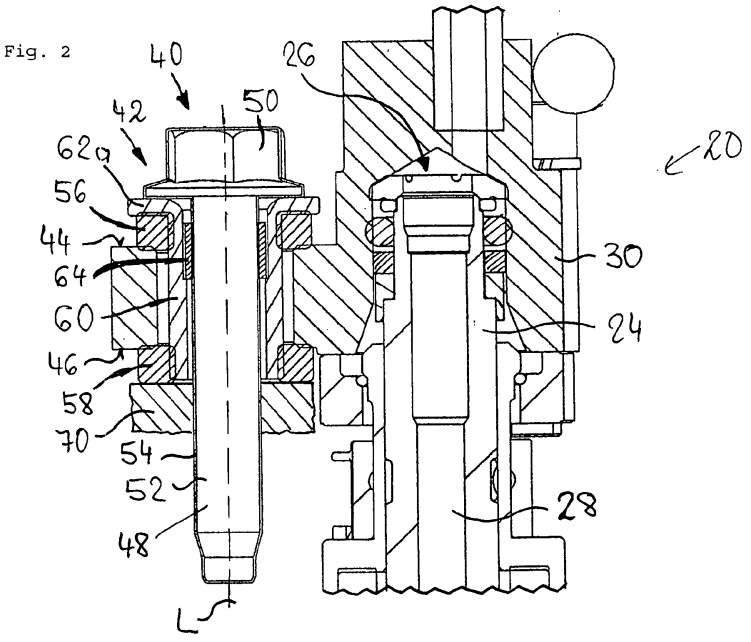
(71) Applicant: **Continental Automotive GmbH**
30165 Hannover (DE)

(72) Inventors:
- **Serra, Giandomenico**
  56010 Loc. Ghezzano - S. Giuliano Terme (PI) (IT)
- **Di Domizio, Gisella**
  56019 San Giuliano Terme (IT)
- **Giorgetti, Edoardo**
  57013 Rosignano Marittimo
  LI (IT)
- **Marc, Daniel**
  57125 Livorno (IT)

(54) Coupling device

(57) 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). At least one of the spring elements (56, 58) consists of a rubber or comprises a rubber.

Fig. 2



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Description

[0001] The invention relates to a coupling device for hydraulically and mechanically coupling a fuel rail to a cylinder head of a combustion engine.

[0002] 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.

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

[0004] 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.

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

[0006] 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 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 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 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 and the cylinder head. At least one of the spring elements consists of a rubber or comprises a rubber.

[0007] 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 allows an assembly of the cylinder head and the fuel rail without a direct contact between the cylinder head and the fuel injector cup. As the spring elements consists of a rubber or comprises a rubber, a noise transmission between the cylinder head and the fuel rail can be kept very small. Additionally, the rubber may be selected in view of the desired stiffness of the spring elements in a simple manner so that a favorable dynamic behavior of the fuel rail relative to the cylinder head may be obtained.

[0008] 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 spring elements may be obtained. Consequently, a preset deformation of the spring elements may be obtained easily.

[0009] 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.

[0010] In a further advantageous embodiment the distance element comprises at least one collar being arranged axially between the head portion and the first spring element and/or is arrangeable axially between the second spring element and the cylinder head. Due to the at least one collar a preset deformation of the spring element may be obtained.

[0011] In a further advantageous embodiment the distance element comprises two collars. The first collar is arranged axially between the head portion and the first spring element and the second collar is arrangeable axially between the second spring element and the cylinder head. This can make it very easy to mount the fuel injector cup to the cylinder head on the production line.

[0012] In a further advantageous embodiment at least one 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. A first subassembly consisting of the fastening element, the first spring element, the distance element and one of the retaining elements can be obtained which be joined with the second spring element and which enables an easy construction of the coupling device. Consequently, this arrangement can make it very easy to mount the fuel injector cup to the cylinder head.

[0013] In a further advantageous embodiment the at least one retaining element consists of a plastic or comprises a plastic. This has the advantage that the retaining element can be in secure engagement with the shank portion.

[0014] In a further advantageous embodiment the fastening element is a screw.

[0015] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are:

Figure 1 an internal combustion engine in a schematic view,

Figure 2 a coupling device in a longitudinal sectional view,

Figure 3 parts of the coupling device in a perspective view,

Figure 4 the coupling device in a sectional view, and

Figure 5 the coupling device in a sectional view.

[0016] Elements of same design and function that occur in different figures are identified by the same reference character.

[0017] 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 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 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.

[0018] 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 an injection of fuel into the combustion chamber 25 is prevented.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] The coupling device 40 further comprises a first spring element 56 and a second spring element 58. The spring elements 56, 58 consist of a rubber or comprise a rubber. Depending on the axial extension and the shape of the spring elements 56, 58 and the type of rubber used for 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 arranged axially between the second surface 46 of the fuel injector cup 30 and the cylinder head 70.

[0023] The coupling device 40 comprises a distance element 60 which has the shape of a sleeve. The 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. The distance element 60 is arranged inside the through hole 42. The shank portion 52 is arranged inside the distance element 60.

[0024] In one embodiment the distance element 60 comprises one collar 62a (Figures 2 and 5). The collar 62a is arranged axially between the head portion 50 and the first spring element 56 (Figure 2) or between the second spring element 58 and the cylinder head 70 (Figure 5). The collar 62a enables to obtain a preset deformation of the spring elements 56, 58. The collar 62a which is arranged between the second spring element 58 and the cylinder head 70 can have a larger contact area than the second spring element 58 so that the pressure between the coupling device 40 and the cylinder head 70 can be very low. Therefore, an imprinting into the cylinder head 70 can be avoided.

[0025] In a further embodiment the distance element 60 comprises two collars 62a, 62b (Figure 4). The distance element 60 has two parts, un upper part 60a and a lower part 60b, which are separated from each other. The upper part 60a of the distance element 60 comprises a first of the collars 62a, the lower part 60b of the distance element 60 comprises a second of the collars 62b. The first collar 62a is arranged axially between the head portion 50 and the first spring element 56. The second collar 62b is arranged axially between the second spring element 58 and the cylinder head 70. This can make it very easy to mount the fuel injector cup 30 to the cylinder head 70 on the production line.

[0026] The coupling device 40 further comprises at least one retaining element 64, 66. In a preferred embodiment, the coupling device 40 comprises a first retaining element 64 and a second retaining element 66. The retaining elements 64, 66 are arranged inside the distance element 60 and are in engagement with the shank portion 52. Preferably, the retaining elements 64, 66 consist of a plastic or comprise a plastic. The retaining elements 64, 66 enable 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.

[0027] 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. The second spring element 58 can be mounted with the first subassembly 80 as shown in Figure 2. In a further embodiment (Figure 4) a second subassembly 90 consists of the second spring element 58, the lower part 60b of the distance element 60 and the second retaining element 66. The pre-mounted subassemblies 80, 90 allow an easy mounting of the fuel injector cup 30 with the cylinder head 70 on the production line.

[0028] 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 or even be avoided.

Claims

1. Coupling device (40) for mechanically coupling a fuel rail (18) to a cylinder head (70) of a combustion engine (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),
   - 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),
   - 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),

   wherein at least one of the spring elements (56, 58) consists of a rubber or comprises a rubber.

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 (42), and the shank portion (52) is at least partially arranged inside the distance element (60).

4. Coupling device (40) in accordance with claim 2 or 3, wherein the distance element (60) comprises at least one collar (62a, 62b) being arranged axially between the head portion (50) and the first spring element (56) and/or being arrangeable axially between the second spring element (58) and the cylinder head (70).

5. Coupling device (40) in accordance with claim 4, wherein the distance element (60) comprises two collars (62a, 62b), the first collar (62a) being arranged axially between the head portion (50) and the first spring element (56) and the second collar (62b) being arrangeable axially between the second spring element (58) and the cylinder head (70).

6. Coupling device (40) in accordance with one of the claims 2 to 5, wherein at least one retaining element (64, 66) is arranged inside the distance element (60) and is in engagement with the shank portion (52).

7. Coupling device (40) in accordance with claim 6, wherein the at least one retaining element (64, 66) consists of a plastic or comprises a plastic.

8. Coupling device (40) in accordance with one of the preceding claims, wherein the fastening element (48) is a screw.

FIG 1

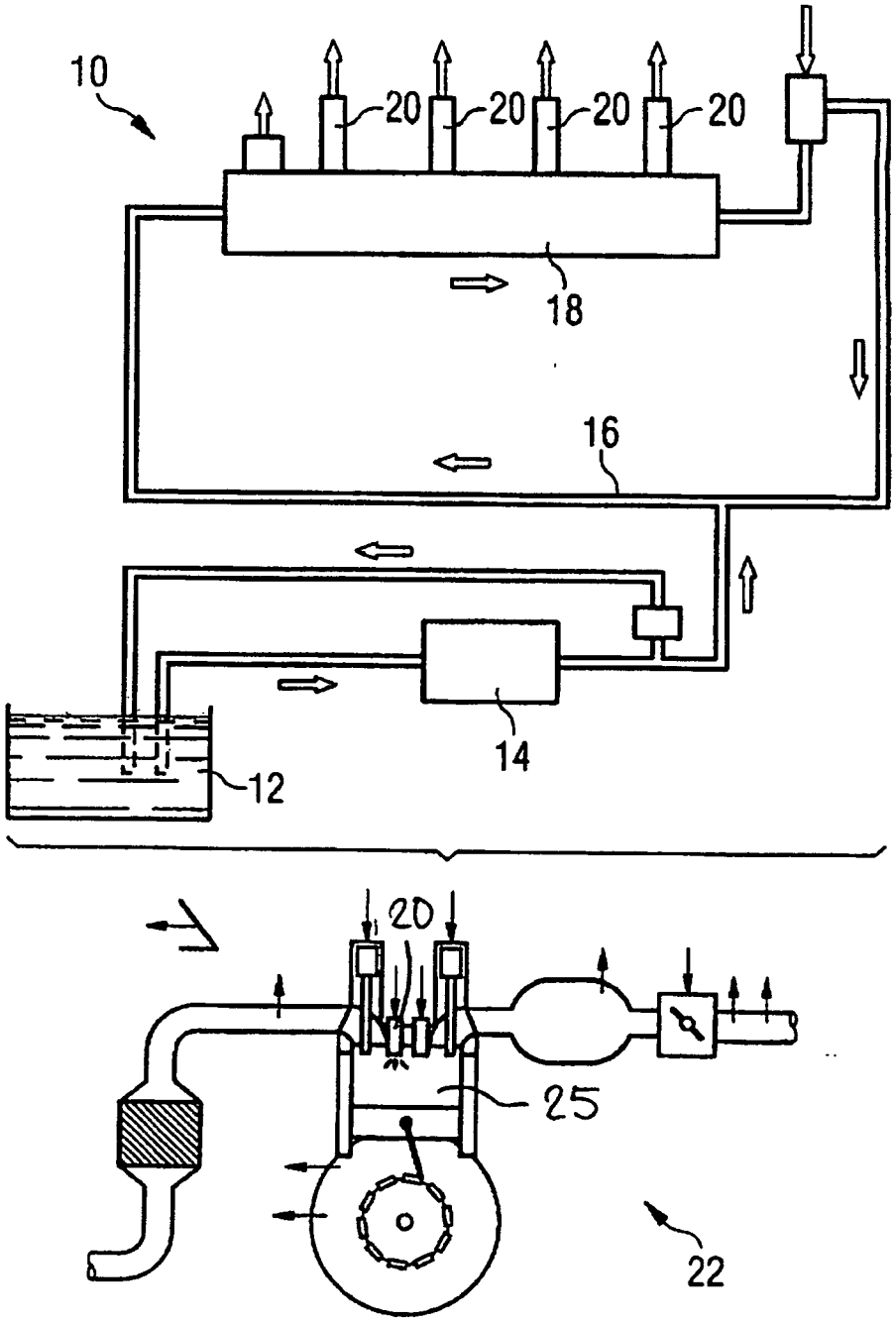

Fig. 2

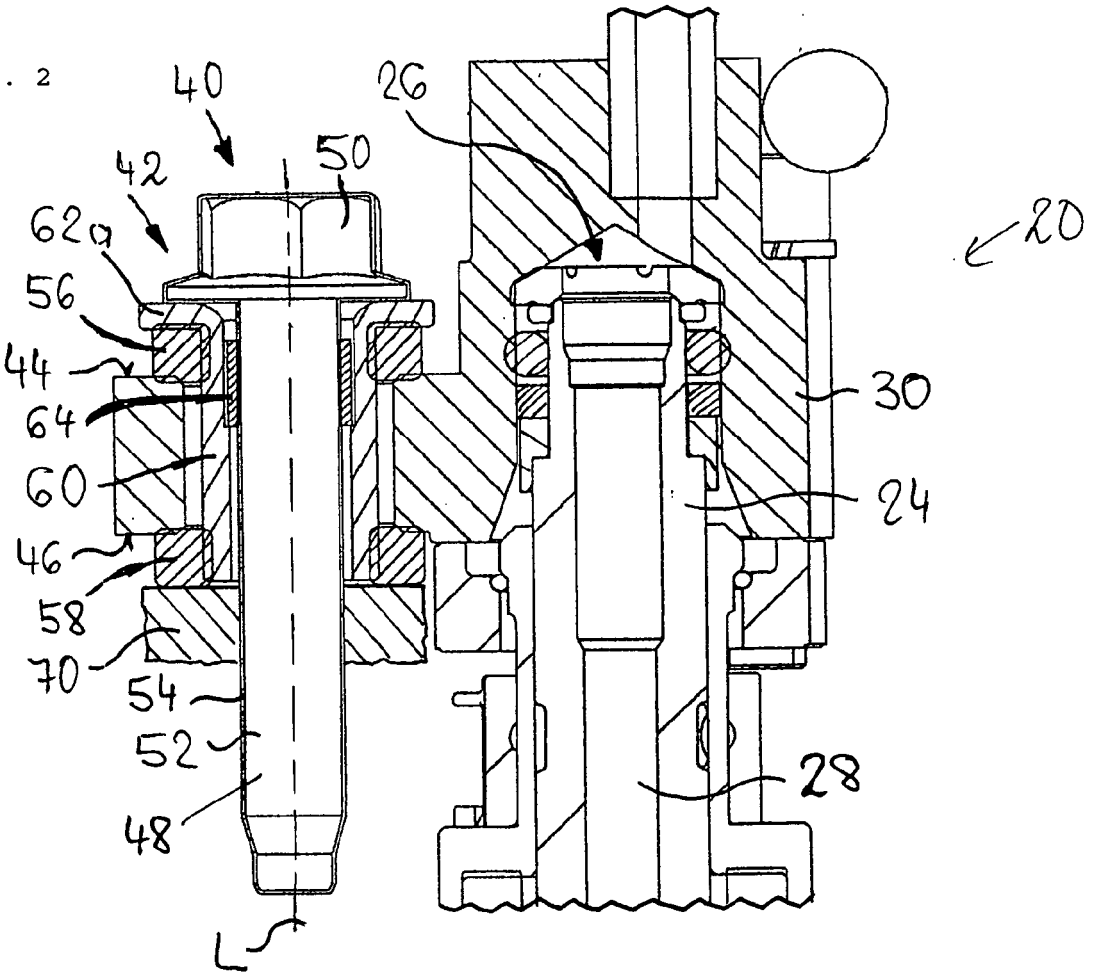
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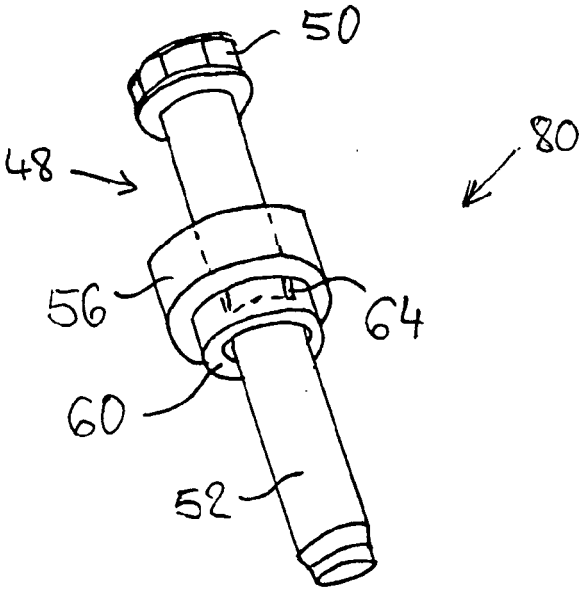
Fig. 3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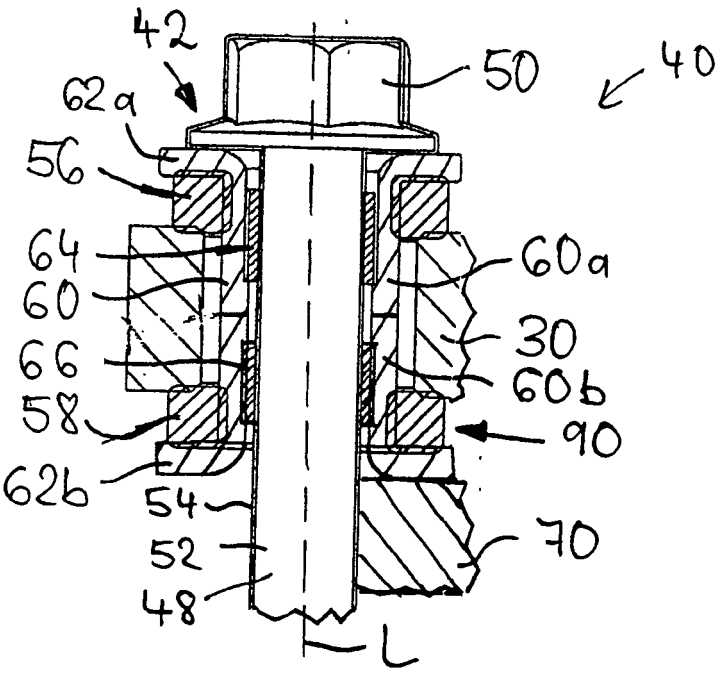
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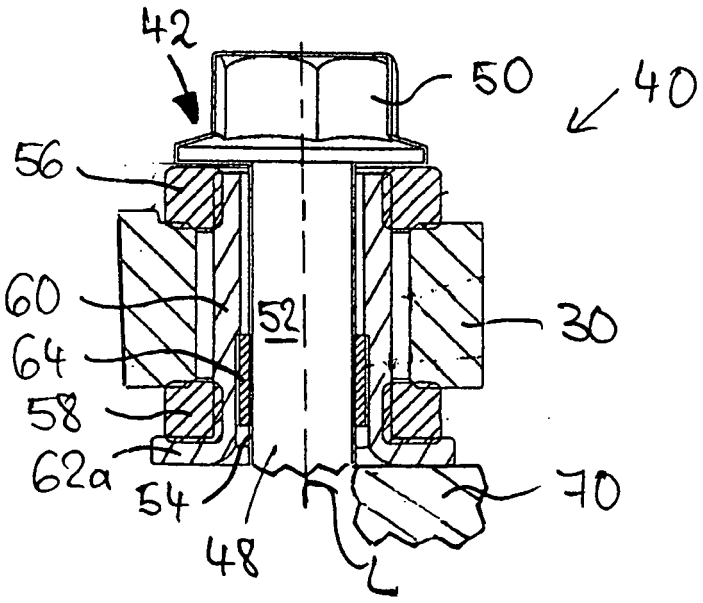
Fig. 5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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 2236

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	US 2008/075403 A1 (HOLT JASON [US] ET AL) 27 March 2008 (2008-03-27) * paragraphs [0046], [0051], [0052]; figures 2,9,10 * * abstract * -----	1-5,8	INV. F02M55/02 F02M61/14 ADD. F02M63/00
X	DE 10 2005 020380 A1 (BOSCH GMBH ROBERT [DE]) 9 November 2006 (2006-11-09) * paragraphs [0008], [0017], [0018]; figure 1 * * abstract * -----	1-3,8	
A	JP 2000 009000 A (MITSUBISHI MOTORS CORP) 11 January 2000 (2000-01-11) * abstract; figure 1 * -----	1-8	

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	16 July 2010	Hermens, Sjoerd

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 00 2236

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16-07-2010

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