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(54) Fuel injection pump.

(57) A fuel injection pump (1) with a simple structure that is able to respond to the demands of an engine by enabling both the pilot injection amount and the interval between pilot injection and main injection to be varied in accordance with the load (fuel injection amount). In the fuel injection pump, formed on the outer surface of the plunger is a pilot spill slit (32) that communicates with the fuel suction and discharge hole (26) of the plunger, a pilot injection cutoff port (33) is formed in the control sleeve (18) in a position in the axial direction that corresponds to the pilot spill slit (32), separately from the main injection cutoff port (30), and the angle of inclination from the horizontal of the pilot spill slit (32), and the mutual angle of inclination between the upper (32A) and lower edges (32B) of the slit, can be adjusted.

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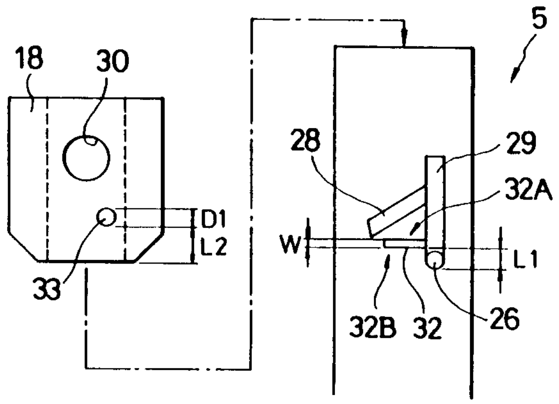

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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a fuel injection pump used in diesel engines or other internal combustion engines, and particularly to a fuel injection pump that is equipped with a prestroke adjustment mechanism and performs pilot injection.

Description of the Prior Art

Conventional fuel injection pumps are provided with prestroke adjustment mechanisms used to vary their prestrokes, and typically the prestroke is varied by adjusting the relative positions of a vertically-reciprocating plunger and a control sleeve around the plunger. Descriptions of such prestroke adjustment mechanisms are found in Japanese Utility Model Public Disclosure No. Sho 61-118936, as one example.

In diesel engines retardation of the ignition timing is used to prevent the formation of nitrogen oxides, and pilot injection followed by main injection is used to reduce the noise of the combustion. Examples of this are described in Japanese Utility Model Public Disclosure Nos. Sho 61-167470 and Sho 63-83458, Japanese Patent Publication No. Sho 62-261667, Japanese Utility Model Public Disclosure No. Sho 56-15398, and Japanese Patent Publication Nos. Sho 29-2502 and Sho 47-5863, for example.

However, in the conventional fuel injection pump it is not possible to vary the pilot injection amount and the interval between pilot injection and main injection (the cam angle interval) in accordance with the load (the fuel injection amount). Hence, it is difficult to select an appropriate pilot injection amount and interval that corresponds to engine demands across all load regions, from low to high.

Especially when engine ignition retardation period varies according to load, from the point of view of adjusting this ignition retardation period it is desirable that the pilot injection amount and the interval between pilot injection and main injection be adjustable.

SUMMARY OF THE INVENTION

The object of the present invention is therefore to provide a fuel injection pump having a simple construction that is able to respond appropriately to the demands of an engine by enabling both the pilot injection amount and the interval between pilot injection and main injection to be varied in accordance with the load (fuel injection amount).

In accordance with the present invention, this object is achieved by a fuel injection pump in which the above pilot injection amount and interval can be varied by appropriately adjusting the shape of a pilot spill slit formed in a plunger, comprising a plunger barrel provided with a fuel pressure chamber, a plunger which reciprocates within this plunger barrel to take in fuel from a fuel reservoir chamber via a fuel suction and discharge hole and deliver this fuel from the fuel pressure chamber under pressure, and a control sleeve slidably fitted on the plunger, with the prestroke being adjusted by altering the relative position of the control sleeve and the plunger in the axial direction, an inclined control groove that is formed on the outer surface of the plunger and communicates with the fuel suction and discharge hole of the plunger, a main injection cutoff port formed in the control sleeve at a position corresponding to the inclined control groove in the axial direction, a pilot spill slit that is formed on the outer surface of the plunger and communicates with the fuel suction and discharge hole of the plunger, a pilot injection cutoff port formed in the control sleeve at a position corresponding to the pilot spill slit in the axial direction, and in which the angle of inclination from the horizontal of the pilot spill slit, and the mutual angle of inclination between the upper and lower edges thereof, can be adjusted.

In the fuel injection pump thus arranged according to this invention, by providing the plunger with a pilot spill slit and the control sleeve with a pilot injection cutoff port in addition to the conventional arrangement of the inclined control groove formed in the plunger for controlling the main injection and the main injection cutoff port formed in the control sleeve, main injection is completed by the engagement of the inclined control groove and main injection cutoff port, and pilot injection is completed by the engagement of the pilot spill slit and pilot injection cutoff port. The shape of the pilot spill slit, an element that determines the pilot injection amount and the interval between pilot injection and main injection, has been made variable. This shape can be adjusted by simply adjusting the inclination of the slit or the angle of the top and bottom edge thereof, thereby making it an easy matter to set the pilot injection amount and the interval between pilot injection and main injection. The shape, position and length of the pilot spill slit can also be used to realize pilot injection at all speed regions and loads.

Further features of the invention, its nature and various advantages will become more apparent from the accompanying drawings and following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional side view of a fuel injection pump equipped with a prestroke adjustment mechanism in accordance with a first embodiment of the present invention;

Figure 2 is a front view of the plunger and control sleeve used in the arrangement of the above embodiment;

Figure 3 is a graph showing the injection amount relative to the cam angle in the same embodiment;

Figure 4 is a graph showing the relationship between the position of the injection amount adjustment rod and the cam lift acting on the plunger, in the same embodiment;

Figure 5 is a detail view of the plunger showing the pilot spill slit shape arrangement according to the first embodiment;

Figure 6 is a graph of the plunger-based pilot injection amount Qpilot, interval ΔA and main injection amount Qmain;

Figure 7 is a detail view of the plunger showing the pilot spill slit shape arrangement according to a second embodiment of the invention;

Figure 8 is a graph of the plunger-based pilot injection amount Qpilot, interval ΔA and main injection amount Qmain in the second embodiment;

Figure 9 is a detail view of the plunger showing the pilot spill slit shape arrangement according to a third embodiment of the invention;

Figure 10 is a graph of the plunger-based pilot injection amount Qpilot, interval ΔA and main injection amount Qmain in the third embodiment;

Figure 11 is a detail view of the plunger showing the pilot spill slit shape arrangement according to a fourth embodiment of the invention; and

Figure 12 is a graph of the plunger-based pilot injection amount Qpilot, interval ΔA and main injection amount Qmain in the fourth embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the invention will now be described with reference to Figure 1 which is a cross-sectional side view of a fuel injection pump 1. Formed in the pump housing 2 of the fuel injection pump 1 is a number of vertical holes 3 corresponding to the number of engine cylinders. Inserted into each of these vertical holes 3 is a lower plunger barrel 4 that is secured to the pump housing 2, and inserted into each lower plunger barrel 4 is a plunger 5 that is capable of rotary and reciprocating motion.

The upper end of the plunger 5 is inserted into an upper plunger barrel 6 that is secured to the pump housing 2 via the lower plunger barrel 4. A delivery valve 7 is provided inside the upper plunger barrel 6. A fuel pressure chamber 8 is formed between this delivery valve 7 and the plunger 5, and a fuel outlet 9 is formed over the delivery valve 7.

The lower end of the plunger 5 abuts via tappet 12 against a cam 11 mounted on a camshaft 10. The camshaft 10 is rotated by an engine to which it is linked so that, with the cooperative action of a spring 13, the plunger 5 maintains an abutment that follows the peripheral edge of the cam 11, producing a reciprocating motion in the vertical direction, with reference to the drawing.

The plunger 5 has a driving face that engages with an injection amount adjustment sleeve 15. Through the engagement of a projection 16 with this injection amount adjustment sleeve 15 whereby an injection amount adjustment rod 17 in engagement with the projection 16 is rotated perpendicularly, with reference to the surface of the drawing sheet, by an amount corresponding to the amount by which an accelerator pedal (not shown) is depressed, the injection amount adjustment sleeve 15 rotates the plunger 5. Thus, the effective stroke used to effect the fuel injection under pressure can be adjusted by rotating the plunger 5 by means of the injection amount adjustment rod 17.

The upper portion of the plunger 5 can slide within a control sleeve 18 that is provided with a guide groove 19, located on the left in the drawing, and an engaging groove 20, located on the right in the drawing. This guide groove 19 engages with a guide pin 21 provided on the lower plunger barrel 4, and the engaging portion 23 of a timing control rod 22 locates in the engaging groove 20. The timing control rod 22 is housed in a horizontal hole 24 formed in the pump housing 2, where it is held rotatably by a bearing (not shown). When an electronic control system is used, the timing control rod 22 is linked to a stepping motor or other such actuator (not shown) and is driven by being rotated by the actuator.

Thus, the prestroke can be adjusted by using the rotation of the timing control rod 22 to move the control sleeve 18 vertically. That is, when the timing control rod 22 is rotated clockwise or counterclockwise with reference to the drawing, the engaging portion 23 is also rotated as one with the timing control rod 22 to thereby produce vertical movement of the control sleeve 18, changing the relative position of the plunger 5 and control sleeve 18 in the vertical direction. That is, it is possible to adjust the prestroke of the plunger 5, the prestroke being defined as the distance between the control sleeve 18 and the position of the fuel suction and discharge hole 26 (described later) at the bottom dead center point of the plunger 5, which is to say the prestroke of the plunger 5 is the distance of travel from the bottom dead center point of the plunger 5 to the point at which the fuel suction and discharge hole 26 closes, which is when fuel injection starts.

Turning the timing control rod 22 clockwise moves the control sleeve 18 upwards, increasing the prestroke, retarding the injection start time and providing a high injection rate (the ratio of the fuel injection amount relative to the unit angle of rotation of the camshaft 10; that is, the rate of time-based change in the injection amount) suited to high engine speeds. Conversely, turning the timing control rod 22 counterclockwise moves the control sleeve 18 downwards, decreasing the prestroke and advancing the injection start time, providing a lower injection rate than the one suited to high engine speeds. However, the absolute amount of the injection increases.

When the plunger 5 slidably arranged in the lower plunger barrel 4 is driven by the rotary motive power of the engine via the camshaft 10 and cam 11 so that it reciprocates within the lower plunger barrel 4 and upper plunger barrel 6, fuel in the fuel reservoir chamber 25 is sucked into the fuel pressure chamber 8 and is then injected from a fuel injection nozzle (not shown) by being delivered under pressure from the fuel outlet 9 through a fuel injection pipe (not shown).

The plunger 5 is provided with the radially-oriented fuel suction and discharge hole 26 which acts as a fuel inlet port that opens into the fuel reservoir chamber 25, a center communicating hole 27 formed along the center axis that connects the fuel suction and discharge hole 26 and the fuel pressure chamber 8, the inclined control groove 28 formed on the outer surface of the plunger, and a vertical connecting groove 29 that connects the inclined control groove 28 and the opening portion of the fuel suction and discharge hole 26. A main injection cutoff port 30 is formed radially in the control sleeve 18 slidably arranged on the plunger 5. This main injection cutoff port 30 is disposed so as to be able to connect to the inclined control groove 28 in accordance with the vertical motion of the plunger 5.

The fuel reservoir chamber 25 is connected to a fuel inlet 31 via the horizontal hole 24 formed in the pump housing 2. In addition to the inclined control groove 28 of the plunger 5 and the main injection cutoff port 30 of the control sleeve 18, as shown in Figure 2, for pilot injection a pilot spill slit 32 is formed in the plunger 5 and a pilot injection cutoff port 33 is formed in the control sleeve 18. To communicate with the fuel suction and discharge hole 26 of the plunger 5, the pilot spill slit 32 is formed horizontally on the outer surface on the same side as the inclined control groove 28 with respect to fuel suction and discharge hole 26 and vertical communicating groove 29, so that it has a constant width and extends a prescribed circumferential length.

Also, as described later, the type of arrangement shown in Figure 2, in which the pilot spill slit 32 is formed horizontally with a constant width, is a fixed design in which the main injection amount and the interval between main injection and pilot injection cannot be adjusted in accordance with the load. The pilot injection cutoff port 33 is formed in the control sleeve 18 at a position relative to the axial direction of the plunger 5 that corresponds to the pilot spill slit 32. The pilot injection cutoff port 33 is formed lower on the control sleeve 18 than the main injection cutoff port 30.

The operation of the fuel injection pump 1 thus configured will now be described. At the beginning of the ascent of the plunger 5 from bottom dead center the fuel suction and discharge hole 26 opens into the fuel reservoir chamber 25 and the fuel reservoir chamber 25 and fuel pressure chamber 8 are in communication via the fuel suction and discharge hole 26 and the center communicating hole 27, so there is no rise in the pressure of the fuel in the fuel pressure chamber 8 and the delivery valve 7 remains closed.

In the actual delivery of the fuel, the plunger 5 rises and the fuel suction and discharge hole 26 is closed by the lower end of the control sleeve 18, thereby raising the pressure of the fuel in the fuel pressure chamber 8, and when the delivery valve opening pressure is exceeded the delivery valve 7 opens and fuel is delivered (under pressure) from the fuel outlet 9, and pilot injection commences. Pilot injection is ended when fuel spills into the fuel reservoir chamber 25 from the fuel pressure chamber 8 as a result of communication between the pilot spill slit 32 and the pilot injection cutoff port 33.

With the further rise of the plunger 5 communication between the pilot spill slit 32 and the pilot injection cutoff port 33 is cut off, thereby again closing off the fuel pressure chamber 8, and main injection starts. The interval between the completion of pilot injection and the start of main injection is interval ΔA. Main injection is completed by the engagement of the inclined control groove 28 with the main injection cutoff port 30.

That is, with the further rise of the plunger 5, the inclined control groove 28 in communication with the fuel suction and discharge hole 26 comes into communication with the main injection cutoff port 30 of the control sleeve 18, thereby producing communication between the main injection cutoff port 30 and the fuel pressure chamber 8 via the main injection cutoff port 30, inclined control groove 28, vertical communicating groove 29, fuel suction and discharge hole 26 and center communicating hole 27, whereupon fuel in the fuel pressure chamber 8 flows into the fuel reservoir chamber 25, the pressure of the fuel in the fuel pressure chamber 8 declines and the delivery valve 7 closes, completing the fuel injection.

Figure 3 is a graph showing the injection amount relative to the angle of rotation of the cam 11. When pilot injection first starts (pilot injection amount Qpilot), the period during which the pilot spill slit 32 and the pilot injection cutoff port 33 are in communication is interval ΔA, and this is followed by main injection (main injection amount Qmain).

When the plunger 5 descends, the negative pressure causes the fuel in the fuel reservoir chamber 25 to be sucked into the fuel pressure chamber 8 via the fuel suction and discharge hole 26. The prestroke, i.e. fuel injection timing, can be controlled by turning the timing control rod 22 to thereby move the control sleeve 18 vertically.

Figure 4 is a graph showing the relationship between the position of the injection amount adjustment rod 17 and the cam lift acting on the plunger 5. The pilot spill slit 32 is formed horizontally on the outer surface of the plunger 5, so the pilot injection amount Qpilot remains constant whatever the position of the injection amount adjustment rod 17, while the main injection amount Qmain corresponds to the position of the injection amount adjustment rod 17. Moreover, as the pilot spill slit 32 has a constant width, interval ΔA is constant whatever the position of the injection amount adjustment rod 17.

With reference to Figure 2, the pilot injection amount is determined by three factors, which are the distance L1 from the fuel suction and discharge hole 26 to the pilot spill slit 32, the distance L2 from the lower edge of the control sleeve 18 to the lower edge of the pilot injection cutoff port 33, and the width W of the pilot spill slit 32 in the axial direction. Interval ΔA between pilot injection and main injection is determined by the sum of the above width W of the pilot spill slit 32 and the diameter D1 of the pilot injection cutoff port 33.

Therefore, it is possible to vary pilot injection amount Qpilot and interval ΔA in accordance with the load (fuel injection amount), by determining whether the pilot spill slit 32 is horizontal (the inclination angle of the pilot spill slit 32), and whether the upper edge 32A and the lower edge 32B thereof are horizontal or inclined (the angle of mutual inclination between upper edge 32A and lower edge 32B), and adjusting these as required.

The shape of the pilot spill slit for adjusting pilot injection amount Qpilot and interval ΔA based on the load (fuel injection amount) will now be explained. Figure 5 shows the pilot spill slit shape arrangement of a plunger 40, according to the first embodiment, and Figure 6 is a graph of the pilot injection amount Qpilot, interval ΔA and main injection amount Qmain with respect to plunger 40.

As shown in Figure 5, the upper edge 41A and lower edge 41B of the pilot spill slit 41 are parallel to each other (i.e. the space between them is constant), while the pilot spill slit 41 has a slight downward inclination from the horizontal. Thus, as shown in Figure 6, moving the position of the injection amount adjustment rod 17 further toward the high load side (as the plunger 40 is rotated to the right in the drawing) retards the engagement of the pilot spill slit 41 and pilot injection cutoff port 33, increasing the pilot injection amount Qpilot. That is, with the upper edge 41A and lower edge 41B of the pilot spill slit 41 parallel and the width W therebetween being constant, interval ΔA is constant.

Figure 7 is a view of a plunger 50 showing the pilot spill slit shape arrangement, according to a second embodiment of the invention, and Figure 8 is a graph of the pilot injection amount Qpilot, interval ΔA and main injection amount Qmain in the case of plunger 50. As shown in Figure 7, the upper edge 51A and lower edge 51B of the pilot spill slit 51 are parallel to each other, while the pilot spill slit 51 has a slight upward inclination from the horizontal. Therefore, as shown by Figure 8, moving the position of the injection amount adjustment rod 17 further toward the high load side advances the engagement of the pilot spill slit 51 and pilot injection cutoff port 33, reducing pilot injection amount Qpilot. Thus, as main injection amount Qmain increases, pilot injection amount Qpilot decreases. With the upper edge 51A and lower edge 51B of the pilot spill slit 51 parallel and the width W therebetween being constant, interval ΔA is constant.

Figure 9 is a detail view of a plunger 60 showing the pilot spill slit shape arrangement according to a third embodiment of the invention, and Figure 10 is a graph of the pilot injection amount Qpilot, interval ΔA and main injection amount Qmain with respect to plunger 60. As shown in Figure 9, the upper edge 61A of the pilot spill slit 61 is formed level while the lower edge 61B has a downward inclination in the high load direction. Thus, upper edge 61A and lower edge 61B are formed at a mutual angle whereby the width of the pilot spill slit 61 is wider toward the end of the slit. Therefore as the upper edge 61A is level, regardless of the position of the injection amount adjustment rod 17, the pilot injection amount Qpilot does not increase or decrease but instead remains constant, as shown by Figure 10. Thus, whether the main injection amount Qmain increases or decreases, the pilot injection amount Qpilot remains the same.

Since the further the injection amount adjustment rod 17 is moved toward the high load side, the longer the state of engagement that is maintained between the pilot spill slit 61 and pilot injection cutoff port 33, the interval ΔA increases with the increase in main injection amount Qmain.

Finally, Figure 11 is a view of a plunger 70 and the pilot spill slit shape arrangement, according to a fourth embodiment of the invention, and Figure 12 is a graph of the plunger-based pilot injection amount Qpilot, interval ΔA and main injection amount Qmain in the case of plunger 70. As shown in Figure 11, the upper edge 71A of the pilot spill slit 71 is formed level while the lower edge 71B has an upward inclination in the high load direction. Thus, the upper edge 71A and lower edge 71B are formed at a mutual angle whereby the width of the pilot spill slit 71 narrows going toward the end of the slit. Therefore as the upper edge 71A is level, regardless of the position of the injection amount adjustment rod 17, the pilot injection amount Qpilot does not increase or decrease but instead remains constant, as shown by Figure 12. Thus, the pilot injection amount Qpilot remains the same whether the main injection amount Qmain increases or decreases. Since the further the injection amount adjustment rod 17 is moved toward the high load side, the shorter the state of engagement that is maintained between the pilot spill slit 71 and pilot injection cutoff port 33, the interval ΔA decreases with the increase in main injection amount Qmain.

Thus, it is possible to set the pilot injection amount Qpilot, interval ΔA, and main injection amount Qmain as required by selecting a prescribed combination of inclination angle of the pilot spill slit 32 (41, 51, 61, 71) and the angle formed between the upper edge 32A (41A, 51A, 61A, 71A) and the lower edge 32B (41B, 51B, 61B, 71B) and the lower edge, so that each setting is based on the requirements of the engine.

This invention is directed at enabling the pilot injection amount and interval to be adjusted based on the load (fuel injection amount). It is not directed at enabling the pilot injection amount Qpilot and interval ΔA to be adjusted in accordance with the engine speed in rpm corresponding to the speed of plunger reciprocal motion.

In accordance with this invention, using a pilot spill slit of a prescribed length enables pilot injection to be effected in the case of prestroke values in high load or low load regions. By utilizing the change in the pilot spill slit end position in the circumferential direction resulting from the rotation of the plunger to limit the circumferential position of the slit, it is also possible to limit the load regions produced by pilot injection. That is, it is possible to not perform pilot injection during low load operation, or to not perform pilot injection during high load operation.

In this invention, various configurations may be used for the fuel suction and discharge hole formed in the plunger and the inclined control groove and vertical connecting groove and the relative positions thereof, and this also applies to where to form the pilot spill slit for direct communication therewith, and to the shape of the slit itself.

It goes without saying that in the control sleeve the main injection cutoff port is formed at a position corresponding to the inclined control groove, and the pilot injection cutoff port is formed at a position corresponding to the pilot spill slit.

Claims

1. A fuel injection pump comprising:

a plunger barrel provided with a fuel pressure chamber;

a plunger which reciprocates within this plunger barrel to take in fuel from a fuel reservoir chamber via a fuel suction and discharge hole and deliver this fuel from the fuel pressure chamber under pressure;

a control sleeve slidably fitted on the plunger;

in which the prestroke may be adjusted by altering the relative position of the control sleeve and the plunger in the axial direction;

wherein an inclined control groove is formed on the outer surface of the plunger that communicates with the fuel suction and discharge hole of the plunger and a main injection cutoff port is formed in the control sleeve in the axial direction at a position corresponding to the inclined control groove;

a pilot spill slit is formed on the outer surface of the plunger that communicates with the fuel suction and discharge hole of the plunger and a pilot injection cutoff port is formed in the control sleeve in the axial direction at a position corresponding to the pilot spill slit, separately from the main injection cutoff port;

and the angle of inclination from the horizontal of the pilot spill slit, and the mutual angle of inclination between the upper and lower edges thereof can be adjusted.

2. A fuel injection pump according to claim 1 wherein for communication with the fuel suction and discharge hole of the plunger the pilot spill slit is formed on the outer surface so that it is on the same side as the fuel suction and discharge hole, extends over a prescribed circumferential length and is below the inclined control groove.

3. A fuel injection pump according to claim 1 wherein the pilot injection cutoff port is formed so that it is further towards the lower end of the control sleeve than is the main injection cutoff port.

4. A fuel injection pump according to claim 1 wherein

pilot injection is started by the plunger rising whereby the fuel suction and discharge hole is closed by the lower end of the control sleeve;

pilot injection is ended by the pilot spill slit coming into communicating engagement with the pilot injection cutoff port;

main injection is started by the release of communicating engagement between the pilot spill slit and the pilot injection cutoff port; and

main injection is ended by the inclined control groove coming into communicating engagement with the main injection cutoff port.

5. A fuel injection pump according to claim 1 wherein the gap between the upper edge and the lower edge of the pilot spill slit is constant.

6. A fuel injection pump according to claim 1 wherein the gap between the upper edge and the lower edge of the pilot spill slit is wider towards the end of the slit.

7. A fuel injection pump according to claim 1 wherein the gap between the upper edge and the lower edge of the pilot spill slit is narrower towards the end of the slit.

8. A fuel injection pump according to claim 1 wherein the upper edge of the pilot spill slit is horizontal.

9. A fuel injection pump according to claim 1 wherein the upper edge of the pilot spill slit has a downward inclination from the horizontal.

10. A fuel injection pump according to claim 1 wherein the upper edge of the pilot spill slit has an upward inclination from the horizontal.

11. A fuel injection pump according to claim 1 wherein the lower edge of the pilot spill slit is horizontal.

12. A fuel injection pump according to claim 1 wherein the lower edge of the pilot spill slit has a downward inclination from the horizontal.

13. A fuel injection pump according to claim 1 wherein the lower edge of the pilot spill slit has an upward inclination from the horizontal.

14. A fuel injection pump according to claim 1 wherein the pilot spill slit is horizontal.

15. A fuel injection pump according to claim 1 wherein the pilot spill slit has a downward inclination from the horizontal.

16. A fuel injection pump according to claim 1 wherein the pilot spill slit has an upward inclination from the horizontal.

FIG.1

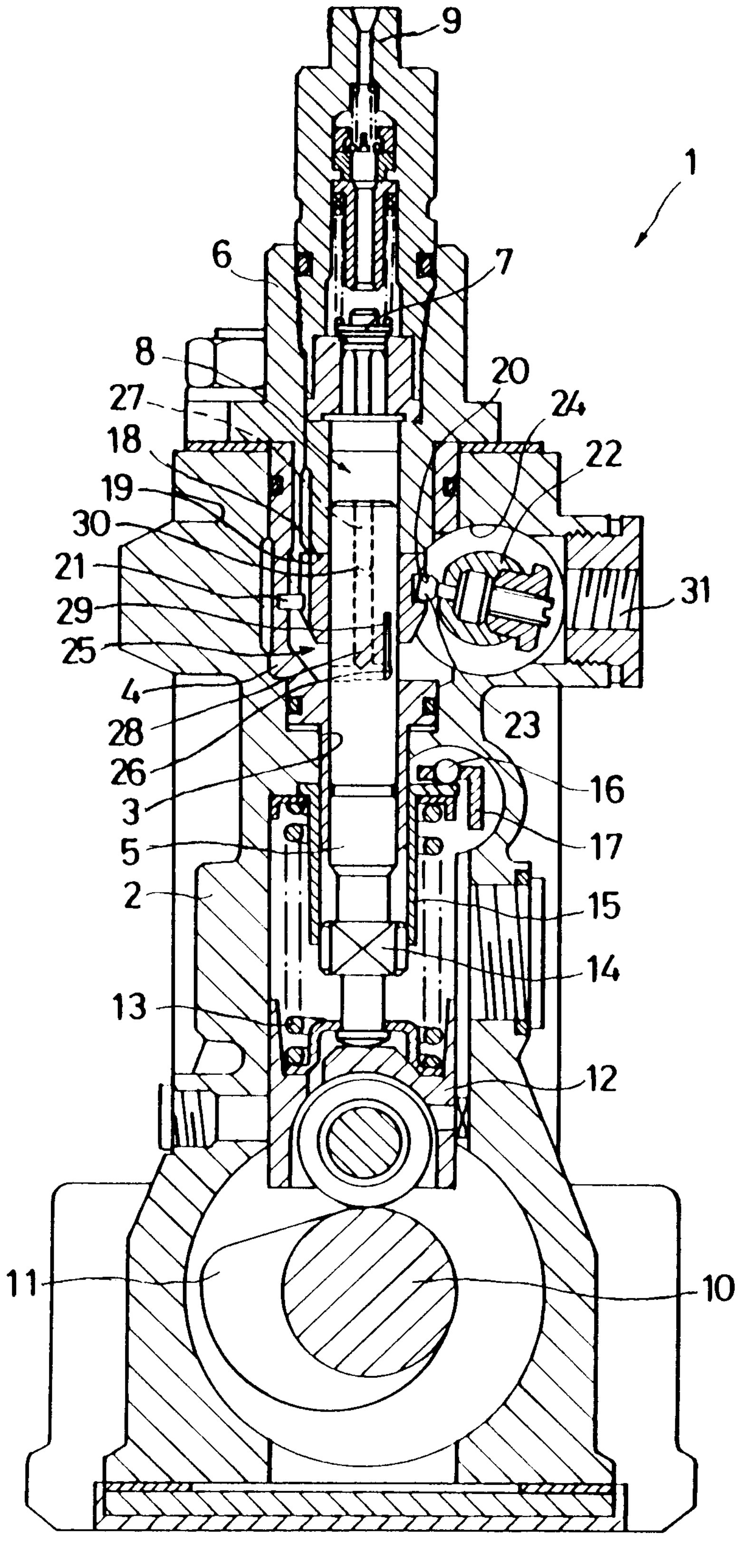
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FIG.2

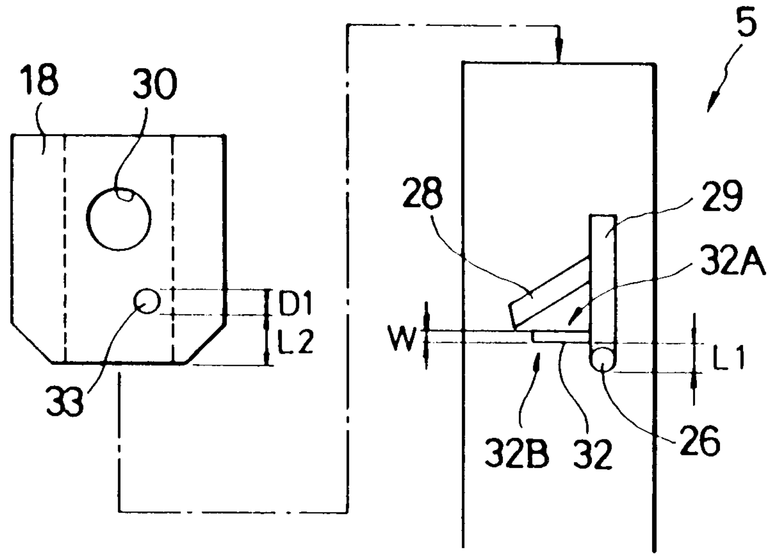


FIG.3

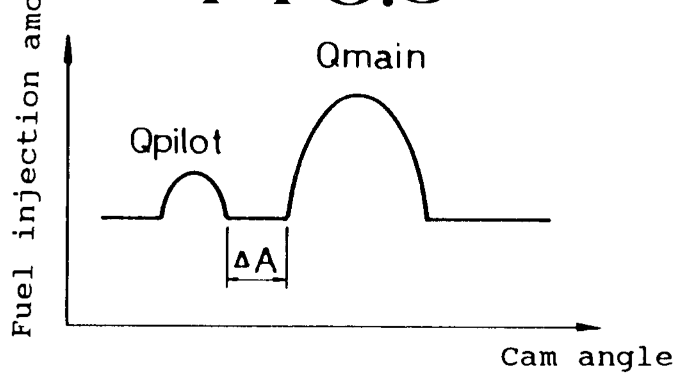
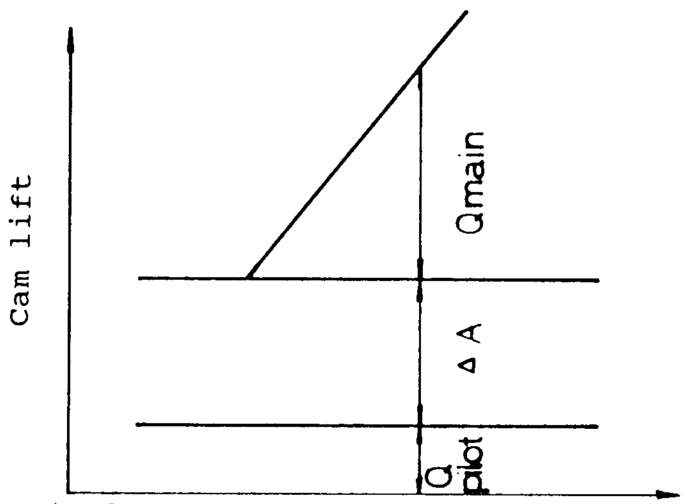


FIG.4

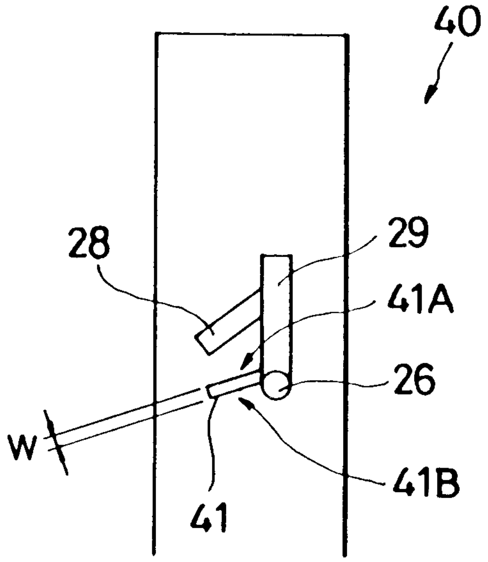


Prestroke

Injection amount adjustment rod position -->

high load

FIG.5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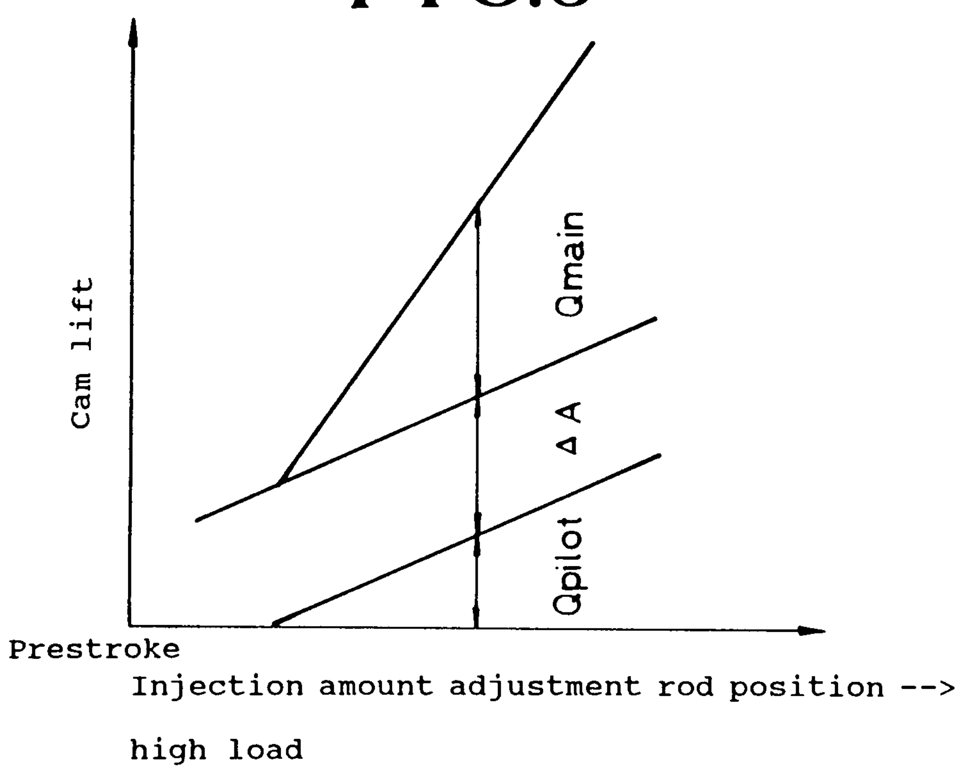
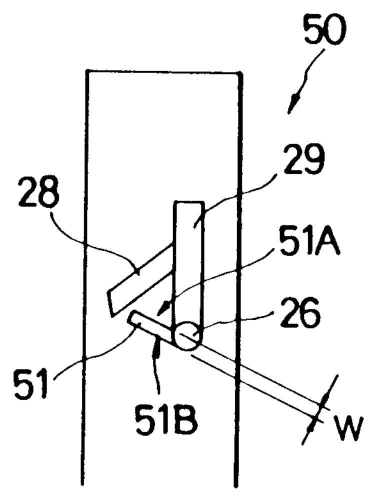
28
29
41A
26
W
41
41B

FIG.6


Cam lift
Qmain
Δ A
Qpilot
Prestroke
Injection amount adjustment rod position -->
high load

F I G.7



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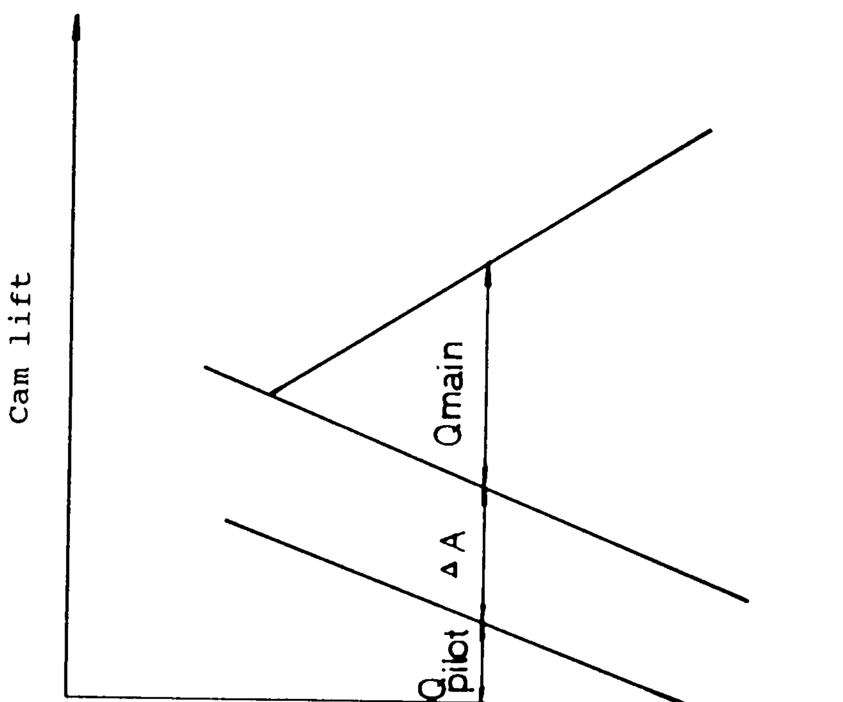


Prestroke

Injection amount adjustment rod position -->

high load

FIG.9

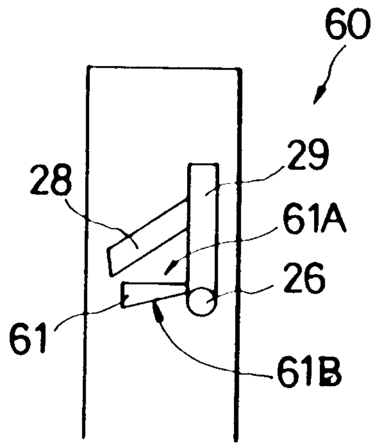
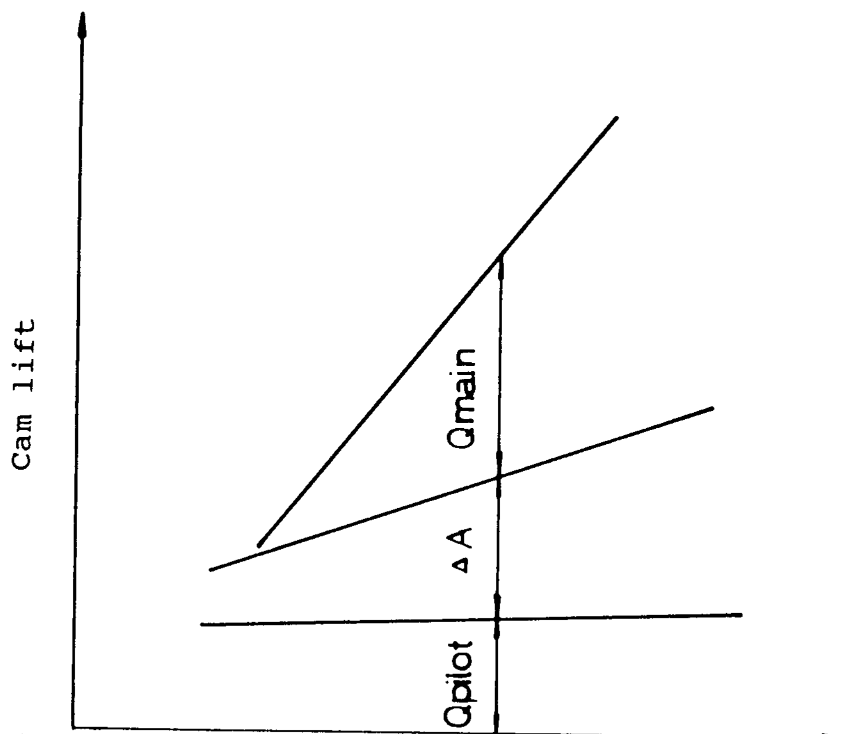


FIG.10

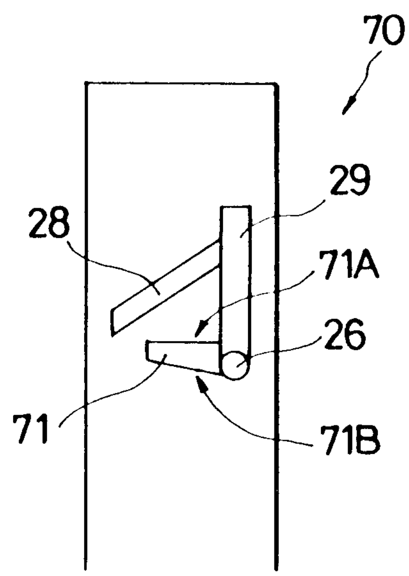


Prestroke

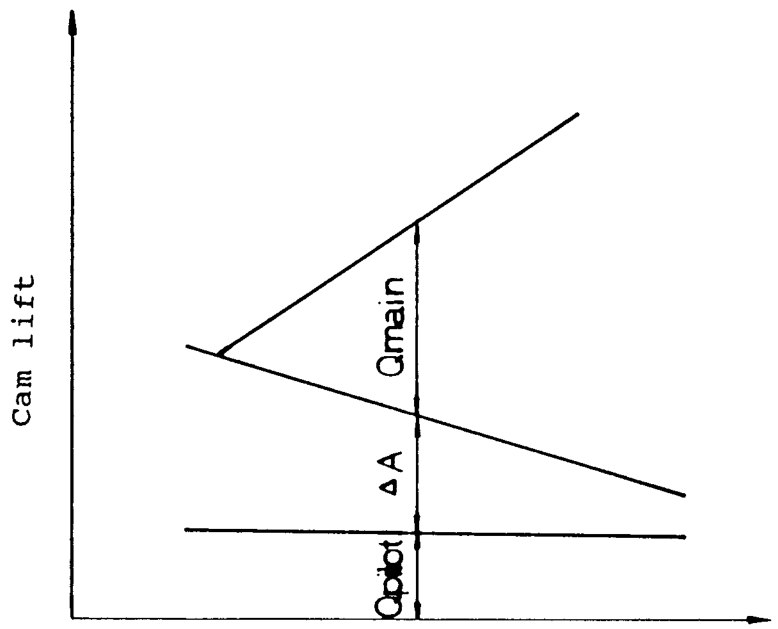
Injection amount adjustment rod position -->

high load

F I G.11



F I G. 12



Prestroke

Injection amount adjustment rod position -->

high load

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 10 7507

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.5)
D,A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 141 (M-691)(2988) 28 April 1988 & JP-A-62 261 667 (DIESEL KIKI) 13 November 1987 * abstract * ---	1,3-5	F02M45/06 F02M59/26
A	EP-A-0 294 822 (KLÖCKNER-HUMBOLDT-DEUTZ) * column 6, line 30 - column 8, line 17; figures 7-9 * ---	1,4,5,7,9,12,15	
D,A	JP-U-63 083 458 (DIESEL KIKI) * the whole document * ---	7,8,13	
A	GB-A-421 818 (OLDHAM) * page 3, line 23 - line 47; figure 3 * ---	2-5,9,11,12,15	
A	DE-C-923 400 (KORNACKER) * page 2, line 66 - line 121; figures 1,2 * -----	7,9,11	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 JULY 1992	SIDERIS MARIOS

CATEGORY OF CITED DOCUMENTS

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