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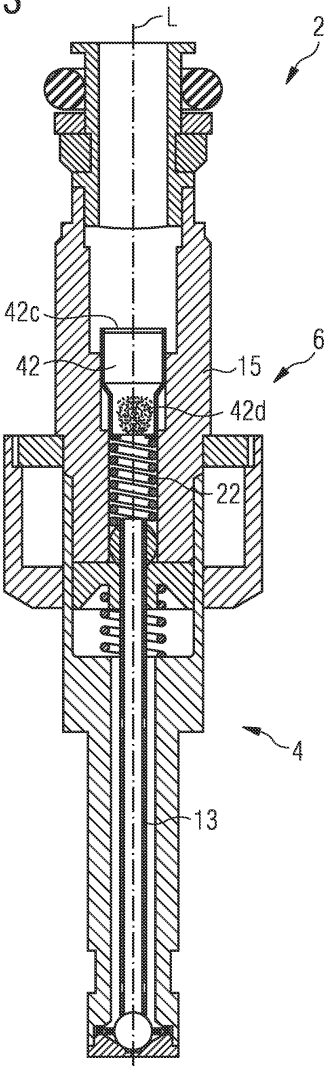
(54) Adjusting fuel filter assembly and injection valve

(57) An adjusting fuel filter assembly for an injection valve comprises an external bush (42c) including a central longitudinal axis (L') and a circumferential step (42e) being arranged orthogonal to said axis (L'), said circumferential step (42e) segmenting the external bush (42c) into an upper section (42c') and into a lower section (42c"), whereby an outer diameter of the upper section (42c') is greater than an outer diameter of the lower section (42c"), and an internal filter material (42d), arranged within at least a part of said lower section (42c") and being of sintered material. The injection valve comprises a central longitudinal axis (L), a fuel inlet tube (15) with an inner surface, an actuator unit (6), and a valve assembly (4) including a valve needle (13). The injection valve further comprises said adjusting fuel filter assembly (42), whereby at least a part of the upper section (42c') of the external bush (42c) is either directly or indirectly engaged with said inner surface of the fuel inlet tube (15).

FIG 3



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Description

[0001] The invention relates to an adjusting fuel filter 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 be, for example, 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 high pressures. The pressures may be in case of a gasoline engine, for example, in the range of up to 200 bar, and in case of a diesel engine, in the range of 2000 bar, and above.

[0005] In addition, in order to enhance the combustion process, an injection valve normally comprises a fuel filter for filtering the fluid, and it also comprises an adjusting member for adjusting the maximal calibration spring load of the injection valve. Filtering the fuel is necessary for keeping possible impurities of the fuel off from the needle and off from the injection nozzle. For these purposes it is known to provide a so-called adjusting fuel filter assembly comprising three parts: a frame, a bush, and a screen. Such an adjusting fuel filter assembly cooperates with a spring, which preloads the valve needle. However, creating such an adjusting fuel filter assembly is rather complicated, and therefore expensive.

[0006] The object of the invention is to create an adjusting fuel filter assembly for an injection valve and an injection valve which is simple to be manufactured and which facilitates a reliable and precise function.

[0007] This object is achieved by the features of the independent claims. Advantageous embodiments of the invention are given in the sub-claims.

[0008] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are as follows:

Figure 1, a traditional injection valve with a traditional adjusting fuel filter assembly, in a longitudinal section view,

Figure 2, an enlarged and detailed view of the traditional adjusting fuel filter assembly of the traditional injection valve in a perspective view,

Figure 3, an embodiment of an injection valve including an adjusting fuel filter assembly, both of the invention,

Figure 4, an enlarged and detailed view of an embodiment of the adjusting fuel filter assembly according to the invention, in a perspective view,

Figure 4a, the external bush of the embodiment of Fig. 4 in a cross sectional view,

Figure 5, an embodiment of the internal filter material of the adjusting fuel filter assembly according to the invention, and

Figure 6, another embodiment of an injection valve including the adjusting fuel filter assembly, both of the invention,

[0009] Elements of the same design and function that appear in different illustrations are identified by the same reference characters.

[0010] An injection valve 2, as shown in Fig. 1, that is in particular suitable for dosing fuel to an internal combustion engine, generally comprises, among others, a fuel inlet tube 15, an actuator unit 6, and a valve assembly 4 including a valve needle 13. The valve needle 13 is arranged along a central longitudinal axis L of the injection valve 2 and it can be moved within the valve assembly 4 along said central longitudinal axis L.

[0011] The injection valve 2 of Fig. 1 additionally comprises a traditional adjusting fuel filter assembly 42, arranged within the fuel inlet tube 15. Its purpose is, on the one hand, to filter incoming fuel, and, on the other hand, to cooperate with a main spring 22, also being arranged within the fuel inlet tube 15. The main spring 22 is arranged between the adjusting fuel filter assembly 42 and the valve needle 13, and it is mechanically coupled to the valve needle 13 and to the adjusting fuel filter assembly 42 to exert a force onto the valve needle 13 in the direction of said central longitudinal axis L. In this way an adjusting fuel filter arrangement can be established.

[0012] As can be seen from Fig. 2, the traditional adjusting fuel filter assembly 42 consists of a frame 42a, an external bush 42c, which may be made of stainless steel, and of a screen 42b for filtering the fuel. The screen 42b is made of nylon and it may be adapted to filter contamination out from the fuel having a size of more than 30 μm in diameter. The screen 42b is fixed to the frame 42a.

[0013] When manufacturing the injection valve 2, within a calibration procedure the adjusting fuel filter assembly 42 is axially moved along said central longitudinal axis L in order to exert a force onto the valve needle 13 in the direction of said central longitudinal axis L. This is to preload the main spring 22 with a desired amount of

spring force. Thus the maximum amount of needle lift of the valve needle 13 can be precisely calibrated, which is essential for minimizing occurrence of waste gas as much as possible. This calibration procedure is done by coupling the external bush 42c of the adjusting fuel filter assembly 42 to an inner surface of the fuel inlet tube 15 by interference at a desired, given position of said inner surface.

[0014] Fig. 3 shows a first embodiment of an injection valve 2 according to the present invention, comprising the adjusting fuel filter assembly 42 also according to the present invention. This new and inventive adjusting fuel filter assembly 42 consists of an external bush 42c and an internal filter material 42d. The external bush 42c is made of a stainless material, especially of stainless steel. The internal metallic filter material 42d is also of a stainless material. It is advantageous to have it made of sintered material like ceramic powder, plastic powder, steel powder or of wire mesh, and with a porosity, which allows filtering fuel impurities in the range of 2 μm and larger (for instance 60 μm).

[0015] In Figs. 4, 4a and 5 this adjusting fuel filter assembly 42 is shown in more details: Fig. 4 shows the external bush 42c in a perspective view (the internal filter material 42d cannot be seen in this view) and Fig. 4a shows the external bush 42c in a longitudinal section. The external bush 42c comprises a longitudinal axis L' and a circumferential step 42e. The circumferential step 42e is arranged orthogonal to said longitudinal axis L'. It segments the external bush 42c into an upper section 42c' and into a lower section 4c", whereby an outer diameter of the upper section 42c' is greater than an outer diameter of the lower section 4c". The internal filter material 42d is shown in Fig. 5. It is arranged within in the lower section 4c" of the external bush 42c.

[0016] In the embodiment of Fig. 3 the adjusting fuel filter assembly 42 is arranged within the fuel inlet tube 15, whereby at least a part of the upper section 42c' of the external bush 42c is directly engaged with an inner surface of the fuel inlet tube 15, for instance by interference.

[0017] Fig. 6 shows another embodiment of the injection valve according to the invention. This embodiment differs from the embodiment of Fig. 3 only insofar, as there is fixed an adjusting tube 40 within the fuel inlet tube 15, and the adjusting fuel filter assembly 42 is engaged within this adjusting tube 40, so that an outer surface of the adjusting tube 40 is engaged with the inner surface of the fuel inlet tube 15, and an inner surface of the adjusting tube 40 is directly engaged with at least a part of the outer surface of the upper section 42c' of the external bush 42c of the adjusting fuel filter assembly 42.

[0018] It is also possible (not shown in the drawing) to have made both, the fuel inlet tube 15 and the adjusting tube 40, made of one piece by providing the fuel inlet tube 15 with a step, whereby that part of the fuel inlet tube 15, which is arranged below the step, has a smaller diameter than that part of the fuel inlet tube 15, which is arranged above the step, and whereby that part of the fuel inlet tube 15, which is arranged below the step, acts as the adjusting tube 40.

[0019] The subject matters of the invention have the advantages, beyond the advantages already described, that they are better protected against aggressive fuel, that they show a simplified shape, and that they are of reduced dimensions, compared with the respective subject matters of the prior art, in each case.

[0020] A further advantage of the adjusting fuel filter assembly 42 is that the internal filter material 42d also has dampening properties. Pressure pulsations and drops of pressure, occurring with the fuel pressure, when the fuel is passing through the filter material 42d, is reduced and minimized significantly by using said internal filter material 42d.

Claims

1. Adjusting fuel filter assembly for an injection valve, comprising:

   - an external bush (42c) including a central longitudinal axis (L') and a circumferential step (42e) being arranged orthogonal to said axis (L'), said circumferential step (42e) segmenting the external bush (42c) into an upper section (42c') and into a lower section (42c"), whereby an outer diameter of the upper section (42c') is greater than an outer diameter of the lower section (42c"), and
   - an internal filter material (42d), arranged within at least a part of said lower section (42c") and being of a stainless material.

2. Adjusting fuel filter assembly according to claim 1, **characterized in that** the external bush (42c) is made of stainless steel.

3. Adjusting fuel filter assembly according to claim 1 or 2, **characterized in that** the internal filter material (42d) is sintered material, in particular made from stainless steel powder, plastic powder or ceramic powder.

4. Adjusting fuel filter assembly according to claim 1 or 2, **characterized in that** the internal filter material (42d) is wire mesh.

5. Injection valve comprising

   - a central longitudinal axis (L),
   - a fuel inlet tube (15) with an inner surface,
   - an actuator unit (6), and
   - a valve assembly (4) including a valve needle (13), **characterized by** an adjusting fuel filter assembly (42) according to one of the preceding

claims,

- whereby at least a part of the upper section (42c') of the external bush (42c) is either directly or indirectly engaged with said inner surface of the fuel inlet tube (15).

6. Injection valve according to claim 5, **characterized in that** the engagement of the external bush (42c) with the inner surface of the fuel inlet tube (15) is given by an adjusting tube (40) arranged within the fluid inlet tube (15) and which comprises the adjusting fuel filter assembly (42), whereby the inner surface of the fluid inlet tube (15) is directly engaged with an outer surface of the adjusting tube (40), and whereby an inner surface of the adjusting tube (40) is directly engaged with said part of the upper section (42c') of the external bush (42c).

7. Injection valve according to claim 5, **characterized in that** the fuel inlet tube (15) is provided with a step, whereby the engagement of the external bush (42c) with the inner surface of the fuel inlet tube (15) takes place below the step, seen in a direction towards the needle (13), so that that part of the fuel inlet tube (15), which is arranged below said step, acts as an adjusting tube (40).

8. Injection valve according to any of claims 5 to 7, **characterized in that** the engagement of the external bush (42c) is made by interference.

FIG 1

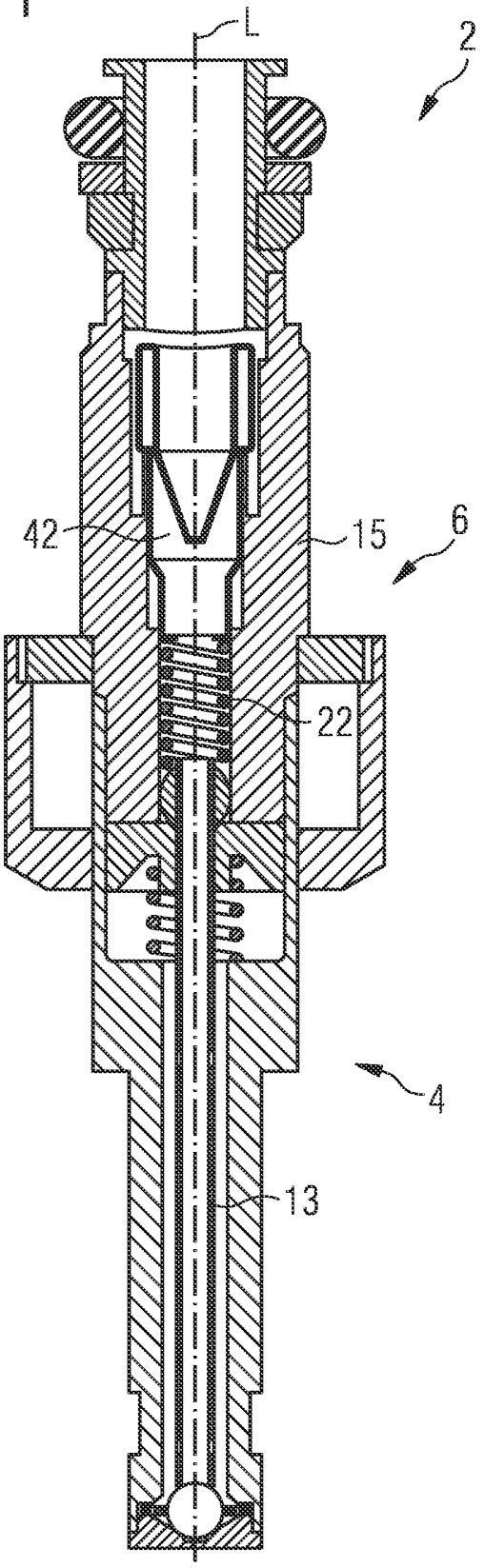


FIG 2

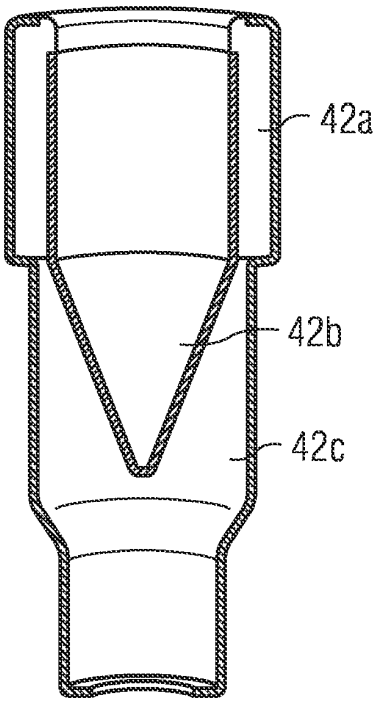


FIG 4

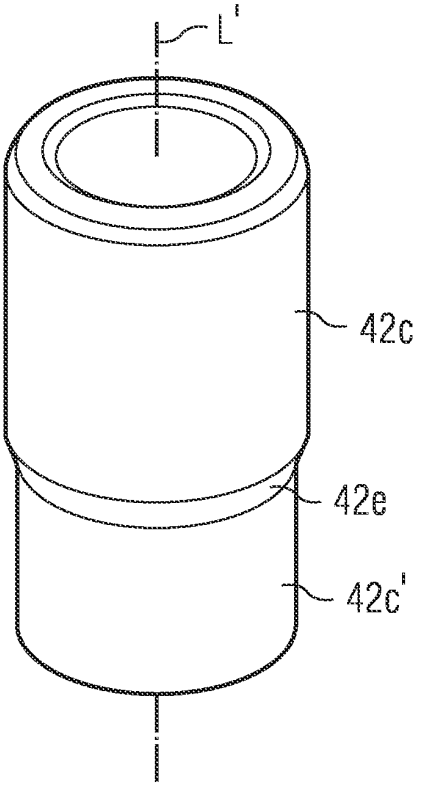


FIG 4a

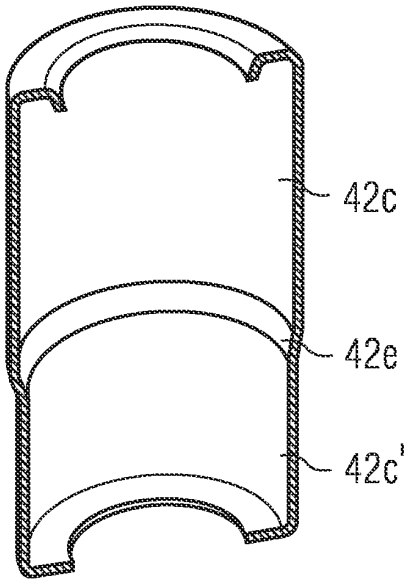


FIG 5

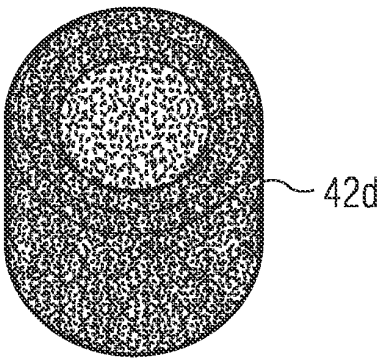


FIG 3

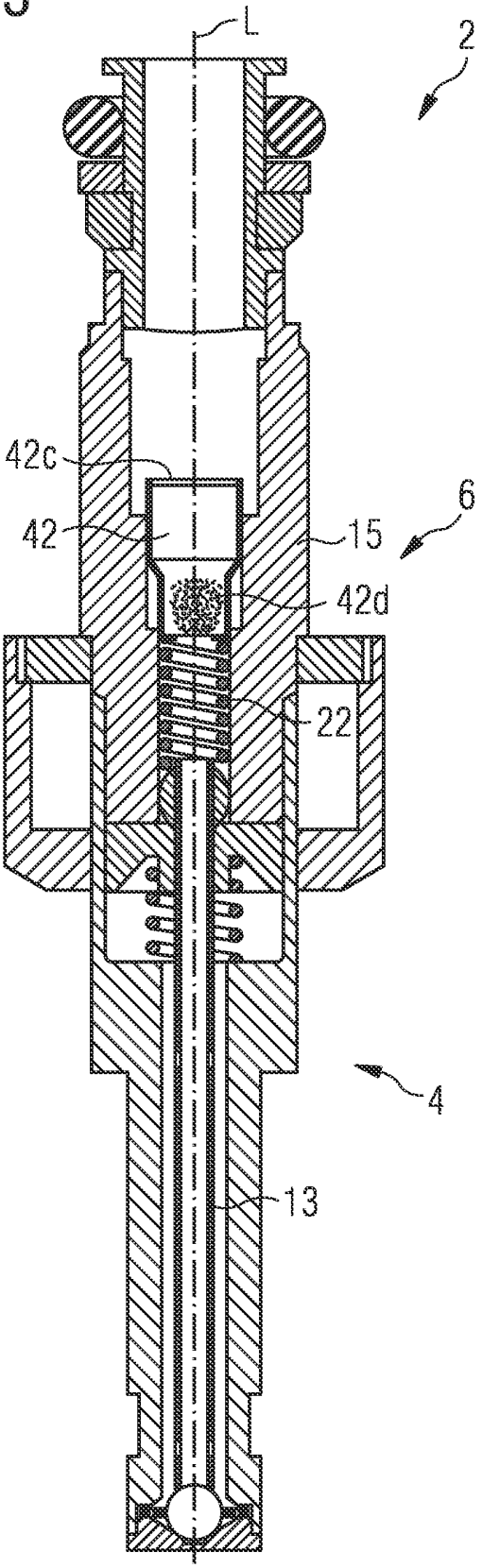
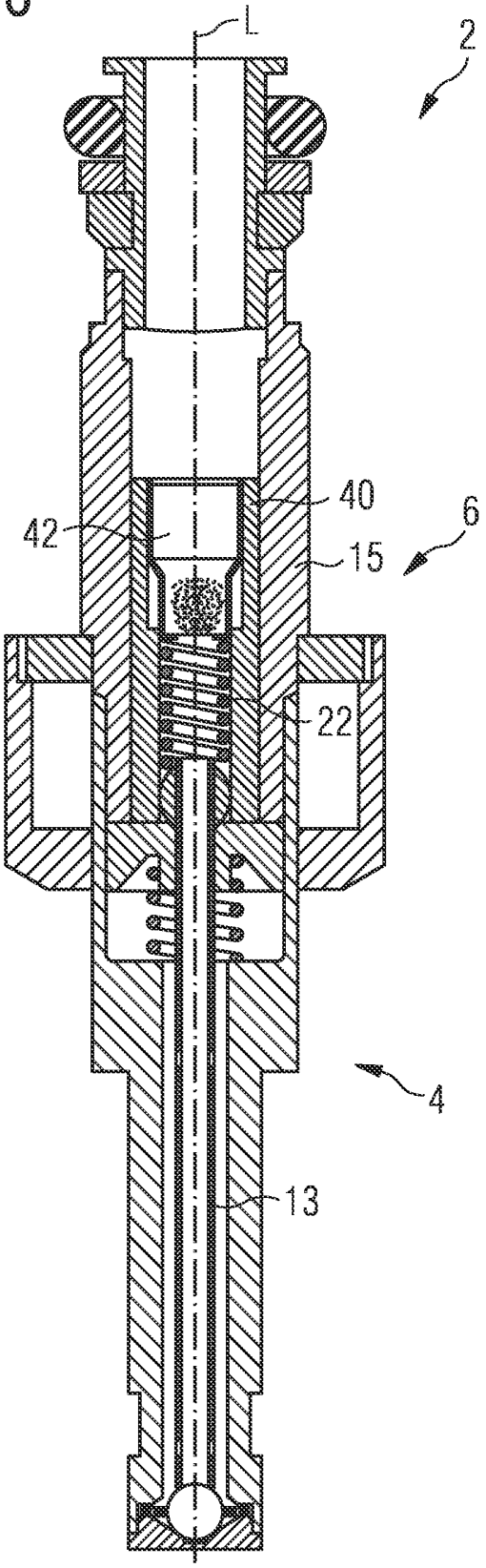


FIG 6



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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 5059

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	DE 10 2007 049963 A1 (BOSCH GMBH ROBERT [DE]) 23 April 2009 (2009-04-23) * page 3, paragraph 0016; figures 1,2 *	1,5	
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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	8 December 2010	Etschmann, Georg

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