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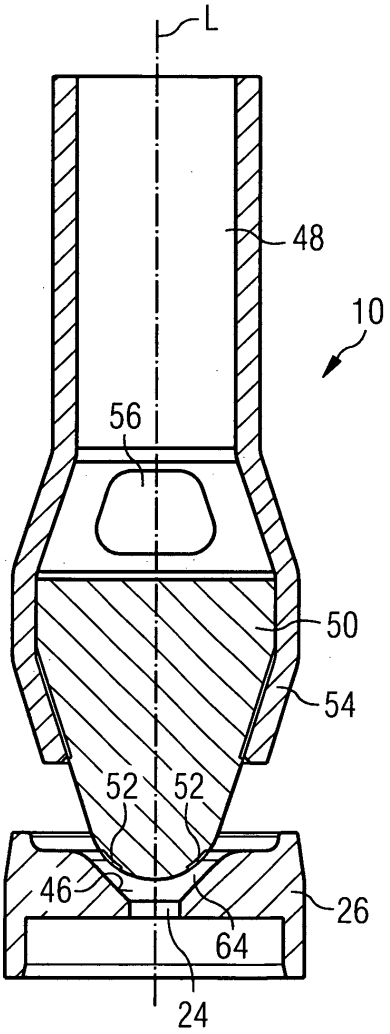
(54) **Valve assembly for an injection valve and injection valve**

(57) Valve assembly (60) of an injection valve (62), the valve assembly (60) comprising a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) with a fluid inlet portion (42), a fluid outlet portion (44) and a needle seat (46). The valve assembly further comprises a valve needle (10) axially movable in the cavity (8), the valve needle (10) comprising a shaft portion (48) and a seat part (50) with a sealing portion (52), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position in which the sealing portion (52) rests on the needle seat (46) and releasing the fluid flow through the fluid outlet portion (44) in further positions. The needle seat (46) consists of a first material and the sealing portion (52) consists of a second material being plastics, and the elasticity module of the first material is greater than the elasticity module of the second material.

FIG 2A



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Description

[0001] The invention relates to a valve assembly for an injection valve and an injection valve.

[0002] Injection valves are in widespread use, in particular for an internal combustion engine where they may be arranged in order to dose the fluid into an intake manifold of the internal combustion engine or directly into the combustion chamber of a cylinder of the internal combustion engine.

[0003] Injection valves are manufactured in various forms in order to satisfy the various needs for the various combustion engines. Therefore, for example, their length, their diameter, and all the various elements of the injection valve being responsible for the way the fluid is dosed may vary in a wide range. In addition to that, injection valves can accommodate an actuator for actuating a needle of the injection valve, which may, for example, be an electromagnetic actuator or a piezoelectric actuator.

[0004] In order to enhance the combustion process in view of degradation of unwanted emissions, the respective injection valve may be suited to dose fluids under very high pressures. The pressures may be in case of a gasoline engine, for example, in the range of up to 200 bar.

[0005] The object of the invention is to create a valve assembly for an injection valve and an injection valve which is simple to be manufactured and which facilitates a reliable and precise function.

[0006] This object is achieved by the features of the independent claim. Advantageous embodiments of the invention are given in the sub-claims.

[0007] The invention is distinguished by a valve assembly of an injection valve, the valve assembly comprising a valve body including a central longitudinal axis, the valve body comprising a cavity with a fluid inlet portion, a fluid outlet portion and a needle seat. The valve assembly further comprises a valve needle axially movable in the cavity, the valve needle comprising a shaft portion and a seat part with a sealing portion, the valve needle preventing a fluid flow through the fluid outlet portion in a closing position in which the sealing portion rests on the needle seat and releasing the fluid flow through the fluid outlet portion in further positions. The needle seat consists of a first material and the sealing portion consists of a second material being plastics, and the elasticity module of the first material is greater than the elasticity module of the second material.

[0008] This has the advantage, that different parts of the valve needle can be better adapted according to the particular requirements. The seat part of the valve needle may be better adapted to prevent a fluid flow through the fluid outlet portion in a closing position of the valve needle if deformations and surface roughness of the sealing portion of the seat body occur. Furthermore, in the case of misalignments of the valve needle relative to the valve body, a compensation of the misalignment is possible and consequently, a fluid flow through the fluid outlet portion in a closing position of the valve needle can be prevented. Additionally, it is possible to apply small axial forces on the valve needle because of the good elastic deformability of the seat part of the valve needle. This can result in a good dynamic performance of the injection valve by the reduction of transient effects. Consequently, fast responses of the injection valve are possible which enable a linear performance of the valve needle movement.

[0009] In an advantageous embodiment of the invention, the shaft portion is coupled to the seat part by a positive fitting coupling. This allows a mechanically stable coupling between the shaft portion and the seat part.

[0010] In a further advantageous embodiment of the invention, the shaft portion and the seat part are coupled by a crimp coupling. This has the advantage that crimping is a very reliable connection method.

[0011] In a further advantageous embodiment of the invention, the shaft portion comprises a shaft portion cavity in which the seat part is arranged. This has the advantage that the seat part of the valve needle may be positioned very exactly relative to the shaft portion.

[0012] In a further advantageous embodiment of the invention, the sealing portion consists of a rubber. Rubber is a plastics with a low elasticity module and allows a low-cost solution. Preferably, the sealing portion consists of viton (Registered Trade Mark). Viton is a synthetic rubber and a fluoropolymer elastomer which has a high stability against aggressive chemicals like fuels.

[0013] In a further advantageous embodiment of the invention, the seat part comprises a surface layer which consists of plastics. This makes it possible to obtain a simple construction of the sealing portion on the surface of the seat part of the valve needle as the sealing portion is comprised in the surface layer. Preferably, the seat part of the valve needle is built up by applying a thin surface layer of rubber on the seat part which otherwise consists of a harder material.

[0014] In a further advantageous embodiment of the invention, the seat part of the valve needle comprises a double lipped sealing arrangement. By this, a good sealing of the arrangement of the seat part of the valve needle and the needle seat of the seat body can be obtained by preventing a fluid flow between the fluid inlet portion and the fluid outlet portion when the seat part rests on the needle seat.

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

Figure 1, an injection valve in a longitudinal section view,

figure 2a, a first embodiment of a valve assembly of the injection valve in a longitudinal section view,

figure 2b, a second embodiment of the valve assem-

bly of the injection valve in a longitudinal section view,

figure 3, a valve assembly of the injection valve in a side view, and

figure 4, a further embodiment of the valve assembly of the injection valve in a longitudinal section view.

[0016] Elements of the same design and function that appear in different illustrations are identified by the same reference characters.

[0017] An injection valve 62 (figure 1) that is in particular suitable for dosing fuel to an internal combustion engine comprises an inlet tube 2, a housing 6 and a valve assembly 60.

[0018] The valve assembly 60 comprises a valve body 4 with a central longitudinal axis L and a cavity 8 which takes in a valve needle 10 and preferably a part of an armature 12. In the inlet tube 2, a recess 16 is provided which further extends to a recess 18 of the armature 12. A spring 14 is arranged in the recess 16 of the inlet tube 2 and/or the recess 18 of the armature 12. Preferably, it rests on a spring seat being formed by an anti-bounce disk 20. By this, the spring 14 is mechanically coupled to the needle 10. An adjusting tube 22 is provided in the recess 16 of the inlet tube 2. The adjusting tube 22 forms a further seat for the spring 14 and may be axially moved during the manufacturing process of the fluid injection valve in order to preload the spring 14 in a desired way.

[0019] In a closing position of the valve needle 10, it sealingly rests on a needle seat 46 of a seat body 26, by this preventing a fluid flow through at least one injection nozzle 24. The injection nozzle 24 may be, for example, an injection hole. However, it may also be of some other types suitable for dosing fluid. The seat body 26 may be made in one part with the valve body 4 or be a part separate from the valve body 4. In addition to that, a lower guide 28 for guiding the needle 10 and a swirl disk 30 is provided.

[0020] The fluid injection valve is provided with an actuator unit 40 that comprises preferably an electromagnetic actuator comprising a coil 36 which is preferably overmolded. A valve body shell 38, the armature 12 and the inlet tube 2 are forming an electromagnetic circuit. The actuator unit 40 may, however, also comprise another type of actuator, which is known to persons skilled in the art for that purpose. Such an actuator may be, for example, a piezoelectric actuator.

[0021] A fluid inlet portion 42 is provided in the valve body 4 which communicates with a fluid outlet portion 44 which is part of the cavity 8 near the seat body 26.

[0022] As can be seen in figures 2a to 4, the valve needle 10 comprises a hollow shaft portion 48 and a seat part 50. The shaft portion 48 has a shaft end portion 54 and an orifice 56 which enables a fluid flow from the inside area of the hollow shaft portion 48 to the cavity 8 of the valve body 4. The seat part 50 comprises a sealing portion 52.

[0023] The shaft end portion 54 forms a shaft portion cavity in which the seat part 50 is arranged. At its ends, the shaft end portion 54 is bended to obtain an exact fixing of the seat part 50 in the shaft end portion 54. By this, an exact positioning of the seat part 50 relative to the shaft portion 48 is possible. The coupling between the shaft portion 48 and the seat part 50 may be realized by crimping the shaft end portion 54 so that it is bended inwards. It is obvious that any other method for coupling the seat part 50 with the shaft portion 48 may be applied as well as long as an exact positioning of the seat part 50 relative to the shaft portion 48 and a rigid coupling of the seat part 50 with the shaft portion 48 may be obtained.

[0024] The shaft portion 48 comprises a metal. Preferably, it consists of a metal. The sealing portion 52 of the seat part 50 consists of plastics. In case of deformations and surface roughness of the sealing portion 52 of the seat part 50 the use of rubber for the seat part 50 of the valve needle 10 allows a good adaptation of the seat part 50 of the valve needle 10 if it is in contact with the seat body 26 in the area of the needle seat 46. Furthermore, if the valve needle 10 is misaligned relative to the valve body 4, in particular if the seat part 50 is misaligned relative to the seat body 26, it is possible to compensate the deviation between these two parts in the case the seat part 50 of the valve needle 10 is of plastics. Therefore, good sealing properties can be obtained and a fluid flow through the fluid outlet portion 44 in a closing position of the valve needle 10 can be prevented.

[0025] Additionally, only small axial forces for the movement of the valve needle 10 are necessary as the seat part 52 of the valve needle 10 is elastically well deformable. By this, a good dynamic performance may be obtained due to small transient effects. This allows a fast response of the injection valve which enables a linearity of the injection valve performance.

[0026] In the valve assembly 60 shown in figure 2a the seat part 50 preferably consists of a rubber. In a preferred embodiment, the rubber is viton (Registered Trade Mark), which is a rubber with a high resistiveness against fluids such as fuels thereby enabling a long cycle time of the injection valve.

[0027] Figure 2b shows the valve assembly 60 wherein the seat part 50 comprises a surface layer 51 which preferably consists of a rubber. Preferably, the rubber is viton (Registered Trade Mark). The further sections of the seat part 50 can consist of a further material, for example, a metal or a further plastics. The surface layer comprises the sealing portions 52.

[0028] Figure 4 shows an embodiment of the invention with a sealing arrangement 58 which has two sealing lips. The sealing arrangement 58 with the two sealing lips improves the sealing capability of the arrangement of the seat part 50 and the needle seat 46 of the seat body 26. By this, a fluid flow between the fluid inlet portion 42 and the fluid outlet portion 44 is prevented when the seat part 50 rests on the needle seat 46.

[0029] In the following, the function of the injection valve is described in detail:

[0030] The fluid is led from the inlet tube 2 to the hollow valve needle 10 and then through the orifice 56 in the shaft portion 48 to the fluid outlet portion 44.

[0031] The spring 14 forces the valve needle 10 via the anti-bounce disk 20 towards the actuator unit 40. In the case when the actuator unit 40 is de-energized the spring 14 can force the valve needle 10 to move in axial direction in its closing position. It is depending on the force balance between the force on the valve needle 10 caused by the actuator unit 40 and the force on the valve needle 22 caused by the spring 14 whether the valve needle 10 is in its closing position or not.

[0032] In the closing position of the valve needle 10 the seat part 50 of the valve needle 10 sealingly rests on the needle seat 46 of the seat body 26 and consequently prevents a fluid flow through the fluid outlet portion 44 and the injection nozzle 24. The use of plastics for the sealing portion 52 can result in a good sealing between the needle seat 46 of the seat body 26 and the sealing portion 52 of the valve needle 10.

[0033] In the case that the actuator unit 40 gets energized, the actuator unit 40 may effect a force on the valve needle 10. The valve needle 10 is able to move in axial direction out of the closing position. Outside of the closing position of the valve needle 10, there is a gap 64 between the seat body 26 and the valve needle 10 at an axial end of the valve needle 10 facing away from the shaft portion 40 of the valve needle 10. This enables a fluid flow through the injection nozzle 24.

Claims

1. Valve assembly (60) of an injection valve (62), the valve assembly (60) comprising

- a valve body (4) including a central longitudinal axis (L), the valve body (4) comprising a cavity (8) with a fluid inlet portion (42), a fluid outlet portion (44) and a needle seat (46),
- a valve needle (10) axially movable in the cavity (8), the valve needle (10) comprising a shaft portion (48) and a seat part (50) with a sealing portion (52), the valve needle (10) preventing a fluid flow through the fluid outlet portion (44) in a closing position in which the sealing portion (52) rests on the needle seat (46) and releasing the fluid flow through the fluid outlet portion (44) in further positions,

wherein the needle seat (46) consists of a first material and the sealing portion (52) consists of a second material being plastics, and the elasticity module of the first material is greater than the elasticity module of the second material.

2. Valve assembly (60) in accordance with claim 1 with the shaft portion (48) being coupled to the seat part (50) by a positive fitting coupling.

3. Valve assembly (60) in accordance with claim 1 or claim 2 with the shaft portion (48) and the seat part (50) being coupled by a crimp coupling.

4. Valve assembly (60) in accordance with one of the preceding claims with the shaft portion (48) comprising a shaft portion cavity in which the seat part (50) is arranged.

5. Valve assembly (60) in accordance with one of the preceding claims with the sealing portion (52) consisting of a rubber.

6. Valve assembly (60) in accordance with one of the preceding claims with the seat part (50) comprising a surface layer (51) consisting of plastics.

7. Valve assembly in accordance with one of the preceding claims with the seat part (50) comprising a double lipped sealing arrangement (58).

8. Injection valve (62) with a housing (6), an actuator unit (40) and a valve assembly (60) according to one of the preceding claims.

FIG 1

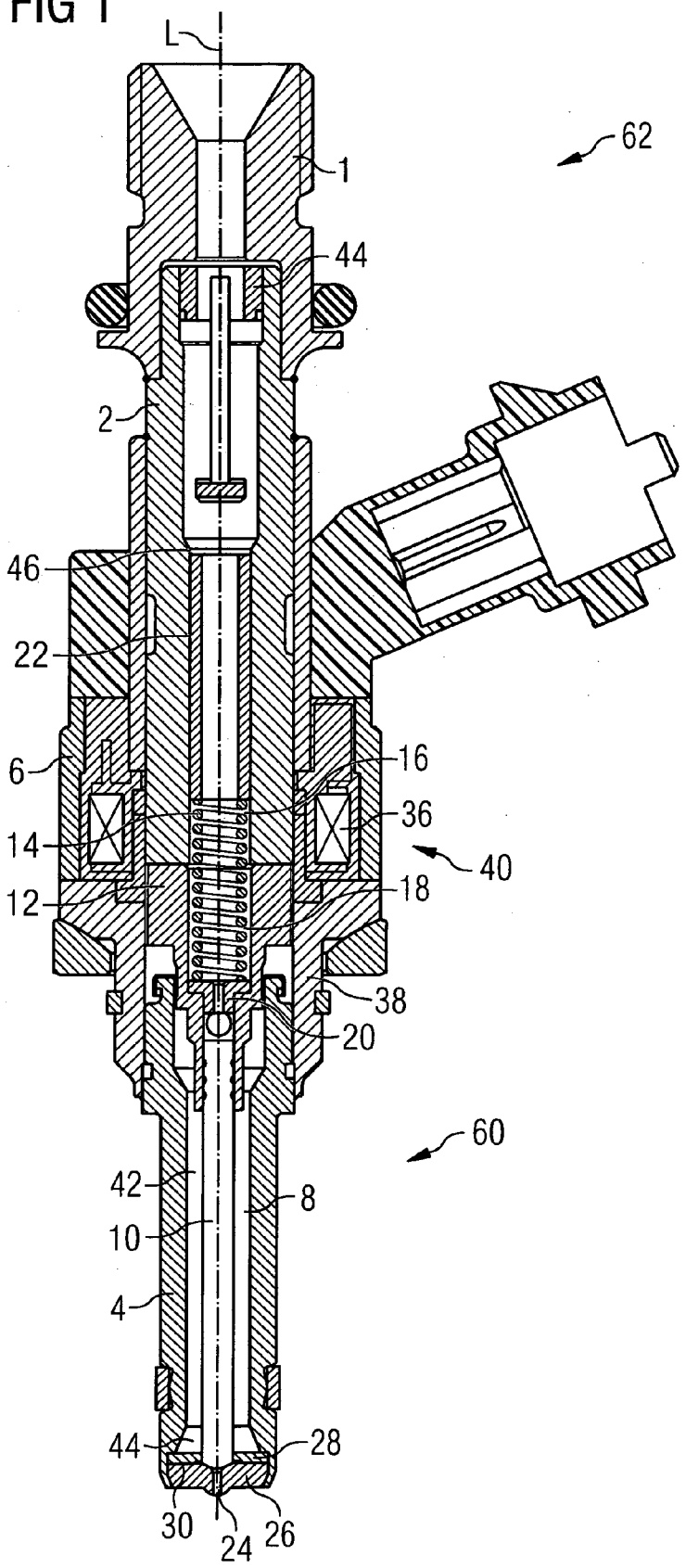


FIG 2A

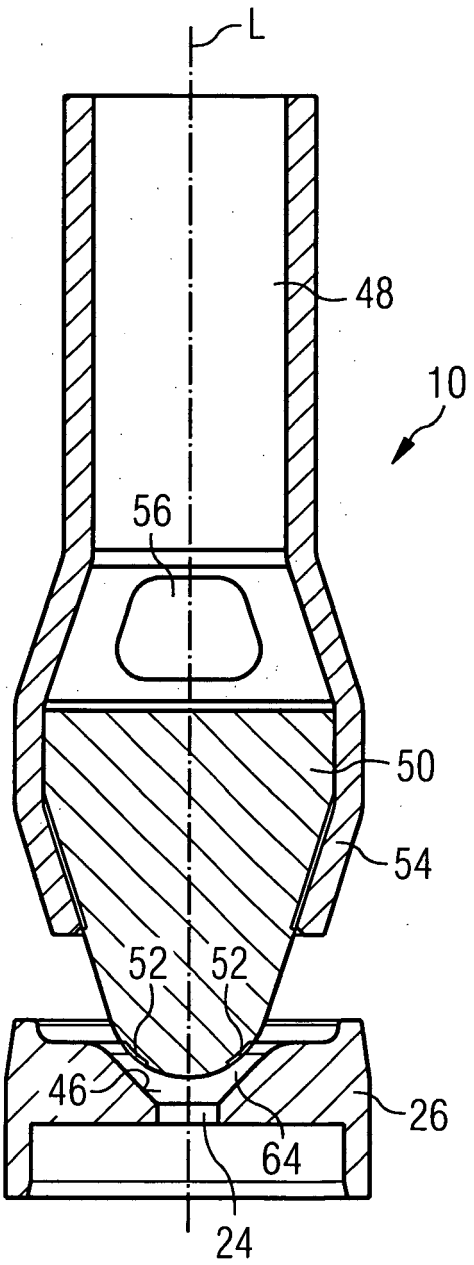


FIG 2B

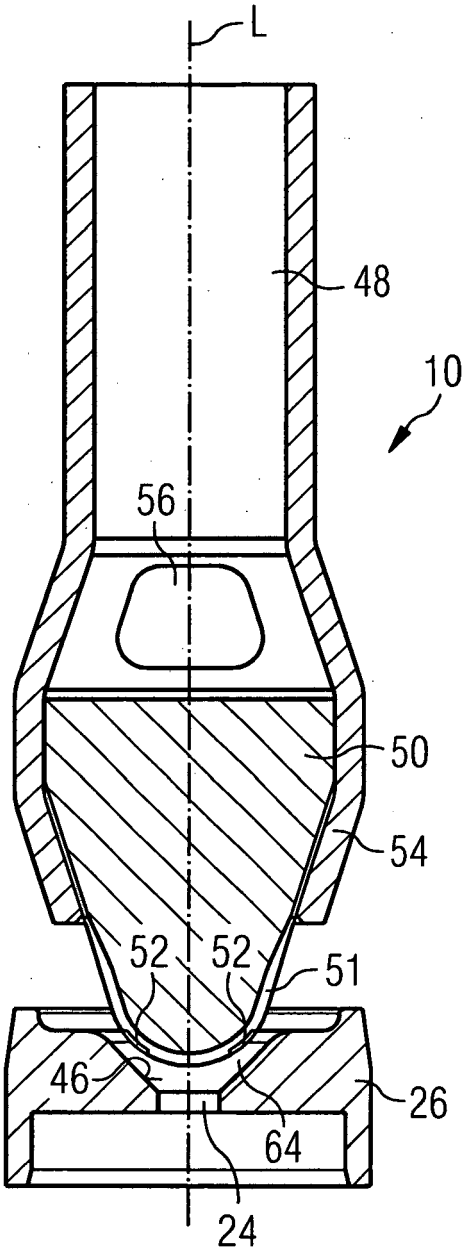


FIG 3

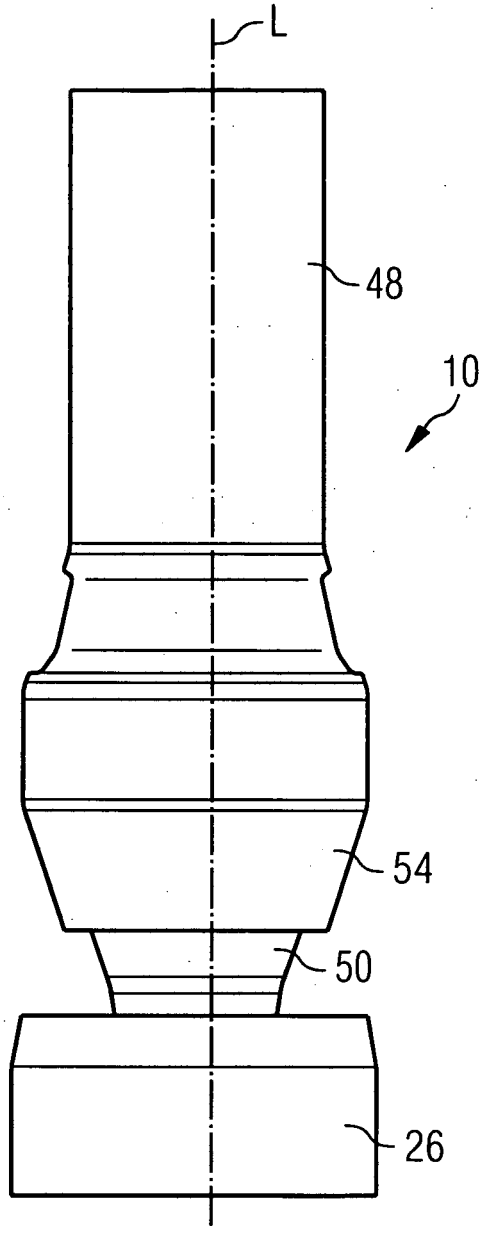
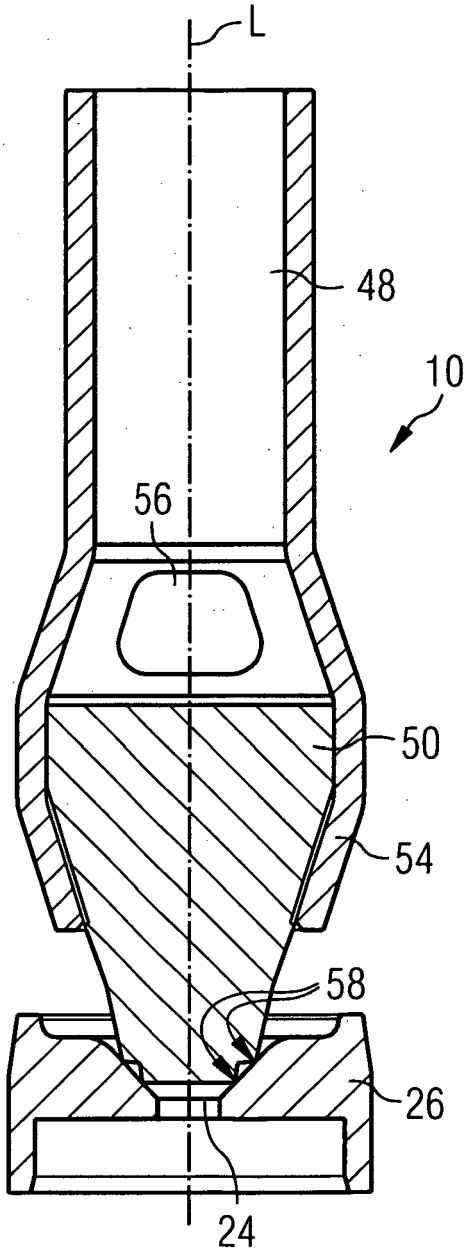


FIG 4



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EUROPEAN SEARCH REPORT

Application Number
EP 06 00 2244

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	WO 2004/040125 A (ROBERT BOSCH GMBH; HAFNER, UDO; HANS, WALDEMAR; BRENNER, FRANK; MILLER) 13 May 2004 (2004-05-13) * figures 1-10 *	1-8	INV. F02M61/04 F02M61/16
A	DE 195 03 224 A1 (ROBERT BOSCH GMBH, 70469 STUTTGART, DE) 8 August 1996 (1996-08-08) * figures 1-5 *	1	

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	27 June 2006	Morales, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 00 2244

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2004040125 A	13-05-2004	EP 1561027 A1	10-08-2005
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