(12) UK Patent Application (19) GB (11) 2 132 268 A

(21) Application No **8331870**
(22) Date of filing **29 Nov 1983**
(30) Priority data
(31) **8236393**
(32) **22 Dec 1982**
(33) **United Kingdom (GB)**
(43) Application published
4 Jul 1984
(51) **INT CL³**
F02M 61/08
(52) Domestic classification
F1B 2J15A2 2J15B2
2J15B3
(56) Documents cited
GB 0765415
GB 0761424
GB 0736264
GB 0467948
GB 0271562
(58) Field of search
F1B
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(54) **Fuel injection nozzle**

(57) A valve member has a valve head 20 shaped to co-operate with a seating 19 defined at the end of a bore 18 in a nozzle body. Secured to the body is a shroud 28 which defines an outlet opening 31 and the valve member 20 has an extension 32 which extends within the opening to define a clearance therewith. The diameters of the opening and the extension are smaller than those of the head and seating.

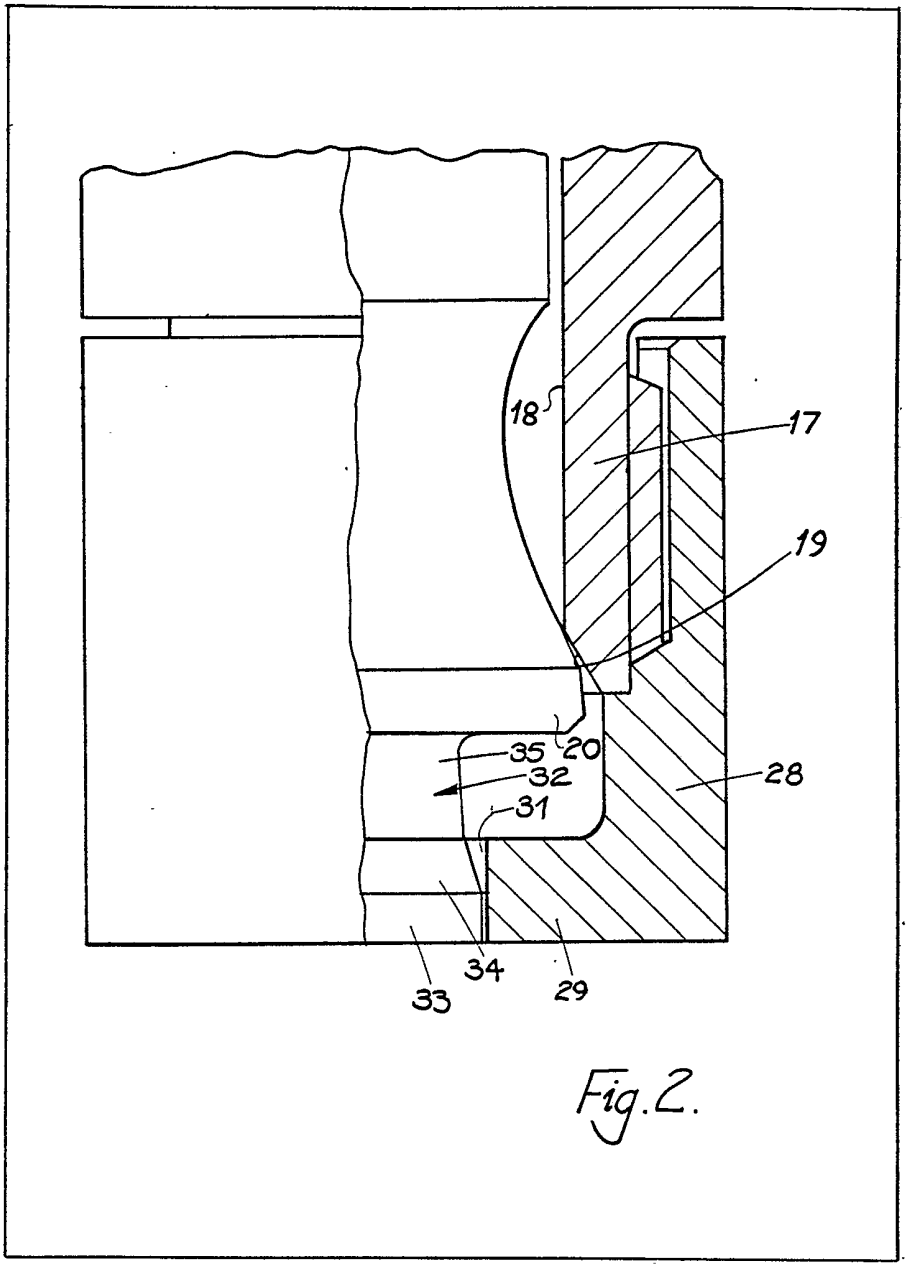

Fig. 2.

GB 2 132 268 A

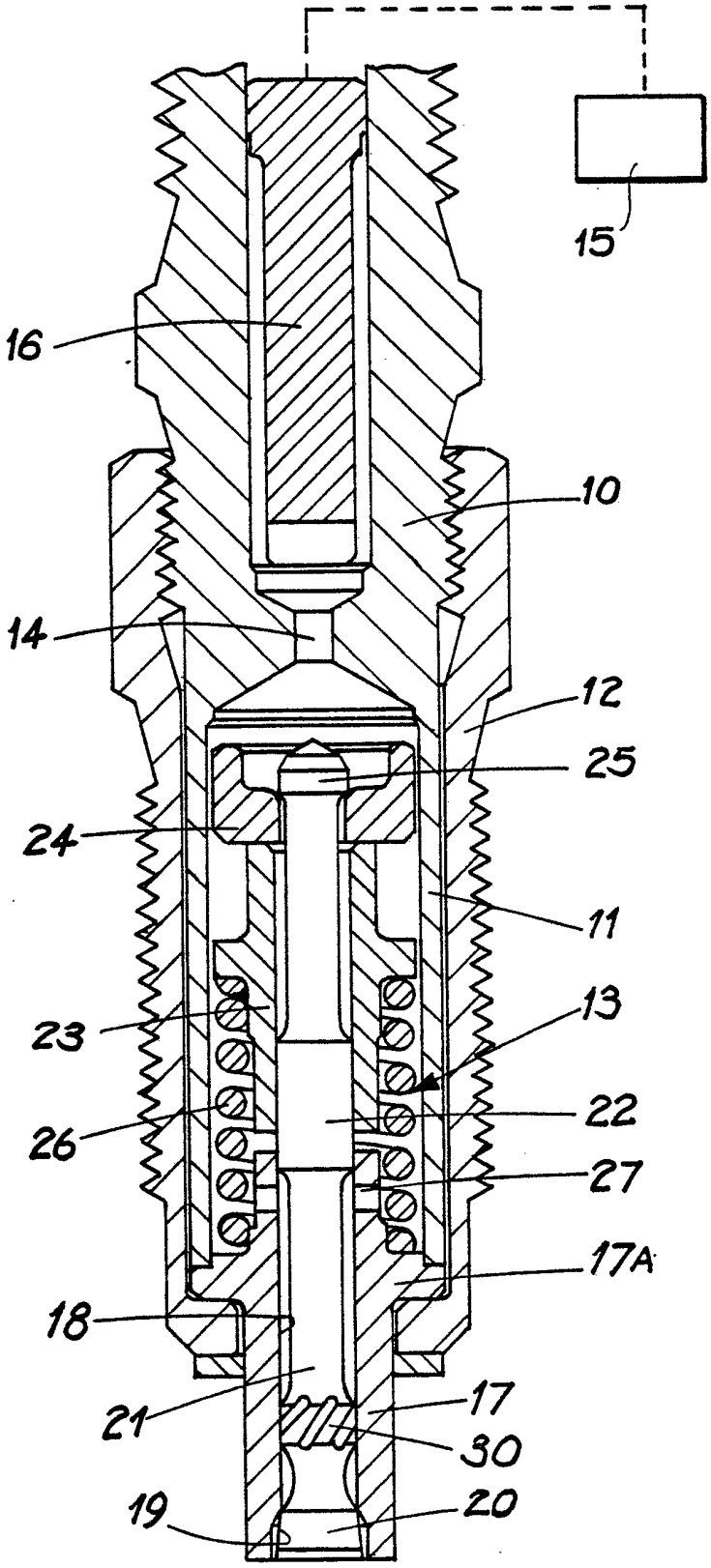

Fig.1.

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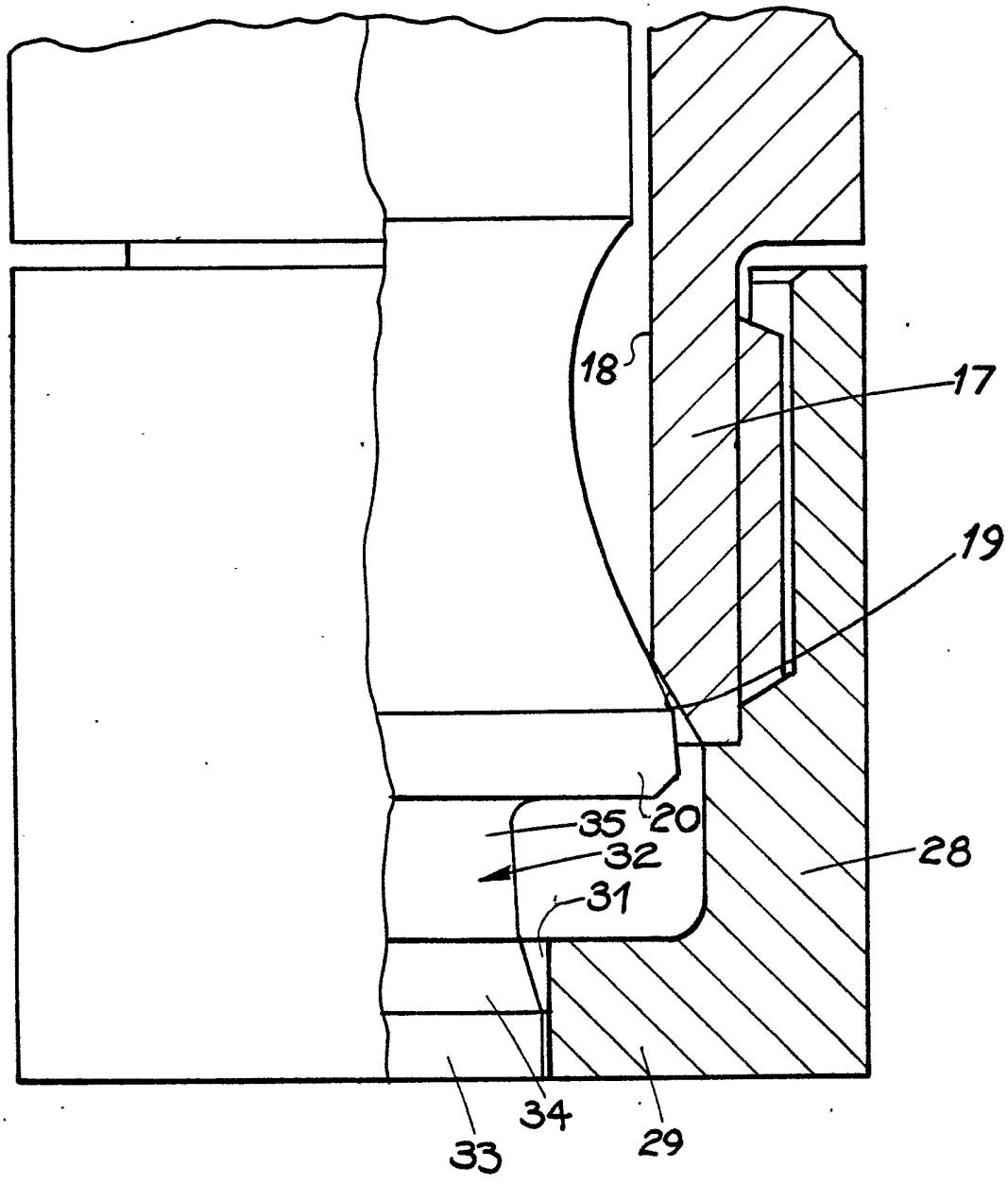

Fig. 2.

SPECIFICATION

Fuel injection nozzles

This invention relates to a fuel injection nozzle of the so-called outwardly opening type and comprising a nozzle body having an outlet opening, a valve member having a valve head located in said opening and defining an annular clearance with the wall thereof, a seating defined in the body, the valve head being shaped for co-operation with said seating and resilient means for biasing said head into contact with said seating, said nozzle having a fuel inlet connected in use to a source of fuel under pressure, the pressure of fuel moving said valve head away from said seating to permit flow of fuel through said annular clearance.

Nozzles of the aforesaid type are well known in the art and have at least two advantages over the so-called inwardly opening type of nozzle. The first advantage is that there is no need to provide a back leak connection for the nozzle and this simplifies the installation of the nozzle. In addition, the nozzle is smaller and cheaper to produce than the inwardly opening type of nozzle. A disadvantage however is that the diameter of the valve head cannot be made as small as is sometimes required to produce a given fuel spray configuration and nozzle opening characteristic. The main reason for this is that the valve head is connected to a stem which of necessity must be smaller in diameter than the head but must be able to withstand the tension forces imposed upon it due to the resilient means and the forces due to fuel pressure.

The object of the invention is to provide a fuel injection nozzle of the kind specified in an improved form.

According to the invention a fuel injection nozzle of the kind specified comprises a shroud secured to the nozzle body the shroud defining the opening, said shroud having an end wall spaced from said end of the body by an amount to at least allow the movement of the valve head, an extension formed on said valve head, said extension extending within said opening and defining said clearance with the wall thereof, said opening and the extension of the valve head being smaller in diameter than the seating and the portion of the valve head which co-operates therewith.

An example of a fuel injection nozzle in accordance with the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 is a sectional side elevation of a known form of outwardly opening injection nozzle, and

Figure 2 is a view to an enlarged scale showing the modification of the nozzle shown in Figure 1.

Referring to Figure 1 of the drawings the nozzle unit includes a housing 10 which has an integral skirt portion 11. The housing has peripheral screw threads with which is engaged a cap nut 12 which retains a nozzle assembly generally indicated at 13 in engagement with the end of the skirt.

The skirt has a cylindrical internal surface and communicating with the chamber defined by the skirt is a fuel inlet passage 14 which in use, is connected to the outlet of a fuel injection pump which is indicated at 15. An edge filter member 16 is provided to the fuel inlet.

The nozzle assembly includes a nozzle body 17 having a flange 17A which is trapped between the end of the skirt portion 11 and the cap nut 12. Extending through the body 17 is a cylindrical bore 18 which extends to the end of the body and constitutes an outlet opening. The outlet opening is of slightly larger diameter and between the bore 18 and the opening is defined a seating 19. For engagement with the seating there is provided the head 20 of a valve member which has a stem 21 extending through the bore 18. The stem is provided with a fluted portion 30 and a cylindrical guide portion 22 both of which co-operate with the wall of the bore to guide the movement of the valve member. The guide portion extends from the bore and mounts a spring abutment 23, the abutment being retained upon the stem by means of a retainer 24 which is located about a reduced portion of the stem and which engages a projection 25 formed at the end of the stem remote from the head 20. The abutment 23 has an outwardly extending flange with which is engaged one end of the coiled compression spring 26 the other end of which engages with the flange 17A of the nozzle body.

The nozzle body is provided with a pair of ports 27 through which fuel can flow from the interior of the skirt portion along the annular clearance defined between the stem 21 and the portion 18 of the bore, past the fluted portion of the stem and when the valve member is in the open position, through the annular clearance defined between the head of the valve member and the outlet opening downstream of the seating. The extend of movement of the valve head away from the seating is limited by the abutment of the spring abutment 23 with the body 17.

The scale of Figure 1 is substantially larger than the actual size of the nozzle and it will therefore be appreciated that the stem 21 is extremely thin but even so, the area of the annular clearance defined between the head and the opening is comparatively large and furthermore, cannot be made appreciably smaller.

In order to provide a small opening and therefore annular clearance, the nozzle shown in Figure 1 is modified as shown in Figure 2 and wherever possible, identical reference numerals are utilised in Figure 2 to those in Figure 1. It will be observed that the nozzle body 17 is modified so that it terminates at the downstream end of the seating 19. Moreover, the portion of the head 20 extending beyond the seating is somewhat smaller than in the example of Figure 1. The end of the body carries a shroud 28 having a base wall 29 which is spaced from the end of the body an amount sufficient to allow the full range of movement of the valve head 20. The end wall of the shroud is provided with an opening 31 the

opening in the example, being of right cylindrical form and having its longitudinal axis coincident with the longitudinal axis of the bore 18. In addition, the valve head carries an extension 32. The longitudinal axis of the extension 32 coincides with the longitudinal axis of the valve member and the extension at its end remote from the valve head is of right cylindrical form this portion being assigned the reference numeral 33. The portion 33 defines an annular clearance with the wall of the opening 31 and between the cylindrical portion 33 and the head 20 are two truncated conical portions 34, 35. The portion 34 is adjacent the cylindrical portion 33 and has a cone angle which is less than that of the portion 35 merging smoothly with the end wall of the head 20.

In operation, when the valve head is lifted from the seating fuel flows into the space downstream of the seating and then flows through the annular clearance defined between the cylindrical portion 33 of the valve member and the opening 31. As the valve member continues to move under the action of fuel under pressure, the area of the annular space increases as the cylindrical portion 33 moves out of the opening. It will be immediately apparent that the mean diameter of the annular clearance between the portion 33 and the wall of the opening 31 is appreciably smaller than the annular clearance between the head 20 and the opening as shown in Figure 1.

In view of the size of the valve head 20 it is necessary to secure the shroud 28 to the body 17 after the valve member has been inserted in position. One way of achieving this is to provide a screw thread connection between the shroud and the body 17. The use of such a connection also facilitates machining of the opening 31, this being done with the shroud attached to the nozzle body but before the valve member is assembled into the body. This enables the opening 31 to be made concentric to the bore 18. After the final assembly of the shroud to the body, electron beam welding or laser joining techniques may be used to permanently secure the shroud to the body. Alternatively the shroud may be subject to a deformation process at its end remote from the opening 31.

CLAIMS

1. A fuel injection nozzle of the so-called outwardly opening type comprising a nozzle body an outlet opening, a valve member having a valve head located in said opening and defining an annular clearance with the wall thereof, a seating defined in the body, the valve head being shaped for co-operation with said seating, resilient means for biasing said head into contact with said seating, said nozzle having a fuel inlet connected in use to a source of fuel under pressure, the pressure of fuel moving said valve head away from said seating to permit flow of fuel through said annular clearance, a shroud secured to the nozzle body the shroud defining the opening, said shroud having an end wall spaced from said end of the body by an amount to at least allow the movement of the valve head, an extension formed on said valve head, said extension extending within said opening and defining said clearance with the wall thereof, said opening and the extension of the valve head being smaller in diameter than the seating and the portion of the valve head which so operates therewith.

2. A nozzle according to claim 1 in which said shroud is adapted to be secured to said body after the valve member has been assembled within the body.

3. A nozzle according to claim 2 in which said shroud is in screw thread engagement with the body.

4. A nozzle according to claim 3 in which said shroud is retained in position on the body by electron beam welding.

5. A nozzle according to claim 1 in which said shroud is retained in position on the body by laser joining technique.

6. A nozzle according to Claim 1 in which said extension includes an outer right cylindrical portion which is joined to the main portion of the head by a truncated conical portion.

7. A fuel injection nozzle of the so-called outwardly opening type comprising the combination and arrangement of parts substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.