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(54) **Improved control valve arrangement**

(57) A fuel injector has a body (10) and a pintle (12) axially movable with respect to the body in upper (18) and lower (20) guides, and limited by an end stop (26). The guides (18,20) are mounted in a support (30) spaced from the body (10) and immersed, in use, in fuel. Differential expansion of the pintle (112) with respect to the spacing between the spray aperture (16) and the end stop (26) is minimised.

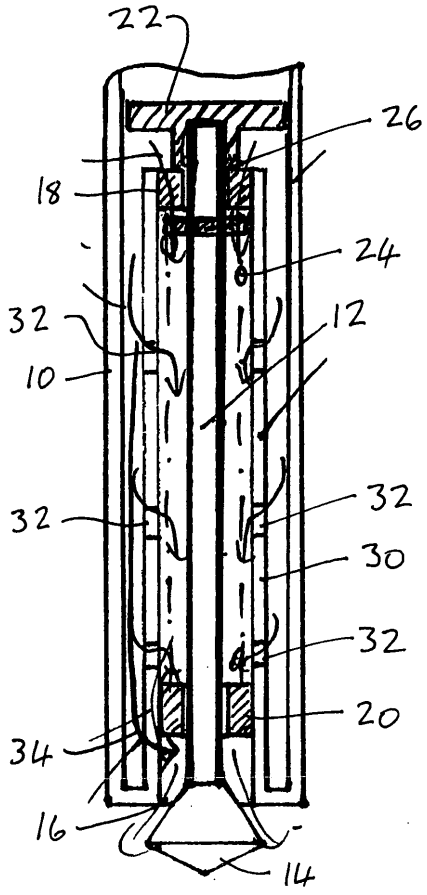


Fig. 2

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Description

[0001] This invention relates to fuel injectors for internal combustion engines, and in particular outwardly opening solenoid actuated fuel injectors for direct injection of gasoline.

[0002] One known type of fuel injector is that having an outwardly opening pintle, biased towards the closed position by a spring and opened by an actuator such as a solenoid or piezo-stack. The pintle is typically slidable within upper and lower guides, and its opening is limited by an end stop which is typically the top surface of the upper guide.

[0003] Due to packaging constraints of the injector tip, the pintle has to be relatively long. During engine operation the injector housing heats up and expands. The pintle however is cooled by the flow of fuel around it and does not show a similar expansion. The difference in expansion leads to a decrease in stroke, which shifts the fuel delivery characteristic in the lean direction. During engine operation the pintle is typically cooled to the fuel temperature of approximately 50°C, while the injector housing can be heated to a temperature of over 100°C. This temperature difference between the injector housing and the pintle can cause a reduction in pintle stroke of more than 20μm.

[0004] Figure 1 shows diagrammatically a prior art approach to dealing with this problem. The injector has a body 10 and a pintle 12 having an external head 14 which is sealingly engageable with a spray aperture 16 of the body 10. The pintle 12 is axially movable in upper and lower guides 18 and 20 by an actuator 22 such as the armature of a solenoid. A return spring 24 biases the pintle 12 to the closed position. An end stop 26 on the pintle 12 cooperates with the upper surface of the upper guide 18 to limit extension of the pintle 12.

[0005] In order to ameliorate the temperature differential between the body 10 and the pintle 12, a swirler (not seen in Figure 1) is placed in the fuel flow path so as to induce swirling of the fuel, as indicated at 28. This promotes heat transfer between the body 10 and the pintle 12 and thus reduces the temperature differential discussed above.

[0006] However, in this prior art injector the largest part of the available fuel pressure is dissipated in the swirler and is not available in the valve group for spray atomisation.

[0007] The present invention provides a fuel injector comprising an injector body having a tip portion defining a spray aperture; a pintle extending within the tip portion; guide means within the tip portion guiding the pintle for axial movement between an extended and a retracted position, the pintle having an external head engageable with the spray aperture in said retracted position to seal the spray aperture; resilient means biasing the pintle to said retracted position; actuating means for selectively moving the pintle into said extended position; and an end stop engageable with the pintle to limit the extension of the pintle;
and is characterised in that the end stop is mounted on a support extending within the housing from a location adjacent the spray aperture and spaced from the housing so as to be, is use, substantially surrounded by fuel.

[0008] Preferred features and advantages of the invention will be apparent from the claims and from the following description.

[0009] An embodiment of the invention will now be described, by way of example only, with reference to the drawings, in which:

Figure 1 is a cross-section of a prior art fuel injector, as discussed above; and
Figure 2 is a cross section of a fuel injector forming one embodiment of the present invention.

[0010] In Figure 2, parts which are similar to those of Figure 1 are denoted by like reference numerals and will not be further described. A support 30 in the form of a tube extends from a location adjacent the spray aperture 16 axially within the body 10. The upper and lower pintle guides 18, 20 are secured to the support 30. The support 30 is cooled by flow of fuel around it with the result that the support 30 and the pintle 12 are at approximately the same temperature. Thus, the spacing between the supports 18, 20 is affected by approximately the same thermal expansion and contraction as the pintle 12, and a reduction in pintle stroke is avoided.

[0011] The support 30 may be provided with apertures 32 above the lower pintle guide 20 to permit fuel to flow both around and inside the support 30. Alternatively, the apertures 32 may be omitted, and apertures (not shown in Figure 2) may be provided below the lower pintle guide 20 to permit fuel to flow as indicated at 34 to the spray aperture 16.

[0012] Having the support 30 in the form of a tube is preferred for reasons of simplicity and ease of manufacture. However, other forms of internal support for the pintle guides could be used. Other modifications may be made to the foregoing embodiment within the scope of the claims.

Claims

1. A fuel injector comprising an injector body (10) having a tip portion defining a spray aperture (16); a pintle (12) extending within the tip portion; guide means (18,20) within the tip portion guiding the pintle (12) for axial movement between an extended and a retracted position, the pintle (12) having an external head (14) engageable with the spray aperture (16) in said retracted position to seal the spray aperture (16); resilient means (24) biasing the pintle (12) to said retracted position; actuating means (22) for selectively moving the pintle (12) into said extended position; and an end stop (26) engageable with the

pintle (12) to limit the extension of the pintle (12); **characterised in that** the end stop (26) is mounted on a support (30) extending within the housing (10) from a location adjacent the spray aperture (16) and spaced from the housing (10) so as to be, in use, substantially surrounded by fuel.

2. A fuel injector according to claim 1, in which the guide means comprises upper (18) and lower (20) guides mounted on said support (30).

3. A fuel injector according to claim 2, in which the end stop (26) is formed by an upper surface of the upper guide (18).

4. A fuel injector according to claim 2 or claim 3, in which the support comprises a tube (30) extending coaxially within the body (10).

5. A fuel injector according to claim 4, in which said tube is (30) apertured (32) between the upper (18) and lower (20) guides to form a flow path for fuel.

6. A fuel injector according to claim 4, in which said tube (30) is apertured below the lower guide (20) to form a flow path for fuel.

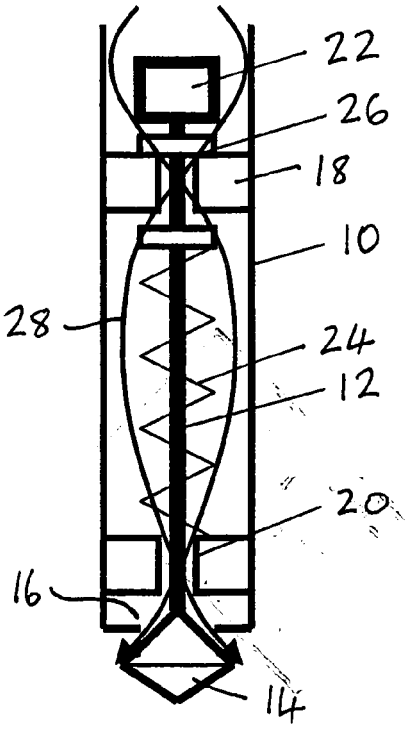

22
26
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Fig. 1

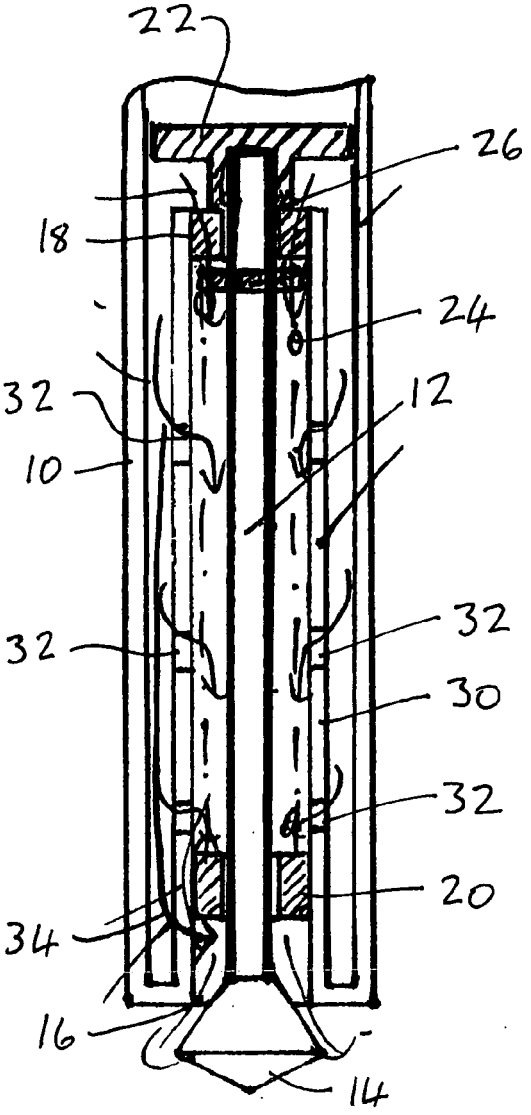

22
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Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 25 1832

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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	7 June 2006	Etschmann, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 25 1832

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82