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(54) **Fuel injection nozzles for internal combustion engines.**

(57) In a fuel injection nozzle for an internal combustion engine a valve member is slidably received within a bore (12) within the wall (4,6,8) of a nozzle body (2). A first bore portion (20) extends from an end face (14) of the nozzle body, in which a cylindrical portion of the valve member is a close sliding fit. A reduced diameter valve member portion extends from the cylindrical valve member portion within a further bore portion (26). The valve member end seats in the closed condition of the nozzle on a valve seat (28) at the end of the further bore portion to prevent access of fuel to spray holes (30) in a nozzle body tip (10). A fuel passage (40) extends from an inlet (38) in the end face (14) of the nozzle body wall and opens into a groove (44) in the wall of the first bore portion (20). The groove is spaced from the end face (14) of the nozzle body and extends along the first bore portion (20) to open into the further bore portion. Maximum cross-sectional area and thus strength of the nozzle body wall (4,6) around the bore are thus achieved, and the length of the first bore portion (20) for guiding the valve member is maximised, while retaining standard external nozzle body dimensions.

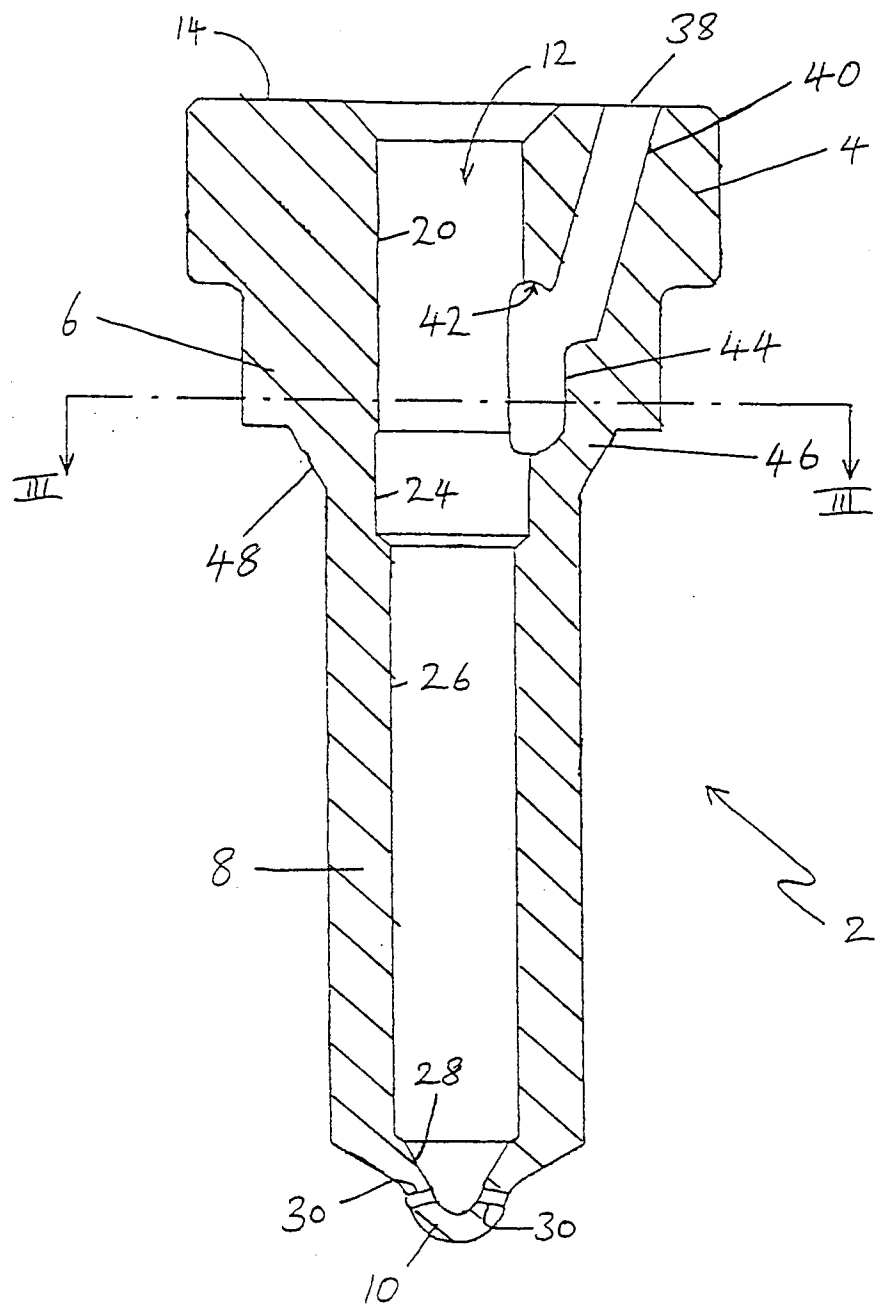


FIG 1

This invention relates to fuel injection nozzles for internal combustion engines.

UK patent application GB2173856A describes a nozzle comprising a nozzle body formed with a central bore extending from an end face and having two spaced bore portions in which an injection valve member is a close sliding fit, the spaced bore portions being separated by a fuel gallery comprising an annular undercut bore portion with a radially extended collecting chamber. A first one of the two close fitting bore portions ends substantially adjacent the end face of the nozzle body. Extending from the further end of the second close-fitting bore portion, opposite the fuel gallery, is a further nozzle body bore portion surrounding a reduced diameter portion of the valve member. The end of the valve member seats, in the closed condition of the nozzle, on a valve seat formed in the nozzle body to prevent access of fuel from the further bore portion to one or more spray holes formed in a tip portion of the nozzle body. The nozzle body has a fuel passage in a wall of the body surrounding the first close fitting bore portion and extending from an inlet in the end face to the collecting chamber for supplying fuel thereto. One or more longitudinal flats are formed along the portion of the valve member surrounded by the second close fitting bore portion, along which flats fuel may flow from the fuel gallery to the further bore portion and thence, in the open condition of the nozzle, to the spray hole or holes.

The invention provides a fuel injection nozzle for internal combustion engines in which a valve member is slidably supported within a bore formed within a nozzle body, the bore extending from an end face of the body and comprising a bore portion in which a cylindrical portion of the valve member is a close sliding fit, and a further bore portion which extends from the close fitting bore portion and surrounds a reduced-diameter portion of the valve member, the end of which seats in the closed condition of the nozzle on a valve seat formed in the nozzle body to prevent access of fuel to one or more spray holes formed in a tip portion of the nozzle body, the nozzle body housing a fuel passage extending within the nozzle body wall from an inlet in the end face, characterised in that the fuel passage is positioned for supplying fuel to a longitudinal groove formed in the wall of the close fitting bore portion, the longitudinal groove being spaced from the end of the close fitting bore portion nearer the end face of the nozzle body, and extending along the remainder of the close fitting bore portion for supplying fuel to the further bore portion.

Advantageously the close-fitting bore portion is formed with more than one longitudinal groove, the grooves being spaced around the circumference of the bore, an annular fuel gallery being formed around the circumference of the close-fitting bore portion to connect the fuel passage to the longitudinal grooves.

The longitudinal grooves, and the fuel gallery if

required, may be machined by proven electrochemical machining (ECM) or electrical discharge machining (EDM) techniques.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 is an axial section of a nozzle body according to the invention;

Figure 2 is a side view of a valve member to fit the nozzle body of Figure 1;

Figure 3 is a radial section on III-III of the nozzle body of Figure 1;

Figure 4 is a longitudinal section of a second nozzle body according to the invention, and

Figure 5 is a radial section on V-V of the nozzle body of Figure 4.

The fuel injection nozzle shown in Figure 1, 2 and 3 is for use in a compression ignition engine. The nozzle body 2 is of the form of a body of revolution having a relatively large outside diameter upper end section 4, an intermediate outside diameter centre section 6 and a nozzle forming portion 8 of further reduced diameter, ending in a nozzle tip 10.

An axial bore 12 extends from the upper end face 14 to the tip 10. To be mounted within the bore 12 is a valve member 16, shown in Figure 2, which comprises a cylindrical portion 18 which is a close sliding fit within a portion 20 of the bore 12 within the upper end section 4 and centre section 6 of the nozzle body 2. The close fitting bore portion 20 leads from the upper end face 14 into an undercut bore portion 24 formed by an enlargement of the bore 12. A further bore portion 26 extends from the undercut bore portion 24 to the tip 10, which terminates in a frusto-conical valve seat 28. Fuel spray holes 30 are formed in the tip 10 beyond the valve seat 28. A reduced diameter portion 32 of the valve member 16 extends from the close fitting valve portion 18 through the undercut bore portion 24 and the further bore portion 26. The valve member 16 terminates in a valve tip 34 comprising two frusto-conical surfaces intersecting at a junction for seating on the valve seat 28.

The valve member 16 is resiliently urged for example by a spring and thrust washer located on a pin 36 into the closed condition of the nozzle in which the valve member 16 seats on the valve seat 28, thereby closing off access to the spray holes 30 from the clearance space between the reduced diameter portion 32 of the valve member 16 and the further bore portion 26. Fuel is delivered to the fuel injector nozzle at the entrance 38 to the fuel supply passage 40, which extends within the wall of the nozzle body 2 from the upper surface 14. The passage 40 connects to the upper end 42 of a longitudinal groove 44 formed along a part of the wall of the close fitting bore portion 20. The longitudinal groove 44 extends from a point 42 approximately midway between the upper face 14 of the nozzle body 2 and the undercut bore portion 24,

to open into the undercut bore portion 24.

Fuel supplied to the fuel supply passage 40 can thus flow through the longitudinal groove 44 to the undercut bore portion 24 and into the clearance space between the bore 12 and the reduced diameter portion 32 of the valve member 16. When fuel is supplied under pressure by a fuel injection pump, the fuel pressure lifts the valve member 16 from the valve seat 28 against the spring located on the pin 36, and fuel flows under pressure through the spray holes 30.

The fuel supply passage 40 is a straight passage and can therefore be drilled mechanically. The longitudinal groove 44 may be formed by mechanical machining, or advantageously by proven electrochemical machining (ECM) or electrical discharge machining (EDM) techniques. The groove 44 should preferably be formed after the passage 40 has been drilled especially if ECM is to be used, as the ECM process tends to remove burrs and sharp edges formed by mechanical machining. Such burrs and sharp edges may otherwise break free from the nozzle body during operation of the injector under the influence of fuel pressure pulses, and can cause damage to the nozzle or engine or detrimentally affect its operation.

The outer dimensions of the nozzle body 2 are determined by the application in which it is to be used, standardised nozzle body dimensions being required for most applications. The invention provides a nozzle in which, for given outer body dimensions, the nozzle strength is high since the thickness of the web 46 adjacent the undercut bore portion 24 is greater than in conventional nozzles. A fillet 48 may be added in nozzles for certain applications further to increase the thickness of the web 46. In addition the length of the close-fitting bore portion 20 may be increased compared with conventional nozzles, providing better location and guiding of the valve member 16.

A second embodiment of the invention is shown in Figures 4 and 5, in which three parallel longitudinal grooves are formed along the lower part of the close-fitting bore portion 120. The fuel supply passage 140 is a straight passage, as in the nozzle body of Figures 1 and 3, but connects at its lower end to a fuel gallery 150 which comprises an annular recess around the wall of the close-fitting bore portion 120. The fuel gallery 150 may be formed by mechanical machining or advantageously by ECM or EDM. The fuel gallery 150 connects to the upper end 142 of each of the three longitudinal grooves 144. Fuel thus flows from the supply passage 140, to the fuel gallery 150 and along the grooves 144 to the undercut bore portion 124. The same valve member 16 shown in Figure 2 may be used with both embodiments of the nozzle body of the invention.

In the embodiment of Figures 4 and 5, as clearly seen in Figure 5 each of the longitudinal grooves may be of smaller cross-sectional area than the single

groove of the first embodiment while still providing the same area for the flow of fuel from the supply passage to the undercut bore portion.

The strength of the nozzle body in the second embodiment may therefore be greater than that of the first as the thickness of the webs 146 may be larger than that of the web 46 for given external nozzle body dimensions. In addition, any side loading of the valve member 16 caused by fuel pressure in the single longitudinal groove 44 of the first embodiment is alleviated by the symmetrical arrangement of grooves 144 in the second embodiment.

Different numbers of grooves may also be used. For example more than three grooves may be used if increased web thickness is required.

Claims

1. A fuel injection nozzle for an internal combustion engine in which a valve member (16) is slidably supported within a bore (12) formed within a nozzle body (2), the bore (12) extending from an end face (14) of the body (2) and comprising a bore portion (20,120) in which a cylindrical portion (18) of the valve member (16) is a close sliding fit, and a further bore portion (24,26,124) which extends from the close fitting bore portion (20,120) and surrounds a reduced-diameter portion (32) of the valve member (16), the end (34) of which seats in the closed condition of the nozzle on a valve seat (28) formed in the nozzle body (2) to prevent access of fuel to one or more spray holes (30) formed in a tip portion (10) of the nozzle body (2), the nozzle body (2) housing a fuel passage (40,140) extending within the nozzle body wall (4) from an inlet (38) in the end face (14), characterised in that the fuel passage (40,140) is positioned for supplying fuel to a longitudinal groove (44,144) formed in the wall of the close fitting bore portion (20,120), the longitudinal groove (44,144) being spaced from the end of the close fitting bore portion (20,120) nearer the end face (14) of the nozzle body (2), and extending along the remainder of the close fitting bore portion (20,120) for supplying fuel to the further bore portion (24,26,124).
2. A nozzle according to claim 1 characterised in that the inner surface of the close fitting bore portion (20,120) is formed with more than one longitudinal groove (144), the grooves being circumferentially spaced around the bore and an annular fuel gallery (150) being formed around the circumference of the close fitting bore portion interconnecting the longitudinal grooves.
3. A nozzle according to claim 2 in which the fuel

passage (140) opens into the fuel gallery (150).

4. A nozzle according to claim 1,2 or 3 characterised in that the groove (44) or grooves (144) and/or the fuel gallery (150) are formed by electrochemical machining (ECM) or electrical discharge machining (EDM).

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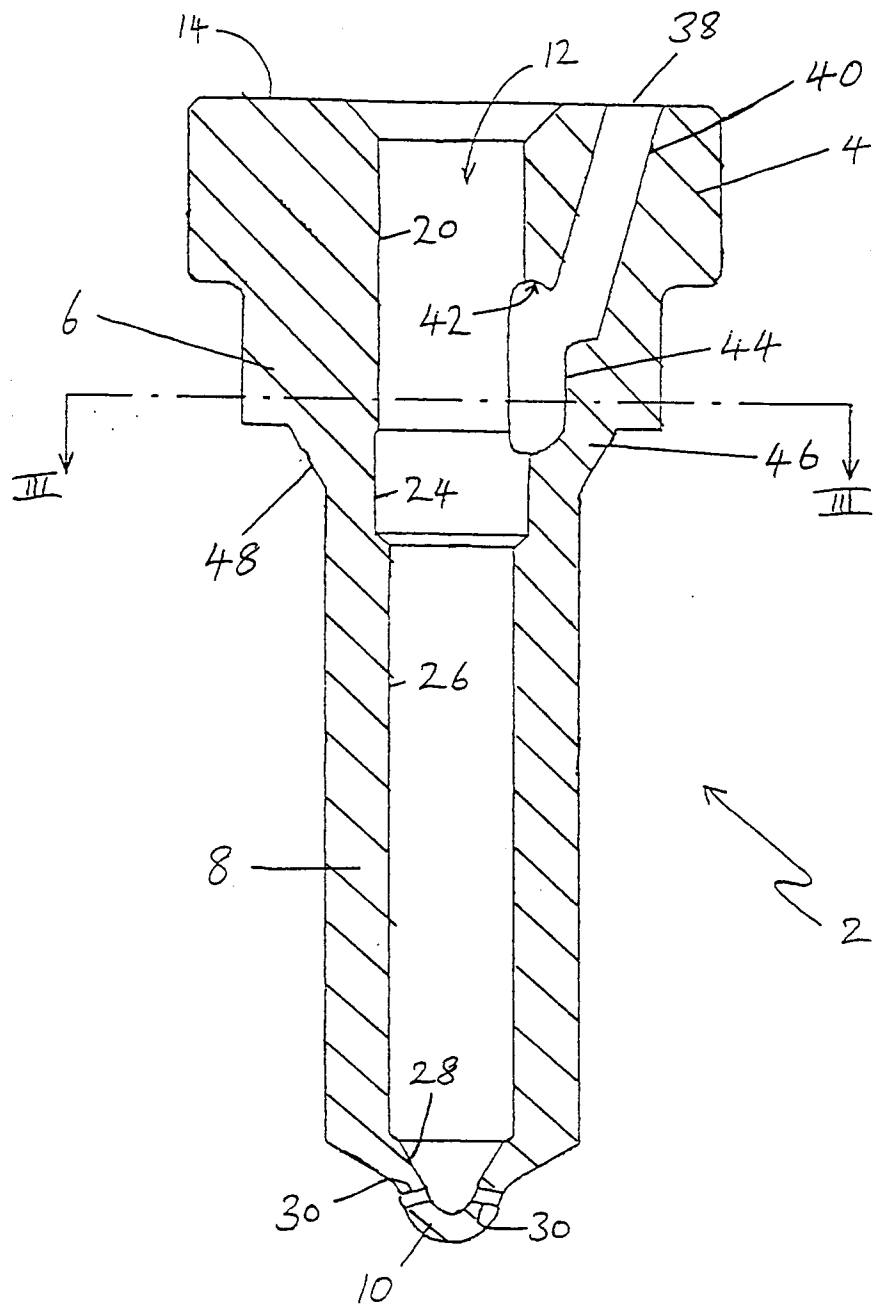
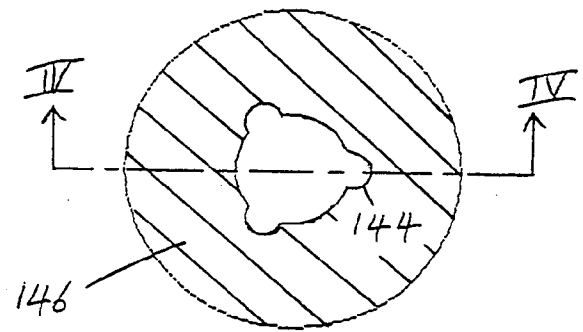
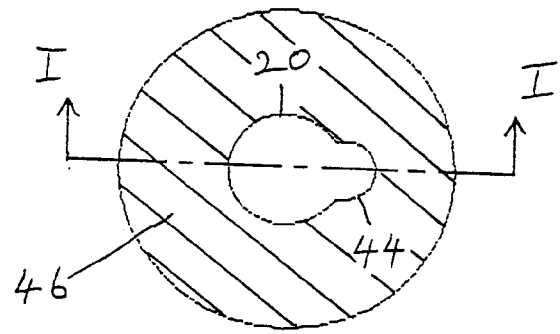
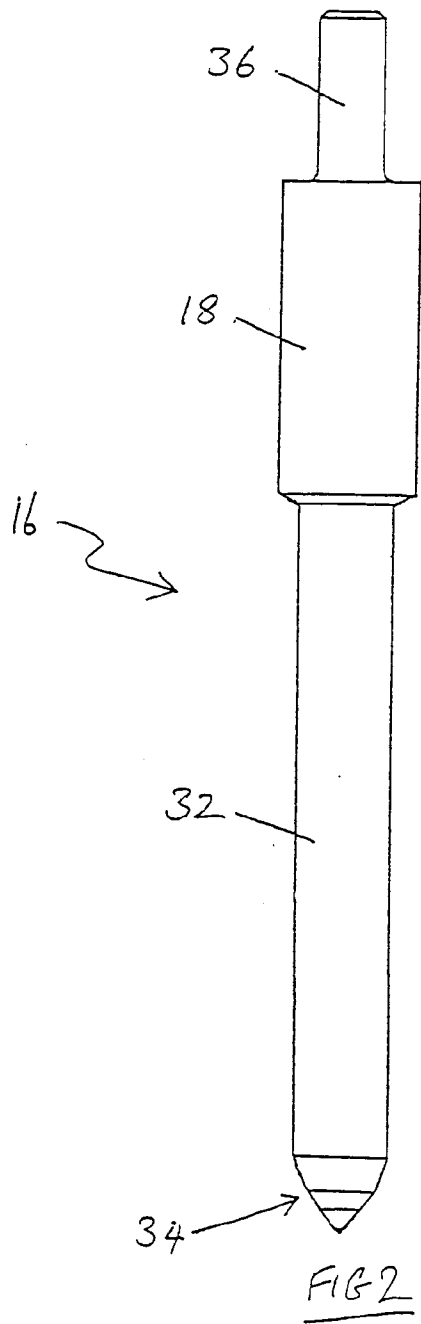


FIG 1



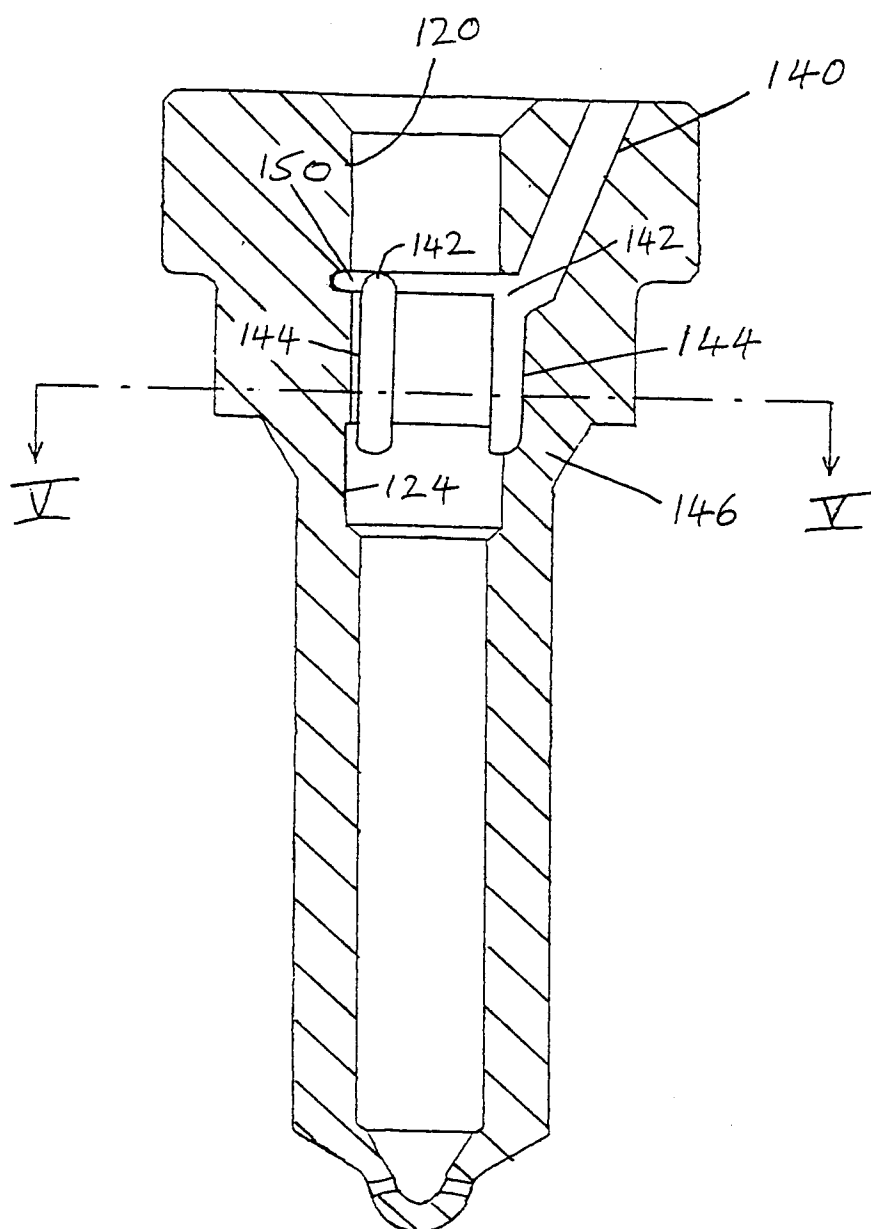


FIG 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 91306538.9
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D, Y	<u>GB - A - 2 173 856</u> (STEYR-DAIMLER-PUCH AG) * Totality * --	1-3	F 02 M 61/16
Y	<u>US - A - 4 494 700</u> (DOLENC) * Fig. 5,6, especially numerals 6,13 * --	1-3	
A	<u>GB - A - 1 447 040</u> (C.A.V. LTD) * Totality * --	1	
A	<u>DE - A1 - 2 358 220</u> (KLÖCKNER-HUMBOLDT-DEUTZ AG) * Totality * ----	4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F 02 M 61/00
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
VIENNA	11-10-1991	PIPPAN	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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