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(54) **Protection mean for the nozzle of an injector**

(57) A protection mean (40) for the nozzle (24) of a multi-port fuel injector (12) is axially (X) arranged in the mounting bore (16) of the cylinder head of a direct injection combustion engine (10). The bore (16) opens in a combustion chamber (18), the tip point (22) of the injector (12) being its nozzle (24) set to deliver pressurized fuel. The protection mean (40) axially extends beyond the nozzle (24) to prevent said nozzle (24) from being in direct contact with lateral gas motions (A) created by pressure differences occurring inside the combustion chamber (16).

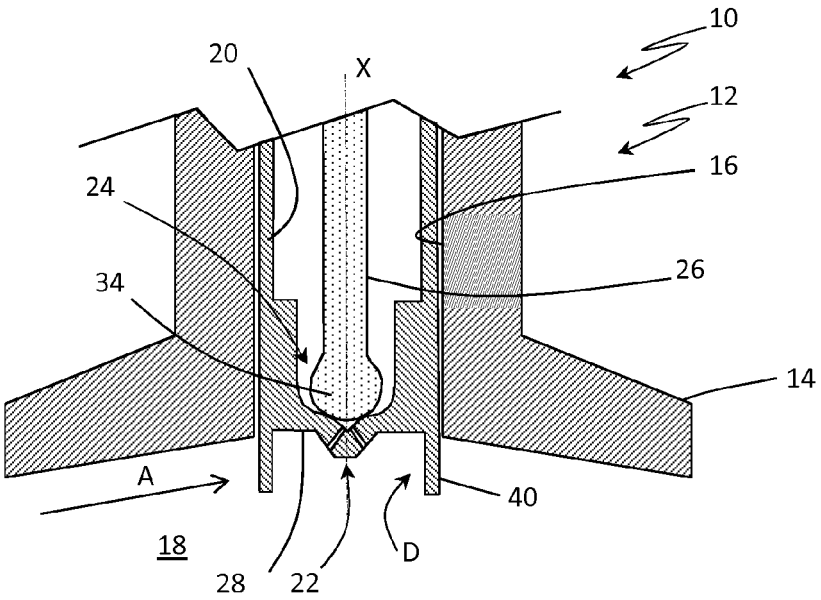

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates generally to a fuel injector and a protection mean preventing soot deposit on its nozzle.

BACKGROUND OF THE INVENTION

[0002] A direct injection engine has adopted a configuration in which a fuel multi-port injector is mounted into a mounting port in a cylinder head, and fuel is injected directly into a cylinder from a nozzle at the tip of this fuel injector. After the injection, the nozzle closes as a pintle inside the body of the injector axially translates and abuts against the inner face of the nozzle. A minor quantity of liquid fuel remains captured in the continuous volume defined by the injection ports connected to the volume, known as the sac volume, which is inside the injector under the extremity of the pintle. In the chamber motions of gas occurs in the chamber resulting from pressure differences between various zones of the chamber. The nozzle is then laterally hit by some gas. Pictorially, one could say the nozzle has a luv side, hit by the burned gas, and an opposite lee side. Consequently the liquid fuel present in the ports opening on the luv side is pushed back in toward the sac volume and, consequently, some unburned liquid fuel exits from the ports opening on the lee side, said fuel settling on the nozzle. This fuel oxidises in an oxygen-poor environment leaving some amounts of soot clinging to the nozzle. With the multitude of such events the soot then accumulates and forms a deposit layer on the nozzle which, in turn allows more fuel to be deposited in there. This accumulation of soot goes against an optimum operation mode of the engine.

SUMMARY OF THE INVENTION

[0003] The present invention aims at solving the above mentioned problem. For this purpose, it is proposed a protection mean for the nozzle of a multi-port fuel injector axially arranged in the mounting bore of the cylinder head of a direct injection combustion engine. The bore opens in a combustion chamber, the tip point of the injector being its nozzle set to deliver pressurized fuel in the combustion chamber. The protection mean axially extends beyond the nozzle to prevent said nozzle from being in direct contact with lateral gas motions created by pressure differences occurring inside the combustion chamber.

[0004] Particularly, the protection mean is a shielding wall extending inside the combustion chamber and providing a protection to the nozzle of the injector. The shielding wall is a cylindrical tube arranged around the nozzle. The cylindrical tube may have a circular section.

[0005] The protection mean can be a standalone component arranged and fixed to the cylinder head for instance in the mounting bore, or fixed to the injector.

[0006] Also, the protection mean can be integral with the injector body and can extend beyond the nozzle in order to surround it and protect it.

[0007] Furthermore, the protection mean may be integral with the cylinder head extending inside the combustion chamber so that when the injector is arranged in the mounting bore, the protection mean surrounds and protects its nozzle.

[0008] The protection axially extends beyond the tip point of the injector by a distance 0.1 to 5 mm. I a preferred embodiment the extension is limited to 2 to 3 mm.

[0009] Alternatively, the injector can be entirely arranged inside the mounting bore, the protection mean being the final section of the bore which axially extends beyond the nozzle into the combustion chamber.

[0010] The invention is also related to a fuel injector for a direct injection combustion engine, the injector comprising a protection mean for its nozzle from being in direct contact with lateral gas motions created by pressure differences occurring inside the combustion chamber. The protection mean is as previously described.

[0011] The invention is further related to an internal combustion engine provided with a fuel injector which nozzle is protected by a protection mean as previously described.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention is now described by way of example with reference to the accompanying drawings in which:

- Figure 1 is a partial cross-section view showing schematically the arrangement of an injector in a cylinder head according to the invention;
- Figure 2 is an alternative arrangement as figure 1.
- Figure 3 is a magnified detail of the nozzle of the injector of Figures 1 or 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] As per the figures, an in-cylinder type gasoline engine 10 is provided with an in-cylinder multi-port fuel injector 12 according to a preferred embodiment of the present invention.

[0014] An internal combustion engine (gasoline engine) 10 is mainly composed of a cylinder block (not shown) and a cylinder head 14. The cylinder head 14 has a mounting bore 16 which extends into a combustion chamber 18 along a main axis X.

[0015] In the following description, the main axis X will be orientated vertically from the bottom to the top, which corresponds to the orientation of the figures, without limiting purpose.

[0016] It has to be noted that the figures show only the lower half portion of the injector 12.

[0017] The fuel injector body 20 is axially inserted in

the mounting bore 16, the tip portion 22 of the fuel injector 12, which comprises a nozzle 24, extending toward the combustion chamber 18. Inside its body 20, the fuel injector 12 comprises a pintle 26 which is axially reciprocally movable in order to control opening and closing of the nozzle 24.

[0018] According to the embodiment shown, the tip portion 22 of the injector has a tubular shape closed at its lower end by a transversal wall 28 that axially deflects toward the chamber 18 in a conical shape 30. The deflection 30 is provided with a plurality of ports 32 enabling the pressurized fuel to be expelled from the inside of the injector body 20 to the combustion chamber 18.

[0019] The pintle 26 has a spherical extremity 34 that closes the nozzle 24 by abutting against the inner face of the deflection 30 along a circular closed line 36 set above the ports 32. As detailed on Figure 3, when the nozzle 24 is closed, a volume defined by the ports 32 and a sac volume 38 keeps captured a small quantity of liquid fuel. The sac volume 38 is defined as the small volume which is below the spherical extremity 34 and the inner tip of the deflection 30. Alternative geometries of the pintle and deflection exist and can benefit from the present invention.

[0020] In a preferred embodiment sketched in Figure 1, the injector body 20 axially extends beyond the nozzle 24 in a tubular cylinder 40 that surrounds the nozzle 24. It is known that the combustion chamber 18 has zones of different pressures and, the pressure differences generate lateral gas motion in the chamber 18 symbolized on the Figures 1 and 2 by the arrow A. The cylinder 40 provides a protection mean for the nozzle 24 so that it is not in direct contact with said lateral gas motion A. The nozzle 40 is substantially flush with the inner face of the combustion chamber 18. The protection mean 40 extends inside de combustion chamber 18 on a distance D that can be up to 5 mm. In a preferred embodiment the distance D is from 2 to 3 mm. According to the preferred embodiment just described, the protection mean 40 is integral to the injector body 20.

[0021] In an alternative embodiment, the protection mean 40 is a standalone component fixed in the wall of the chamber 18, for instance partially inserted in the mounting bore and partially extending out in the chamber. In another alternative embodiment, the mean is integral to the cylinder head and arranged so that when the injector is set, the protection mean protects the nozzle.

[0022] Whatever preceding choice is made, the protection mean 40 previously described as a cylinder tube can be given other shapes according to the in-cylinder design and to the resulting gas motions. For instance the portion extending in the combustion chamber 18 may be a portion of cylinder or a simple flat wall protecting just one side of the injector. This may be sufficient to protect the nozzle 24 from being in direct contact with said lateral gas motion F.

[0023] Another protection mean 40 for the nozzle 40 may be provided by the mounting bore 16 itself. In this alternative, the fuel injector 12 is arranged back inside the bore 16 leaving free a final section 42 of the bore, section extending from the tip of the injector 22 to the opening of the bore 16 in the combustion chamber 18.

Claims

1. Protection mean (40) for the nozzle (24) of a multiport fuel injector (12) axially (X) arranged in the mounting bore (16) of the cylinder head of a direct injection combustion engine (10), the bore (16) opening in a combustion chamber (18), the tip point (22) of the injector (12) being its nozzle (24) set to deliver pressurized fuel in the combustion chamber (18) wherein the protection mean (40) axially extends beyond the nozzle (24) to prevent said nozzle (24) from being in direct contact with lateral gas motions (A) created by pressure differences occurring inside the combustion chamber (16).

2. Protection mean (40) as set in the preceding claim wherein the mean (40) is a shielding wall (40) extending inside the combustion chamber (18) and providing a protection to the nozzle (24) of the injector (12).

3. Protection mean (40) as set in claim 2 wherein the shielding wall (40) is a cylindrical tube arranged around the nozzle (24).

4. Protection mean (40) as set in claim 3 wherein the cylindrical tube has a circular section.

5. Protection mean (40) as set in any of the preceding claim wherein the mean (40) is a standalone component arranged and fixed to the cylinder head for instance in the mounting bore (16), or fixed to the injector (12).

6. Protection mean (40) as set in any of the claim 1 to 4 wherein the mean is integral with the injector body (20) and extends beyond the nozzle (24) in order to surround it and protect it.

7. Protection mean (40) as set in any of the claim 1 to 4 wherein the mean is integral with the cylinder head extending inside the combustion chamber (18) so that when the injector (12) is arranged in the mounting bore (16), the protection mean (40) surrounds and protects its nozzle (24).

8. Protection mean (40) as set in any of the preceding claim wherein the mean axially extends beyond the tip point (22) of the injector (12) by a distance (D) of 0.1 to 5 mm.

9. Protection mean (40) as set in claim 1 wherein the

injector (12) is entirely arranged inside the mounting bore (16), said mean being the final section (42) of the bore (16) which axially extends beyond the nozzle (24) into the combustion chamber (18).

10. Fuel injector (12) for a direct injection combustion engine (10) comprising a protection mean (40) for its nozzle (24) from being in direct contact with lateral gas motions (A) created by pressure differences occurring inside the combustion chamber (16), the protection mean (40) being as set in any of the preceding claim.

11. Internal combustion engine (10) provided with a fuel injector (12) which nozzle (24) is protected by a protection mean (40) as set in any of the claims 1 to 9.

Fig. 1

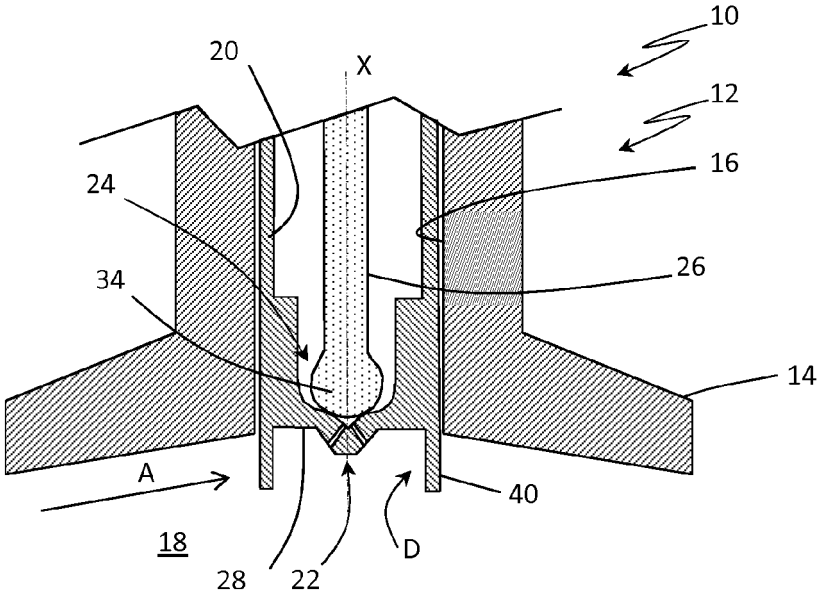


Fig. 2

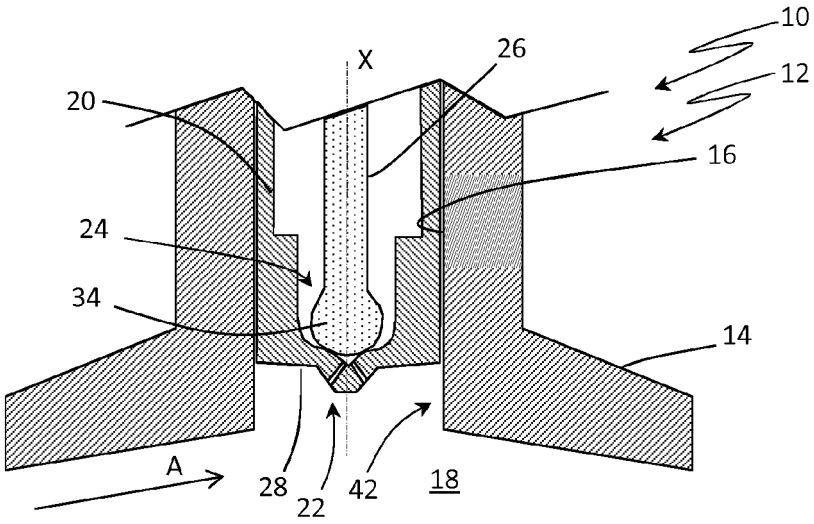
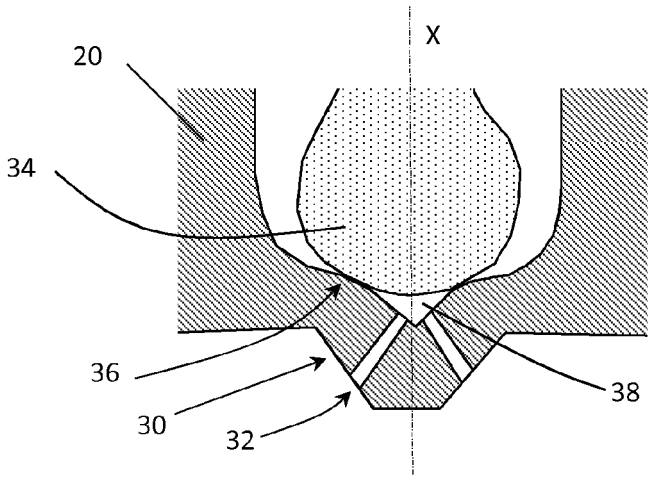


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 8032

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 398 497 A2 (DENSO CORP [JP]) 17 March 2004 (2004-03-17) * paragraphs [0004], [0005], [0017]; figures 2,13 * * abstract *	1-8,10, 11	INV. F02M53/04 F02F1/24 F02M61/14 F02M61/18 F02M61/16
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X	JP 2003 003930 A (DENSO CORP) 8 January 2003 (2003-01-08) * abstract; figures 1,2,3 *	1-6,10, 11	
X	WO 03/002867 A1 (BOSCH GMBH ROBERT [DE]; DANTES GUENTER [DE]; NOWAK DETLEF [DE]) 9 January 2003 (2003-01-09) * page 6, line 20 - page 7, line 23; figure 2 * * abstract *	1-5,10, 11	
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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
The Hague	26 April 2013	Hermens, Sjoerd

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 15 8032

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