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PAGE WHITE & FARRER
54 Doughty Street
London WC1N 2LS (GB)(54) **Fuel injection device for internal combustion engines**

(57) The fuel injection device easily sets the full lift position of the valve assembly and assures stable lift of the control piston(2) without being affected by pulsations of the fuel pressure in the balance chamber(35). In this fuel injection device, the valve assembly comprises a control piston(2) inserted into the control sleeve(7) and a needle valve(3) that opens and closes the nozzle holes(50). The end surface(75) of the control piston(2) is provided with a projecting portion(71) that projects into the balance chamber(35) formed in the control sleeve (7). In an area of the exhaust passage(26) in the control sleeve(7) a projecting portion(70) is provided which is formed with a slit(72) opening to the balance chamber (35) at all times. The end surfaces(77, 76) of these projecting portions(71, 70) engage with each other when the control piston(2) reaches its full lift.

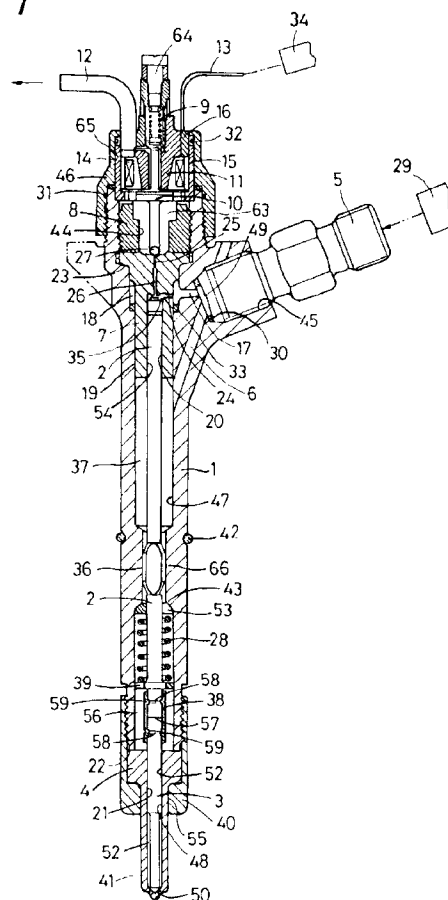
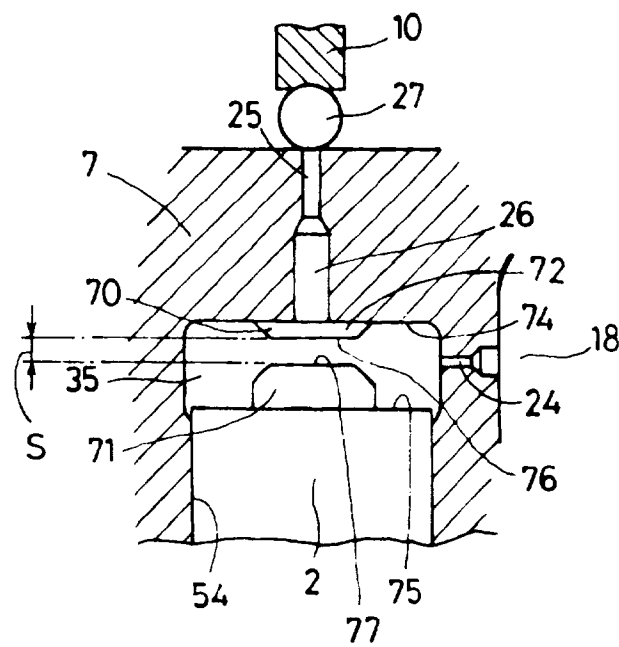
FIG. 1

FIG. 2



Description

The present invention relates to a fuel injection device used on internal combustion engines.

Among conventional fuel injection devices for multi-cylinder engines are a fuel injection system (electronic control fuel injection system) that controls the amount of fuel injected and the timing of fuel injection by using electronic circuits, a common injection system (common rail injection system) that distributes fuel from an injection pump to combustion chambers through a common passage, and a pressure accumulation type injection system (accumulator injection system) that distributes fuel from an injection pump to combustion chambers through a common passage and a pressure accumulation chamber. These fuel injection devices themselves do not have a pressure accumulation chamber for temporarily storing fuel from the injection pump and therefore the supply of fuel to the fuel injection devices is done through a common rail, a common passage that works as a pressure accumulation chamber.

In a conventional fuel injection device, a balance chamber that controls the lift of a valve assembly is known to have a structure as shown in Figure 7. The balance chamber 35 in the fuel injection device is formed in a hollow portion enclosed by a top portion of a bore 54 in a control sleeve 7 and a control piston 2 of the valve assembly. A high-pressure fuel from a high pressure fuel source (represented by reference number 29 in Figure 1) such as a common rail is supplied to the balance chamber 35 through a supply passage, and the high-pressure fuel in the balance chamber 35 is discharged outside through an exhaust passage. The supply passage comprises an annular chamber 18 formed around the control sleeve 7 and an orifice 24 formed in the control sleeve 7. The exhaust passage comprises a fuel passage 26 and an orifice 25 both formed in the control sleeve 7 that provides the upper surface of the balance chamber 35. When a needle valve closes a nozzle, the orifice 25 is closed by a ball 27 and a solenoid valve 10. When the control piston 2 and the needle valve are lifted, the ball 27 and the solenoid valve 10 move up, opening the orifice 25. In Figure 7, an underside 74 of the control sleeve 7 is formed with a projecting portion 70, and a top surface 75 of the control piston 2 is formed with a projecting portion 71. The full lift of the control piston 2 is so set as to form a gap S between an endface 76 of the projecting portion 70 and an endface 77 of the projecting portion 71. The balance chamber 35 is so constructed as to communicate with the orifice 24 and the fuel passage 26 at all times.

The conventional fuel injection device is disclosed, for example, in Japan Patent Publication No. 81935/1994. The fuel injection device has a piston slidably installed in an inner bore of a cylindrical component. The inner bore has a control chamber therein. Fuel is supplied to the control chamber through a flow passage and an orifice formed in the piston. Fuel in the control

chamber is discharged through an orifice formed in the cylindrical component. The full lift of the piston (a needle valve's vertical stroke) is so set as to form a gap between the top end surface of the piston and the wall surface of the control chamber.

An example of the electromagnetic type fuel injection device for internal combustion engines is disclosed in Japan Patent Laid-Open No. 118261/1993. In this electromagnetic type fuel injection device, a control valve is installed in a hollow body of the injection device by a liquid-tight coupling means. The liquid-tight coupling means has a pair of precision-ground surfaces and a sealing ring compressed, adjacent to the precision-ground surfaces, between the hollow body and the valve assembly. Formed in the hollow body are a cylindrical axial space and a control chamber, with a sliding rod controlled by a pressure in the control chamber and the cylindrical axial space. Supply of fuel to the control chamber and the cylindrical space is through an input conduit, an annular chamber, and a conduit formed in the hollow body.

As shown in Figure 7, in the fuel injection device the full lift of the control piston 2 is set at such a position that a gap S is formed between the endface 76 of the projecting portion 70 and the endface 77 of the projecting portion 71. Because the full lift position of the control piston 2 is not set at a position that brings the endfaces 76, 77 of the projecting portions 70, 71 into contact with each other, the position setting of the control piston is performed by using a separate stopper (not shown). Further, because the passage cross section of the orifice 24 is set smaller than that of the orifice 25, the fuel pressure fluctuates in the balance chamber 35 when the ball 27 opens the orifice 25. Fluctuation of the fuel pressure that controls the lift of the control piston 2 makes the amount of lift of the control piston 2 unstable.

The present invention applies to fuel injection devices of a type that supplies fuel through a common rail, a common passage that works as a pressure accumulation chamber. The invention relates to a fuel injection device, in which a valve assembly that reciprocates in the main body comprises a control piston receiving the fuel pressure and a needle valve that opens and closes nozzle holes; in which the lift of the control piston is controlled by the pressure of the fuel in a balance chamber formed by a bore in a control sleeve; in which the full lift position of the control piston can be set where the upper end surface of the control piston and the wall surface of the control sleeve contact each other so that there is no need to provide a separate stopper for the valve assembly; and in which a slit is formed in at least one of the control piston and the control sleeve to allow the balance chamber and the exhaust passage to communicate with each other.

This invention also relates to a fuel injection device for internal combustion engines, which comprises: a valve assembly that reciprocates in use in the main body having nozzle holes for injecting fuel and which opens

the nozzle holes by fuel pressure; a fuel chamber for storing fuel formed around the valve assembly extending through the main body; a balance chamber formed in a control sleeve secured to the main body for controlling the lift of the valve assembly by the fuel pressure; and an actuator for driving an open-close valve that opens and closes an exhaust passage for the fuel pressure in the balance chamber; wherein the valve assembly comprises a control piston having one end thereof exposed in the balance chamber and a needle valve integrally formed with the control piston and adapted to open and close the nozzle holes; wherein the exhaust passage and the balance chamber communicate with each other through a slit formed in a projecting portion, the projecting portion being provided to the control piston or the control sleeve and projecting into the balance chamber.

In a preferred embodiment, when the control piston reaches the full lift, the projecting portion contacts the upper end surface of the control piston or the wall surface of the balance chamber.

The control piston and the control sleeve can each be provided with a projecting portion, and the end surfaces of these projecting portions contact each other when the control piston reaches the full lift.

The slit is formed in the projecting portion provided to the control sleeve and/or to the projecting portion provided to the control piston.

Because this fuel injection device has the above construction, the slit functions as a passage for permitting communication between the balance chamber and the exhaust passage at all times and the projecting portion works as a stopper that restricts the full lift of the valve assembly, making it extremely easy to set the full lift position of the valve assembly, which comprises the control piston and the needle valve, and obviating the need to provide a stopper to restrict the full lift of the valve assembly. With this construction, when the valve assembly is at the full lift position, the front end of the control piston can be prevented from becoming unstable due to pulsation or oscillation of the fuel pressure, thus ensuring smooth sliding motion of the valve assembly.

In this fuel injection device with the above construction, the balance chamber and the exhaust passage communicate with each other through the slit at all times; it is possible to set the full lift position of the valve assembly where the control piston and the control sleeve contact each other so that there is no need to provide a separate stopper to stop the valve assembly at the full lift position; and the lift of the control piston can be prevented from becoming unstable due to pulsation of the fuel pressure. That is, this fuel injection device can easily set the full lift position of the valve assembly and the control piston can be stably lifted without being affected by pulsations of the fuel pressure in the balance chamber. The slit to allow communication between the balance chamber and the exhaust passage may be formed in the projecting portion provided to the

control piston or in the projecting portion provided to the control sleeve, or both.

Preferred embodiments of the present invention will now be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a cross section of a fuel injection device as one embodiment of this invention;

Figure 2 is an enlarged cross section showing one embodiment of the structure of a balance chamber region in the fuel injection device of Figure 1;

Figure 3 is a plan view showing a wall surface, in the balance chamber of Figure 2, of the control sleeve;

Figure 4 is an enlarged cross section showing another embodiment of the structure of the balance chamber region in the fuel injection device of Figure 1;

Figure 5 is a plan view showing a top surface, in the balance chamber of Figure 4, of the control piston;

Figure 6 is an enlarged cross section showing still another embodiment of the structure of the balance chamber region in the fuel injection device of Figure 1; and

Figure 7 is an enlarged cross section showing a conventional example of the structure of the balance chamber region in the fuel injection device of Figure 1.

Now, by referring to the accompanying drawings, preferred embodiments of the fuel injection device according to this invention will be described. In the following drawings, components having the same structures and functions are assigned identical reference numbers and their explanations are not repeated. By referring to Figure 1, 2 and 3, the fuel injection device as one embodiment of this invention is explained.

This fuel injection device is applied to a common rail injection system and an accumulator injection system, which, though not shown, inject into each of combustion chambers of an internal combustion engine a high-pressure fuel that was supplied from an injection pump through a common passage or pressure accumulation chamber (hereinafter referred to as a common rail 29). A holder body 1 in this fuel injection device is sealingly installed in a hole (not shown) provided in a base such as a cylinder head through a sealing member 42. The lower end portion of the holder body 1 is securely fitted with a nozzle body 4 by screwing a sleeve nut 40 over a threaded portion of the holder body 1. The lower end surface of the holder body 1 and the upper end surface of the nozzle body 4 form interface surfaces 22 that constitute sealing surfaces. The outer circumferential surface of the nozzle body 4 is formed large in diameter at the upper part and small at the lower part. The sleeve nut 40 engages with a stepped surface 55 formed at the lower part of the nozzle body 4 and is screwed over the threaded portion of the holder body 1.

The upper part of the holder body 1 has a plug mounting hole 45 for mounting a threaded fuel inlet plug 5, which is screwed into the plug mounting hole 45. The upper end portion of the holder body 1 is securely fitted with a solenoid type valve actuation mechanism 65, which reciprocates the valve assembly, by screwing the sleeve nut 46 over the threaded portion of the holder body 1. Sealing between the sleeve nut 46 and the solenoid type valve actuation mechanism 65 as well as the holder body 1 is provided by sealing members 31, 32. A fuel from the common rail 29 is supplied into the fuel injection device through the fuel inlet plug 5. In this fuel injection device, electric currents of drive signals from a control unit 34 are supplied through a connector or harness 13 and a terminal 16 to the solenoid type valve actuation mechanism 65. The solenoid type valve actuation mechanism 65 constitutes an actuator (coil 14, solenoid 11, solenoid valve 10 and ball 27 all described later) that discharges a fuel pressure applied to the valve assembly through a fuel pressure exhaust passage (fuel passage 26, orifice 25, hollow chamber 63 and fuel return pipe 12 all described later).

The fuel inlet plug 5 is screwed into the plug mounting hole 45 in the holder body 1. Sealing between the holder body 1 and the fuel inlet plug 5 is achieved by a seal member 30. The holder body 1 is formed with a center through-hole 47 through which a valve assembly is passed and also with a supply hole 6 that allows communication between the center through-hole 47 and a fuel inlet 49 of the fuel inlet plug 5. At virtually the center of the center through-hole 47 of the holder body 1 is formed a diameter-constricted guide portion 66, which has a guide surface 36 and through which a control piston 2 of the valve assembly is passed. The center through-hole 47 of the holder body 1 forms a fuel chamber 37 for storing a fuel around the control piston 2 that passes through the center through-hole 47 of the holder body 1. The nozzle body 4 has a center through-hole 48 that communicates with the center through-hole 47 and through which a needle valve 3 of the valve assembly is passed. The nozzle body 4 is also formed with nozzle holes 50 to inject fuel into the combustion chamber (not shown).

The valve assembly, as described above, has the control piston 2 and the needle valve 3 connected together by a coupling means 38. The control piston 2 and the needle valve 3 abut against each other at their engagement surfaces 57 and are axially held together by the coupling means 38 that has a spring force to allow axis deviation between them in a direction perpendicular to the axial direction. The control piston 2 has an annular groove 58 formed at the lower end portion thereof and the needle valve 3 is formed with an annular groove 58 at the upper end portion thereof. The coupling means 38 has inwardly projecting beads 59 at both ends that form locking portions. The coupling means 38 is fitted over the facing end portions of the needle valve 3 and the control piston 2, with the beads 59 of the coupling

means 38 fitted in the annular groove 58 of the control piston 2 and the annular groove 58 of the needle valve 3.

In the region where the control piston 2 and the needle valve 3 are connected by the coupling means 38, a fuel chamber 56 communicating with the fuel chamber 37 is formed. The needle valve 3 is slidably inserted in the center through-hole 48 of the nozzle body 4 with a gap 52 formed therebetween and with the face of its front end portion 41 seated on a seat surface of the nozzle body 4 that is formed near the nozzle holes 50. The gap 52 formed around the needle valve 3 constitutes a passage for a high-pressure fuel. Between the center through-hole 48 of the nozzle body 4 and the circumferential surface of the needle valve 3 there is formed a sliding surface 21 having the gap 52.

A control sleeve 7 is fitted in the center through-hole 47 of the holder body 1 and forms an engagement surface 19 that serves as a seal. A shoulder portion of the control sleeve 7 engages with an upper stepped portion of the center through-hole 47 to form an abutment sealing surface 23. An annular chamber 18 is formed between the outer circumferential surface of the control sleeve 7 and the center through-hole 47 of the holder body 1. The control sleeve 7 is held immovable by a fixing plug 8 having a hole 44 therein which is screwed into the threaded part of the upper end portion of the holder body 1. A complete sealing between the holder body 1 and the control sleeve 7 is achieved by a sealing member 33. The annular chamber 18 communicates with the fuel inlet 49 through a supply hole 17 of the supply passage formed in the holder body 1.

In this fuel injection device, a bore 54 in the control sleeve 7 opening downwardly is formed with a sliding surface 20 in which the control piston 2 is slidably fitted, and at the top of the bore 54 there is formed a balance chamber 35 between the bore top and the upper surface of the control piston 2. The balance chamber 35 communicates with the annular chamber 18 through an orifice 24. Further, the control sleeve 7 is formed with the orifice 24 connecting the balance chamber 35 and the supply hole 17, an orifice 25 communicating with the upper surface of the control sleeve 7, and a fuel passage 26. The balance chamber 35 has a function of controlling the lift of the control piston 2 by a fuel pressure in the fuel chamber 37 formed in the holder body 1 that stores the fuel and through which the control piston 2 is passed.

This fuel injection device has a projecting portion 71 formed on the top surface 75 of the control piston 2 and a projecting portion 70 formed on the wall surface (underside) 74 of the control sleeve 7 that has the balance chamber 35. Further, the projecting portion 70 has a slit 72 opening to the balance chamber 35. The endface 77 of the projecting portion 71 of the control piston 2 and the endface 76 of the projecting portion 70 of the control sleeve 7 come into contact with each other when the valve assembly comprising the needle valve 3 and the control piston 2 reaches the full lift. Hence, the fuel

passage 26 that constitutes an exhaust passage communicates at all times with the balance chamber 35 through the slit 72 formed in the projecting portion 70 of the control sleeve 7.

In the solenoid type valve actuation mechanism 65, the fixing plug 8 for fixing the control sleeve 7 in the holder body 1 has an inside space or top chamber 63 therein, in which is a ball 27 installed to open and close the outlet of the orifice 25. The ball 27 is secured to and integrally formed with the lower end of a solenoid valve 10 that is moved up and down by the energization of a solenoid 11. The solenoid 11 is secured to the holder body 1 by the sleeve nut 46 through a solenoid support member 15. A coil 14 is arranged around the outer circumferential surface of the solenoid 11. On the top of the solenoid 11 is installed a solenoid valve spring 9, which is set to the solenoid 11 by a set screw 64. The coil 14 is supplied, through the terminal 16 and connector (harness) 13, with an electric current corresponding to a signal from the control unit 34. The electricity to the coil 14 energizes the solenoid 11, which in turn pulls up the solenoid valve 10 against the force of the solenoid valve spring 9.

On the top of the solenoid type valve actuation mechanism 65 is arranged a fuel return pipe 12 extending from the sleeve nut 46. The fuel return pipe 12 communicates with the top chamber 63 through a passage formed around the solenoid 11. Hence, when the ball 27 integral with the solenoid valve 10 opens the orifice 25, the fuel in the balance chamber 35 is discharged through the slit 72, fuel passage 26, orifice 25 and top chamber 63 and to the fuel return pipe 12. That is, when the solenoid type valve actuation mechanism 65 that constitutes an actuator is operated, the solenoid valve 10 and the ball 27, both forming the valve, opens the orifice 25 allowing the fuel pressure in the balance chamber 35 to be discharged through the slit 72, fuel passage 26, orifice 25, top chamber 63 and fuel return pipe 12, all constituting an exhaust passage.

The return action of the needle valve 3 to close the nozzle hole 50 is achieved by a return spring 28 disposed between a retainer 39 secured to the lower part of the control piston 2 and a retainer 53 engaged and fixed to a stepped portion 43 in the center through-hole 47 of the holder body 1.

The fuel injection device of this invention with the above construction operates as follows.

In the initial state, the solenoid type valve actuation mechanism 65 is not energized, and the solenoid valve 10 and the ball 27 are pushed down by the force of the solenoid valve spring 9, with the orifice 25 closed by the ball 27. In this state the high-pressure fuel from the common rail 29 is supplied to the fuel inlet 49 through the fuel inlet plug 5. The fuel chamber 37 formed around the control piston 2 and the needle valve 3 is filled with the high-pressure fuel supplied from the fuel inlet 49 through the supply hole 6. The gap 52 formed between the outer circumference of the needle valve 3 and the nozzle body

4 is filled with the high-pressure fuel. The annular chamber 18 is supplied with the high-pressure fuel from the fuel inlet 49 through the supply hole 17, and the balance chamber 35 is filled with the high-pressure fuel from the annular chamber 18 through the orifice 24. The high-pressure fuel in the fuel chamber 37 is sealed by the sealing members 30, 33. The high-pressure fuel in the annular chamber 18 and the balance chamber 35 is isolated from the high-pressure fuel in the fuel chamber 37 by the sealing member 33 except that they communicate with each other through the orifice 24.

When the orifice 25 is closed by the solenoid valve 10 and ball 27, the high-pressure fuel in the balance chamber 35 that was supplied through the supply hole 17 and the orifice 24 acts on the upper surface of the control piston 2 as a downward force. The force of the return spring 28 acts on the valve assembly to push it down. The fuel pressure acting on the tapered surface of the front end portion of the needle valve 3, seated on the nozzle holes 50 of the nozzle body 4 to open and close the nozzle holes 50, works to raise the valve assembly. In other words, the valve assembly comprising the control piston 2 and the needle valve 3 is so constructed that it is raised by the fuel pressure acting on it to open the nozzle holes 50. In this embodiment, the fuel pressure acting on the tapered surface of the front portion of the needle valve 3, which is seated or unseated to and from the nozzle holes 50 of the nozzle body 4 to close and open the nozzle holes 50, becomes greater than the sum of the spring force of the return spring 28 and the fuel pressure in the balance chamber 35 acting on the upper surface of the control piston 2, with the result that the valve assembly is moved upward. Further, the total downward force, i.e., the pressure acting on the control piston 2 in the balance chamber 35 and the force of the return spring 28, is set larger than the upward force acting on the needle valve 3, so that the needle valve 3 closes the nozzle holes 50.

Under this condition, when a signal from the control unit 34 supplies electricity to the coil 14 of the solenoid type valve actuation mechanism 65, the solenoid 11 produces an electromagnetic force and lifts the solenoid valve 10 and the ball 27, opening the orifice 25. Once the orifice 25 is open, the high-pressure fuel in the balance chamber 35 is discharged through the slit 72, the fuel passage 26 and the orifice 25 into the top chamber 63, from which it is returned to the fuel tank through the fuel return pipe 12. With the high-pressure fuel in the balance chamber 35 discharged, the upward force acting on the tapered surface of the needle valve 3 overcomes the force of the return spring 28, causing the needle valve 3 that is axially secured to the control piston 2 to move up, opening the nozzle holes 50, through which the fuel begins to be injected into the combustion chamber (not shown).

Next, when a signal from the control unit 34 deenergizes the coil 14 of the solenoid type valve actuation mechanism 65, the solenoid 11 is deenergized, allowing

the solenoid valve 10 and the ball 27 to move down by the force of the solenoid valve spring 9, closing the orifice 25 with the ball 27. When the orifice 25 is closed, the high-pressure fuel from the common rail 29 is supplied through the fuel inlet 49, the supply hole 17 and the orifice 24 into the balance chamber 35 where it is accumulated, acting on the upper surface of the control piston 2 and pushing it down, with the result that the needle valve 3 closes the nozzle holes 50 ending the fuel injection from the nozzle holes 50. The fuel injection device repeats the above-mentioned operation to inject fuel into the combustion chamber intermittently.

Next, by referring to Figure 4 and 5, another embodiment of the fuel injection device according to this invention is explained. This embodiment has the similar construction and workings to those of the previous embodiment except that the slit is formed in the control piston. Components identical with those of the first embodiment are assigned like reference numerals and repetitive explanations are omitted. That is, this embodiment is characterized in that the projecting portion 71 of the control piston 2 is formed with a slit 73 that opens to the balance chamber 35.

Next, with reference to Figure 6 a further embodiment of the fuel injection device according to this invention will be described. This embodiment is similar in construction and workings to the preceding embodiments, except that the control piston and the control sleeve are each formed with a slit. Components identical to those of the preceding embodiments are given like reference numerals and repetitive explanations are omitted. That is, this embodiment is characterized in that the projecting portion 71 of the control piston 2 is formed with a slit 73 that opens to the balance chamber 35 and that the projecting portion 70 of the control sleeve 7 is formed with a slit 72.

Claims

1. A fuel injection device for internal combustion engines comprising:

- a main body having nozzle holes(50)for injecting fuel;
- a valve assembly that reciprocates in use in the main body to open and close the nozzle holes (50);
- a fuel chamber(37) for storing the fuel, formed around the valve assembly extending through the main body;
- a control sleeve(7) secured to the main body;
- a balance chamber(35) formed in the control sleeve (7) and supplied with the fuel for controlling a lift of the valve assembly;
- an exhaust passage(25, 26) communicating with the balance chamber(35) for discharging the fuel from the balance chamber(35);

an open-close valve(10) for opening and closing the exhaust passage(25, 26);
an actuator(11) for driving the open-close valve (10);

the valve assembly including a control piston (2) having one end thereof exposed in the balance chamber (35) to receive a pressure of the fuel contained in the balance chamber(35), and a needle valve(3) connected to the other end of the control piston(2) and adapted to open and close the nozzle holes(50);
a projecting portion(70, 71) provided to at least one of the control piston(2) and the control sleeve (7) and projecting into the balance chamber(35); and
a slit(72, 73) provided to the projecting portion (70, 71) to allow the exhaust passage(25, 26) to communicate with the balance chamber(35).

2. A fuel injection device for internal combustion engines according to claim 1, wherein the slit(72) that allows the exhaust passage(25, 26) to communicate with the balance chamber(35) is formed in a projecting portion(70) provided to the control sleeve (7).
3. A fuel injection device for internal combustion engines according to claim 1, wherein the slit(73) that allows the exhaust passage(25, 26) to communicate with the balance chamber(35) is formed in a projecting portion(71) provided to the control piston (2).
4. fuel injection device for internal combustion engines according to claim 1, wherein the slit(72, 73) that allows the exhaust passage(25, 26) to communicate with the balance chamber(35) is formed in a projecting portion(71) provided to the control piston (2) and in a projecting portion(70) provided to the control sleeve(7).
5. A fuel injection device for internal combustion engines according to claim 1, wherein the projecting portion(71) formed in the control piston(2) contacts a wall surface of the balance chamber(35) when the control piston(2) reaches its full lift.
6. A fuel injection device for internal combustion engines according to claim 1, wherein the projecting portion(70) formed in the control sleeve(7) contacts a wall surface of the control piston(2) when the control piston(2) reaches its full lift.
7. A fuel injection device for internal combustion engines according to claim 1, wherein the projecting portions(71, 70) provided to the control piston(2) and the control sleeve(7) contact each other when the control piston(2) reaches its full lift.

FIG. 1

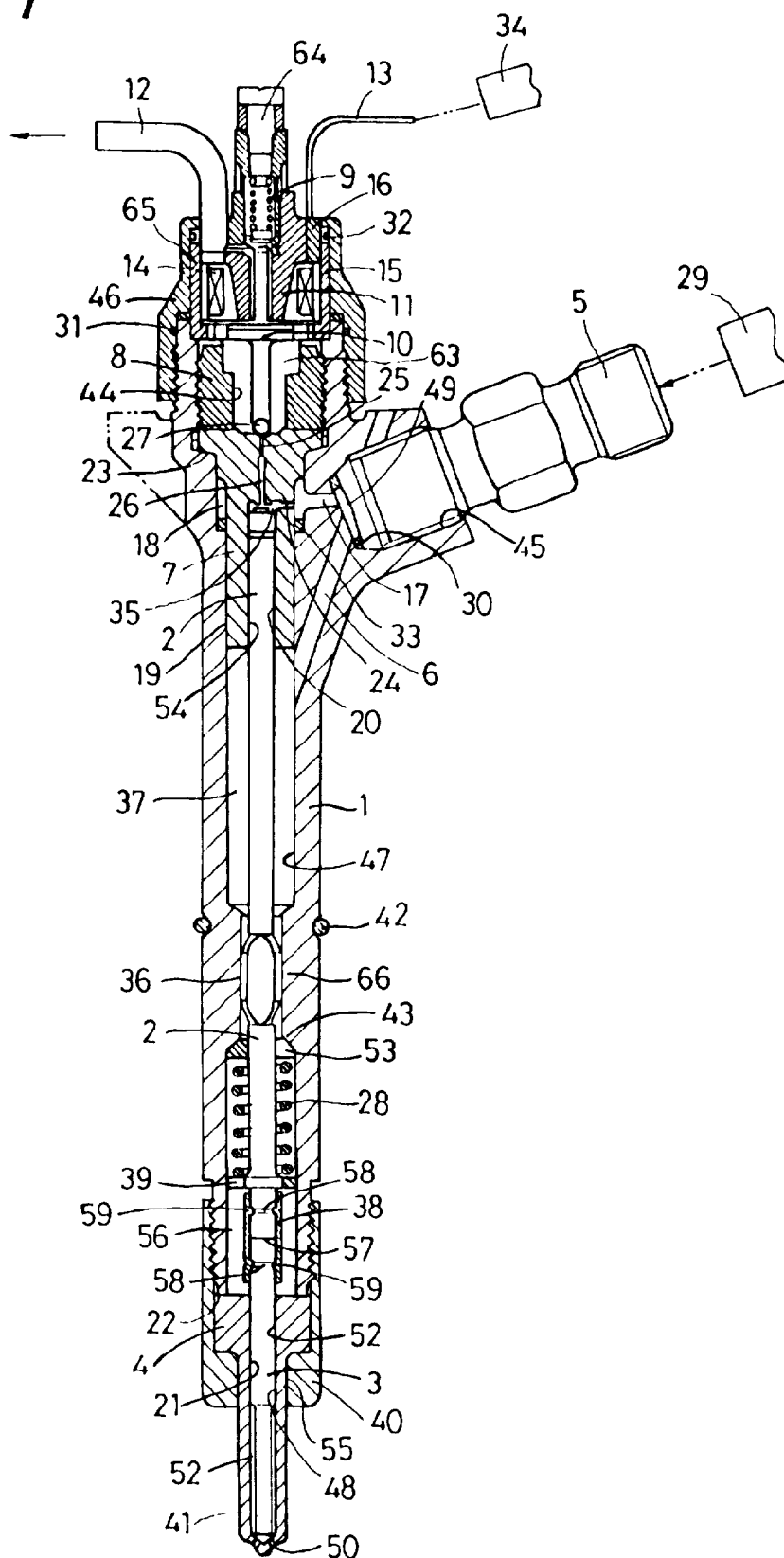


FIG. 2

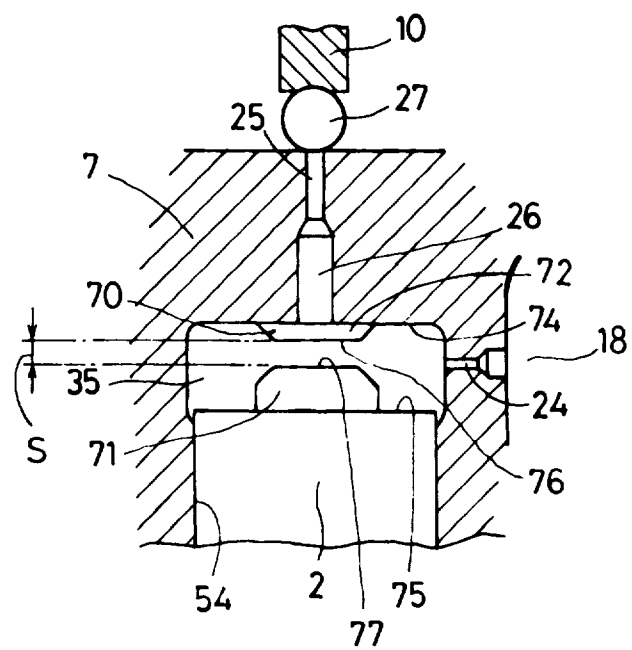


FIG. 3

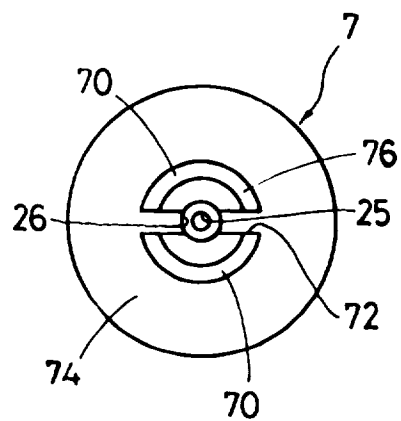


FIG. 4

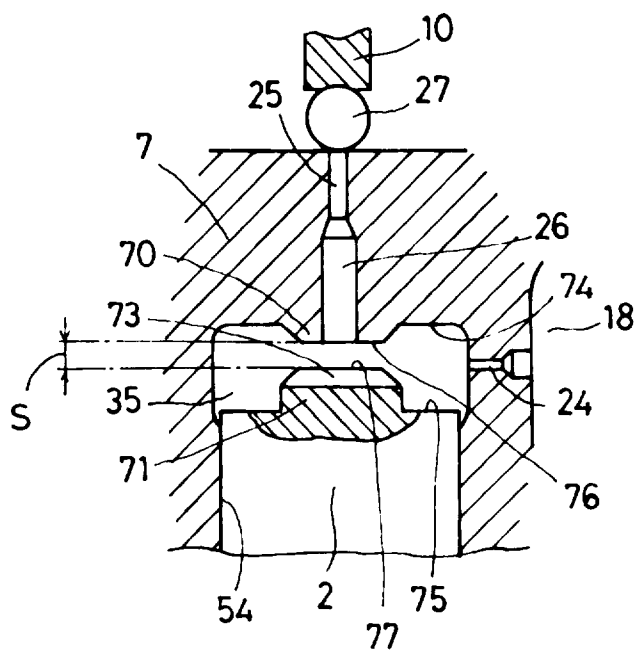


FIG. 5

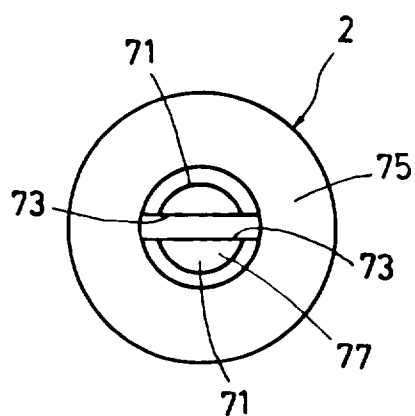


FIG. 6

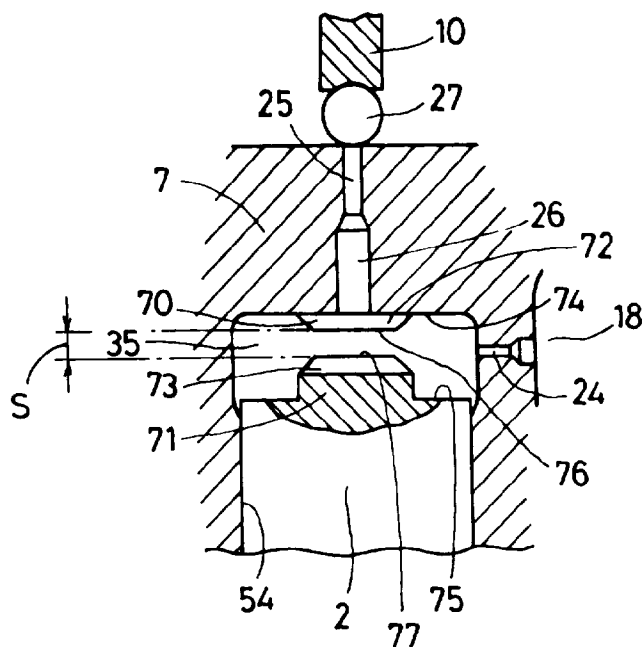
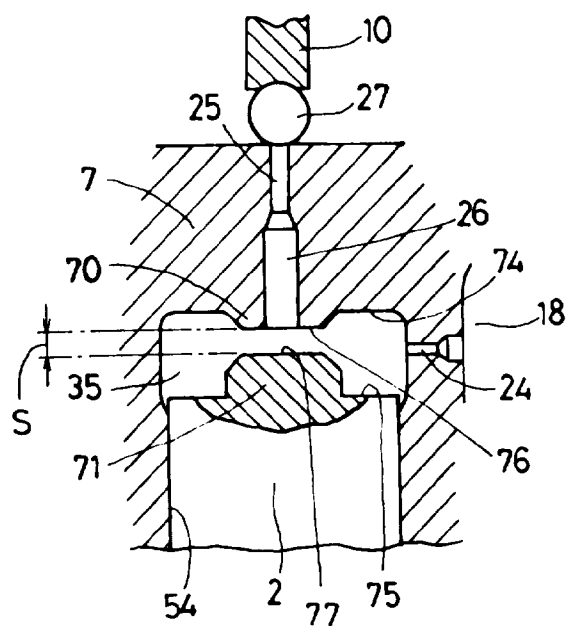


FIG. 7 (PRIOR ART)





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 5156

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 385 399 (WEBER SRL) 5 September 1990 * column 3, line 40 - line 46; figure 2 * ---	1,3,5	F02M47/02
X	EP-A-0 548 916 (ELASIS SISTEMA RICERCA FIAT NE) 30 June 1993 * column 4, line 4 - line 19; figure 1 * ---	1,3,5	
A	US-A-4 471 740 (JOURDE JEAN-PIERRE ET AL) 18 September 1984 * column 2, line 42 - line 48; figure 1 * ---	2,6	
A	CH-A-443 787 (SULZER) 15 February 1968 * column 4, line 8 - line 11; figure 1 * ---	3,5	
A	EP-A-0 426 205 (GANSER MARCO ALFREDO) 8 May 1991 * column 5, line 15 - line 21; figure 1 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F02M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 7 October 1996	Examiner Torle, E
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