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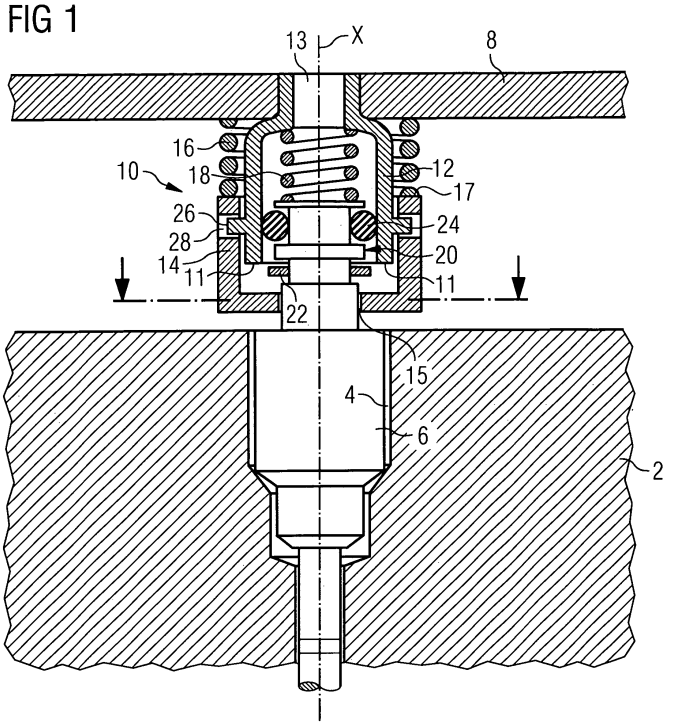
(54) **Coupling arrangement and connection assembly**

(57) A coupling arrangement (10) for coupling an injector (6) to a fluid supply comprises a fuel connection (12) which is cup-shaped having a bottom portion and a side portion, which is fixed to a pipe (8) of the fluid supply. A locking element (14) is cup-shaped and comprises a rim (17), a bottom portion and a side portion and is coupled to the fuel connection (12). At least a part of the side portions of the locking element (14) and of the fuel connection (12) form an overlapping area. An inner spring (18) is arranged in the fuel connection (12) and is fixed to the bottom portion of the fuel connection (12) at an axial end of the inner spring (18). An outer spring (16) is arranged intermediate the pipe (8) and the locking element (14), the outer spring (16) having a larger diameter than the inner spring (18) and the outer spring (16) forcing the locking element (14) away from the pipe (8). At least one pin (26) of the fuel connection (12) is arranged in the overlapping area at the fuel connection (12). At least one recess (28) is formed in the locking element (14) and extends from the rim (17) of the locking element (14) towards the bottom portion of the locking element (14) and further at least partly parallel to the bottom portion of the locking element (14) and further towards the rim (17) of the locking element (14) to a second end (32) of the recess (28) of the locking element (14). The second end (32) of the recess (28) of the locking element (14) takes in the pin (26) of the fuel connection (12).

FIG 1

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## Description

**[0001]** The invention relates to a coupling arrangement for coupling an injector to a fluid supply. The coupling arrangement comprises a fuel connection which is cup-shaped having a bottom portion and a side portion. The fuel connection is fixed to a pipe of the fluid supply and communicates with the pipe through a fuel opening in the bottom portion of the fuel connection. Further, the invention relates to a connection assembly for connecting the injector to the fluid supply comprising the coupling arrangement.

**[0002]** EP 1 255 038 B1 discloses a fuel injection system for the direct injection of fuel into at least one combustion space of an internal combustion engine. The fuel injection system has at least one fuel injection valve for each combustion space. The fuel injection valve can be inserted in each case at an injection portion into an assigned receiving board formed on a cylinder head of the internal combustion engine.

**[0003]** It is an object of the invention to create a coupling arrangement and a connection assembly which enable a proper flexible coupling of an injector to a fluid supply.

**[0004]** The object is achieved by the features of the independent claims 1 and 7. Advantageous embodiments of the invention are given in the sub-claims.

**[0005]** The invention is distinguished concerning a first aspect of the invention by a coupling arrangement for coupling an injector to a fluid supply. The coupling arrangement comprises a fuel connection, a locking element, an outer spring, an inner spring, at least one pin of the connecting element, and at least one recess which is formed in the locking element. The fuel connection is cup-shaped and has a bottom portion and a side portion. The fuel connection is fixed to a pipe of the fluid supply and communicates with the pipe through a fuel opening in the bottom portion of the fuel connection. The locking element is cup-shaped and comprises a rim, a bottom portion, and side portion. The locking element is coupled to the fuel connection. At least a part of the side portion of the locking element and of the fuel connection form an overlapping area. The inner spring is arranged in the fuel connection and is fixed to the bottom portion of the fuel connection at an axial end of the inner spring. The outer spring is arranged intermediate the pipe and the locking element. The outer spring has a larger diameter than the inner spring and the outer spring forces the locking element away from the pipe. The pin of the connecting element is arranged in the overlapping area at the fuel connection. The recess is formed in the locking element and extends from the rim of the locking element towards the bottom portion of the locking element. Further, the recess extends at least partly parallel to the bottom portion of the locking element and further extends towards the rim of the locking element to a second end of the recess of the locking element. The second end of the recess of the locking element takes in the pin of the fuel connection.

**[0006]** The recess of the locking element and the pin of the fuel connection enable a fixation of the locking element to the fuel connection by a positive fit. The outer spring enables the fixation by a press fit. So, the locking element may be fixed to the fuel connection very fast and in a very simple way without the need for special tools. Further, the coupling arrangement enables a light flexible movement in a small range of the locking element relative to the fuel connection. So, the coupling arrangement enables a proper flexible coupling of the locking element to the fuel connection. If the locking element holds an injector, the coupling arrangement contributes to a proper flexible coupling of the injector to the fluid supply.

**[0007]** In an advantageous embodiment of the first aspect of the invention the locking element has a bigger diameter than the fuel connection. The outer spring is circumferentially arranged around an axial section of the fuel connection.

**[0008]** The invention is distinguished concerning a second aspect of the invention by the coupling arrangement for coupling the injector to the fluid supply. The coupling arrangement comprises the fuel connection, the locking element, the inner spring, the outer spring, and at least one pin of the locking element, and at least one recess of the fuel connection. The fuel connection is cup-shaped and has a rim, a bottom portion and a side portion. The fuel connection is fixed to the pipe and communicates with the pipe of the fluid supply through a fuel opening in the bottom portion of the fuel connection. The locking element is cup-shaped and comprises the bottom portion and the side portion. The locking element is coupled to the fuel connection. At least the part of the side portions of the locking element and of the fuel connection form the overlapping area. The inner spring is arranged in the fuel connection and is fixed to the bottom portion of the fuel connection at the axial end of the inner spring. The outer spring is arranged intermediate the pipe and the locking element. The outer spring has the larger diameter than the inner spring and the outer spring forces the locking element away from the pipe. The pin of the locking element is arranged in the overlapping area at the locking element. The recess of the fuel connection is formed in the fuel connection and extends from the rim of the fuel connection towards the bottom portion of the fuel connection. Further, the recess of the fuel connection extends at least partly parallel to the bottom portion of the fuel connection and further extends towards the rim of the fuel connection to the second end of the recess of the fuel connection. The second end of the recess of the fuel connection takes in the pin of the locking element. The pin of the locking element and the recess of the fuel connection enable the fixation of the locking element to the fuel connection by the press fit and the mechanical fit. This may contribute to the proper flexible coupling of the injector to the cylinder head.

**[0009]** In an advantageous embodiment of the second aspect of the invention the locking element has the bigger diameter than the fuel connection and the outer spring

is circumferentially arranged around the axial section of the fuel connection.

**[0010]** The invention is distinguished concerning a third aspect of the invention by a connection assembly for connecting the injector to the fluid supply. The connection assembly comprises the coupling arrangement and a connection section of the injector. The connection section is radially surrounded by the locking element. The connection section protrudes into the coupling arrangement through an injector opening in the bottom portion of the locking element. The connection section has a fixation body which is fixed to the connection section of the injector and which has at least partly a larger diameter than the injector opening of the bottom portion of the locking element.

**[0011]** In an advantageous embodiment of the third aspect of the invention the injector opening of the bottom portion of the locking element and at least a part of the connecting section of the injector are formed and arranged in such a way that the locking element holds the injector in its position respectively a rotation of the injector around an axis of the injector.

**[0012]** The invention is explained in the following with the help of schematic drawings.

**[0013]** These are as follows:

figure 1 a first embodiment of a connection assembly,

figure 2 a cut through the connection assembly according to figure 1,

figure 3 a side view of a locking element,

figure 4 a coupling arrangement of a second embodiment of the connection assembly,

figure 5 a part of a fuel connection.

**[0014]** Elements with the same design or function that appear in the different illustrations are identified by the same reference characters.

**[0015]** A cylinder head 2 (figure 1) has a recess 4. An injector 6 is arranged in the recess 4 of the cylinder head 2. The injector 6 is coupled to a pipe 8 of a fluid supply by a connection assembly. The connection assembly comprises a coupling arrangement 10 and a connecting section 10 of the injector 6.

**[0016]** The coupling arrangement 10 comprises a fuel connection 12 and a locking element 14.

**[0017]** The fuel connection 12 is cup-shaped comprising a rim 11, a bottom portion and a side portion of the fuel connection 12. The fuel connection 12 communicates with the pipe 8 through a fuel opening 13 in the bottom portion of the fuel connection 12. A pin 26 of the fuel connection 12 is arranged at an outside of the side portion of the fuel connection 12 in an overlapping area which is formed by at least a part of the side portion of the locking element 14 and by at least a part of the side portion of the fuel connection 12.

**[0018]** The locking element 14 is cup-shaped having a rim 17 of the locking element 14, a side portion, and a bottom portion. The injector 6 protrudes into the coupling arrangement 10 through an injector opening 15 of the locking element 14 at the bottom portion of the locking element 14. The injector 6 has a connecting section 20 which is radially surrounded by the coupling arrangement 10 and, in particular, by the locking element 14. The connecting section 20 has a fixation body 22. Preferably, the fixation body 22 is a washer which is fixed to the injector 6 at the inside of the washer and which has a larger outer diameter than the injector opening 15 of the locking element 14.

**[0019]** The locking element 14 is pressed away from the pipe 8 by an outer spring 16. The outer spring 16 is circumferentially arranged around an axial section of the fuel connection 12 and intermediate the pipe 8 and the locking element 14. An inner spring 18 is arranged in the fuel connection 12 and is fixed to the bottom portion of the fuel connection 12 at one axial end of the inner spring 18. The inner spring 18 forces the injector 6 away from the pipe 8 in its seat in the recess 4 of the cylinder head 2.

**[0020]** Preferably, the connection section 20 of the injector 6 and the injector opening 15 of the locking element 14 are formed and arranged in such a way that the injector 6 is held in its position according to a rotation of the injector 6 around an axis X of the injector 6 by the injector opening 15 of the locking element 14 (figure 2). For example, a part of the injector opening 15 has a spherical shape and an other part of the injector opening 15 has a linear shape. Then, the injector 6 comprises a similar shape in an corresponding area at the connection section 20 at its outer shell. So, the rotation of the injector 6 around its axis X is prevented by the mechanical fit between the injector opening 15 of the locking element 14 and the corresponding area at the connection section 20 of the injector 6.

**[0021]** A recess 28 (figure 3) of the locking element 40 extends from a first end 30 of the recess 28 of the locking element 14 towards the bottom portion of the locking element 14 and then further the recess 28 of the locking element 14 extends at least partly parallel to the bottom portion of the locking element 14. The recess 28 of the locking element 14 further extends from the at least partly parallel part of the recess 28 of the locking element 14 towards the rim 13 of the locking element 14 to a second end 32 of the recess 28 of the locking element 14. The extension of the recess 28 of the locking element 14 enables a mechanical fit between the locking element 14 and the fuel connection 12.

**[0022]** If the injector 6 is assembled to the fluid supply, at first the locking element 14 is pre-assembled to the injector 6 in such a way that the bottom portion of the locking element 14 is axially arranged between the fixation body 22 of the injector 6 and that part of the injector 6 which is arranged in the recess 4 of the cylinder head 2. Then, the injector 6 is stuck into the fuel connection

12 and the locking element 14 is stuck onto the fuel connection 12 in such a way that the first end 30 of the recess 28 of the locking element 14 takes in the pin 26 of the fuel connection 12. Then, the locking element 14 is forced further towards the pipe 8 and so the pin 26 of the fuel connection 12 follows the recess 28 of the locking element 14. If the pin 26 of the fuel connection 12 reaches the at least partly parallel part of the recess 28 of the locking element 14 the locking element 14 has to be turned in such way that after the turn the pin 26 of the locking element 14 is arranged underneath the second end 26 of the recess 28 of the locking element 14, with respect to figure 3. Then, the outer spring 16 presses the locking element 14 away from the pipe 8 in such a way that the second end 32 of the recess 28 of the locking element is pressed against the pin 26 of the fuel connection 12. So, the outer spring 16 enables a press fit of the locking element 14 to the fuel connection 12.

**[0023]** In this way, the locking element 14 and, respectively, the injector 6, are fixed to the fuel connection 12 by a positive fit and by a press fit. This contributes to a proper coupling of the injector 6 to the fluid supply in a very easy and very fast way. This contributes to low costs for manufacturing the connection assembly.

**[0024]** In an alternative embodiment (figure 4) the fuel connection 12 has a recess 40 (figure 5). Further, the locking element 14 has a pin 46 of the locking element 14.

**[0025]** The recess 40 of the fuel connection 12 extends from the rim 11 of the fuel connection 12 towards the pipe 8 and further at least partly parallel to the bottom portion of the fuel connection 12 and further towards the rim 11 of the fuel connection 12 to a second end 44 of the recess 40 of the fuel connection 12.

**[0026]** If the locking element 14 is assembled onto the fuel connection 12, the pin 46 of the locking element 14 is introduced into the recess 40 of the fuel connection 12. Then the outer spring 16 has to be compressed in such a way that the pin 46 of the locking element 14 arrives in the parallel part of the recess 40 of the fuel connection 12. Then, the locking element 14 has to be turned around its axis X in such a way that the pin 46 of the locking element 40 is arranged above the second end 44 of the locking element 14, with respect to figure 5. Then, the outer spring 16 may force the pin 46 of the locking element 14 against the second end 44 of the recess 40 of the fuel connection 12.

**[0027]** Preferably, an 0-ring seal 24 is arranged between the injector 6 and the fuel connection 12, in order to have a proper sealing between the injector 6 and the fuel connection 12.

**[0028]** The invention is not restricted by the explained embodiment. For example, the recesses of the fuel connection 12 and of the locking element 14 comprise alternative shapes. Further, the fuel connection 12 and/or the locking element 14 may comprise one or more pins. Further, the fuel connection 12 and/or the locking element 14 may comprise the pin 26 and the recess 28 of the fluid connection 12 and, respectively, the pin 46 and the recess 40 of the locking element.

## Claims

1. Coupling arrangement (10) for coupling an injector (6) to a fluid supply comprising

   - a fuel connection (12) which is cup-shaped having a bottom portion and a side portion, which is fixed to a pipe (8) of the fluid supply, and which communicates with the pipe (8) through a fuel opening (13) in the bottom portion of the fuel connection (12),
   - a locking element (14) which is cup-shaped comprising a rim (17), a bottom portion and a side portion and which is coupled to the fuel connection (12), at least a part of the side portions of the locking element (14) and of the fuel connection (12) forming an overlapping area,
   - an inner spring (18) which is arranged in the fuel connection (12) and which is fixed to the bottom portion of the fuel connection (12) at an axial end of the inner spring (18),
   - an outer spring (16) which is arranged intermediate the pipe (8) and the locking element (14), the outer spring (16) having a larger diameter than the inner spring (18) and the outer spring (16) forcing the locking element (14) away from the pipe (8),
   - at least one pin (26) of the fuel connection (12) which is arranged in the overlapping area at the fuel connection (12),
   - at least one recess (28) which is formed in the locking element (14) and which extends from the rim (17) of the locking element (14) towards the bottom portion of the locking element (14) and which further extends at least partly parallel to the bottom portion of the locking element (14) and which further extends towards the rim (17) of the locking element (14) to a second end (32) of the recess (28) of the locking element (14), the second end (32) of the recess (28) of the locking element (14) taking in the pin (26) of the fuel connection (12).

2. Coupling arrangement (10) in accordance with claim 1 with the locking element (14) having a bigger diameter than the fuel connection (12) and with the outer spring (16) being circumferentially arranged around an axial section of the fuel connection (12).

3. Coupling arrangement (10) for coupling an injector (6) to a fluid supply comprising

   - a fuel connection (12) which is cup-shaped having a rim (11), a bottom portion and a side portion, and which is fixed to a pipe (8) of the

fluid supply, and which communicates with the pipe (8) through a fuel opening (13) in the bottom portion of the fuel connection (12),

- a locking element (14) which is cup-shaped comprising a bottom portion and a side portion and which is coupled to the fuel connection (12), at least a part of the side portions of the locking element (14) and of the fuel connection (12) forming an overlapping area,
- an inner spring (18) which is arranged in the fuel connection (12) and which is fixed to the bottom portion of the fuel connection (12) at an axial end of the inner spring (18).
- an outer spring (16) which is arranged intermediate the pipe (8) and the locking element (14), the outer spring (16) having a larger diameter than the inner spring (18) and the outer spring (16) forcing the locking element (14) away from the pipe (8),
- at least one pin (46) of the locking element (14) which is arranged in the overlapping area at the locking element (14),
- at least one recess (40) of the fuel connection (12) which is formed in the fuel connection (12) and which extends from the rim (11) of the fuel connection (12) towards the bottom portion of the fuel connection (12) and which further extends at least partly parallel to the bottom portion of the fuel connection (12) and which further extends towards the rim (11) of the fuel connection (12) to a second end (44) of the recess (40) of the fuel connection (12), the second end (44) of the recess (40) of the fuel connection (12) taking in the pin (46) of the locking element (14).

**4.** Coupling arrangement (10) in accordance with claim 3 with the locking element (14) having a bigger diameter than the fuel connection (12) and with the outer spring (16) being circumferentially arranged around an axial section of the fuel connection (12).

**5.** Connection assembly for connecting an injector (6) to a fluid supply comprising the coupling arrangement (10) according to one of the preceding claims and a connecting section (20) of the injector (6), the connecting section (20) being radially surrounded by the locking element (14), protruding into the coupling arrangement (10) through an injector opening (15) in the bottom portion of the locking element (14), and having a fixation body (22) which is fixed to the connecting section (20) of the injector (6) and which has at least partly a larger diameter than the injector opening (15) of the bottom portion of the locking element (14).

**6.** Connection assembly in accordance with claim 5 with the injector opening (15) of the bottom portion of the locking element (14) and with at least a part of the connecting section of the injector (6) being formed and arranged in such a way, that the locking element (14) holds the injector (6) in its position respectively an rotation of the injector (6) around an axis (X) of the injector (6).

FIG 1

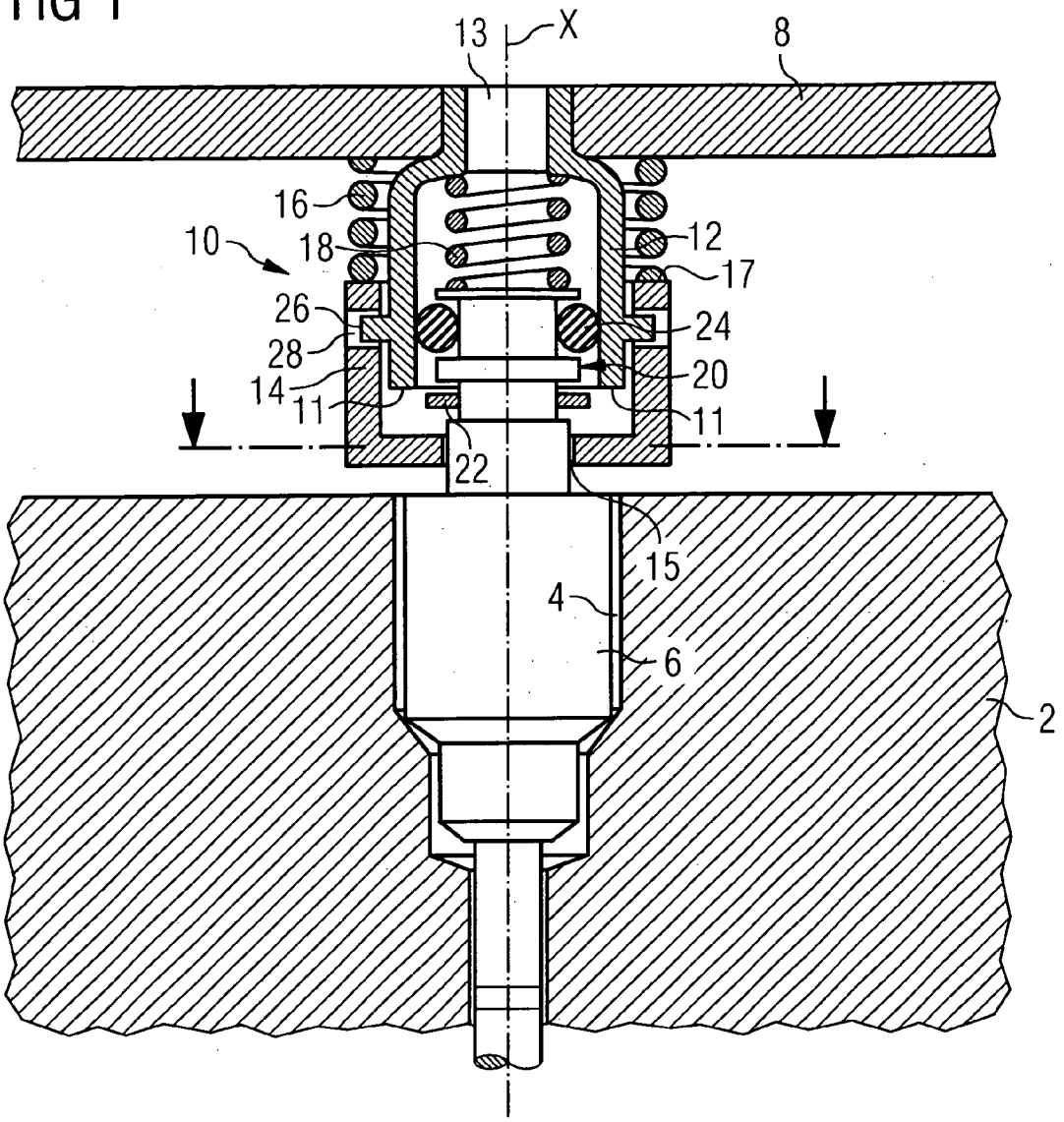



FIG 2

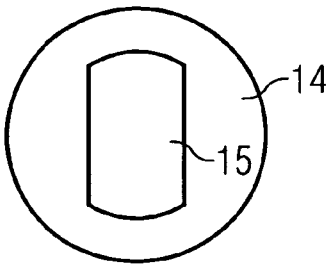



FIG 3

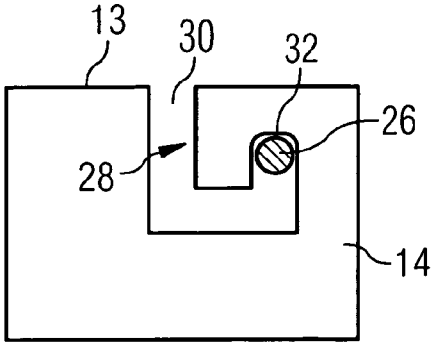


FIG 4

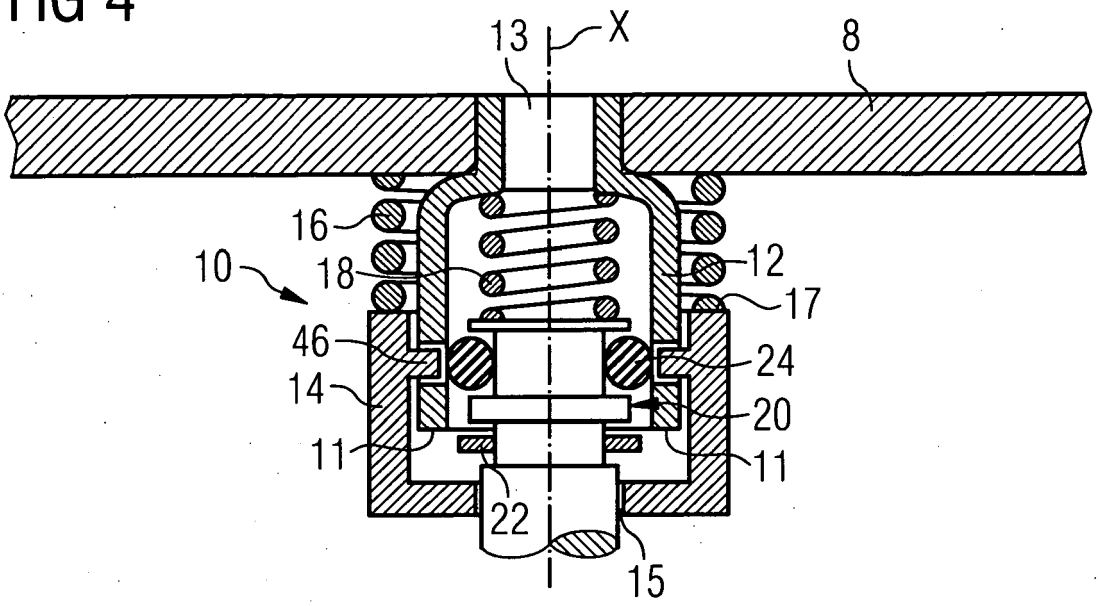
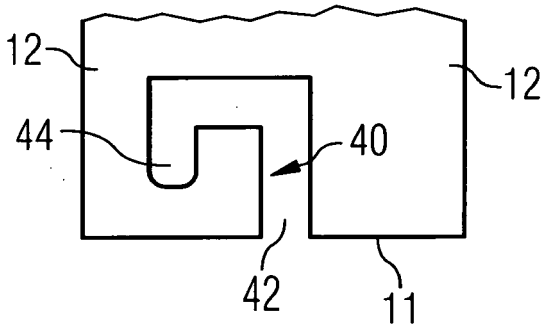



FIG 5



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Application Number
EP 06 01 1398

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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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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 4 August 2006 | Etschmann, G |

CATEGORY OF CITED DOCUMENTS

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## REFERENCES CITED IN THE DESCRIPTION

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