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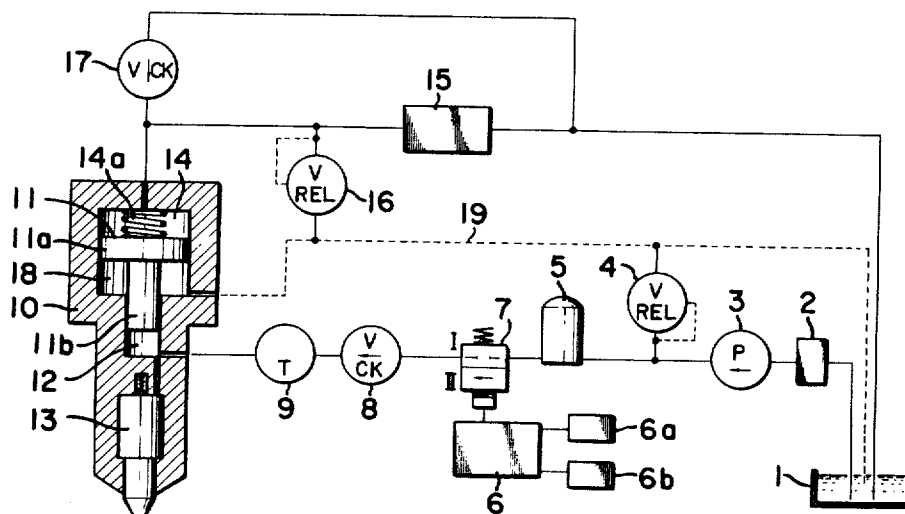
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A fuel injection device for Diesel engines in which the controlling of an amount of fuel is effected by an electromagnetic valve and the changing of an injection timing is made by a plunger.

1 Claim, 3 Drawing Figures



FUEL INJECTION DEVICE FOR DIESEL ENGINES

A fuel injection device for Diesel engines.

This invention relates to a fuel injection device for Diesel engines and more particularly to improvement in a high pressure fuel injection device in which the controlling of an amount of fuel is effected by means of an electromagnetic valve and the changing of an injection timing is made by means of a plunger.

An object of this invention is to provide a fuel injection device for Diesel engines in which a period of fuel injection is made constant with respect to a cam speed as conventional row-type fuel injection pumps for Diesel engines and combustion noise is reduced.

In order that this invention may be more clearly understood, reference will now be made, by way of example, to the accompanying drawing in which:

FIG. 1 is a view showing a basic structure of a fuel injection device according to this invention,

FIG. 2 is a sectional view of a pressure generating device and

FIG. 3 is an operation period diagram of an electromagnetic valve, a fuel pressure diagram, fuel pressure curves and fuel injection curves.

Referring now to FIG. 1, a fuel tank 1 is connected through a filter 2 to a suction side of a fuel supply pump 3. In a discharge portion of the fuel supply pump 3 are provided a relief valve 4 and an accumulator 5. The tank 1 is further connected through an electromagnetic valve 7, a check valve 8 and a fixed throttle member 9, said electromagnetic valve 7 being able to be operated by means of a control circuit 6 having inputs of a load detector circuit 6a and an atmosphere temperature detector circuit 6b, to a plunger chamber 12 provided below a small diameter portion 11b of a servopiston 11 which comprises a large diameter portion 11a within a body 10 and further to an injection nozzle 13.

The electromagnetic valve 7 as described above is operated by means of the control circuit 6 corresponding to operation of an engine, and constructed to, in its position I, close the passage between the oil supply pump 3 and the plunger chamber 12 and in its position II, open it. A piston chamber 14 which is provided in the upper part of the large diameter portion 11a of the servopiston 11, includes a spring 14a which depresses the servopiston 11 downwardly and is connected to a fuel tank 1 through a pressure generating device 15 shown in FIG. 2. Between the pressure generating device 15 and the servopiston chamber 14 is provided a relief valve 16 which acts to return fuel to the fuel tank 1 when the fuel pressure supplied from the pressure generating device 15 exceeds a pressure sufficient for displacing the servopiston. There is provided a check valve 17 between the servopiston chamber 14 and the fuel tank 1 to permit the fuel flow from the fuel tank 1 to the servopiston chamber 14. A counter piston chamber 18 provided below the large diameter portion 11a of the servopiston 11 is connected to the fuel tank 1 through an oil conduit 19 connected with the relief valves 4 and 16 mentioned above. The pressure generating device 15 comprises a plunger 15b which is slidably fitted oil tightly in a barrel 15a as shown in FIG. 2. The plunger 15b is reciprocally moved by rotation of a cam C to provide an identical amount of fuel under pressure and is formed with an upper notch 15c and a lower notch 15d in order to vary timing of fuel injection, said notches 15c and 15d being communicated

through a longitudinal groove 15e and being constructed to be inclined to vary the timing of the injection by rotation of the plunger 15b. The fuel under pressure is supplied when a passage hole 15f provided in the barrel is closed between the notches 15c and 15d. In the above supply device of fuel under pressure or the pressure generating device 15, the plunger head portion is connected to the servopiston chamber 14 and the passage hole 15f is connected to the fuel tank 1.

Times which the electromagnetic valve is in the positions I and II will be now explained with reference to FIG. 3. The period of time which the electromagnetic valve is in the position II is that of the fuel supplied to the plunger chamber 12. By changing such period of time it is possible to have an amount of supplied fuel varied and obtain a changed injection amount Q of the fuel. In a shorter time pulses I II and I I are obtained as shown by the solid line in FIG. 3 (1) and as seen from servopiston displacement S shown by the solid line in FIG. 3(3), a lifting amount of the servopiston is reduced, that is, an amount of the fuel supplied in the plunger chamber is lessened so that an injection amount of the fuel is reduced. The period of time which the electromagnetic valve is in the position I covers the other period of time. The fuel charging period of time in the position II, as seen from FIG. 3(2) showing a variation diagram of a supplied fuel under pressure P by the pressure generating device 15, is the period during which the plunger 15b move downwardly to prepare a next fuel supply under pressure, the upper notch 15c is situated below the passage hole 15f and the servopiston chamber 14 is connected to the fuel tank 1, that is, the period during which the plunger 15b does not close the passage hole 15f.

According to the above construction, the fuel supplied through the filter 2 from the fuel tank 1 by the oil supply pump 3 may be controlled in its pressure by the relief valve 4 and is stored in the accumulator 5. When the upper notch 15c of the pressure generating device 15 moves to a position below the passage hole 15f and the electromagnetic valve 7 is in the position II, the fuel as stored in the accumulator 5 is supplied through the check valve 8 and the fixed throttle member 9 to the plunger chamber 12 so as to move upwardly the servopiston 11 against force of the spring 14a. By the up movement of the servopiston 11, the fuel in the servopiston chamber 14 may pass through the longitudinal groove 15e provided on the plunger 15b, the notch 15d and the passage hole 15f and is returned to the fuel tank 1. As the fuel amount required for an engine and associating with the fuel supply pressure and the time of the fuel supply pump 3 enters the plunger chamber 12, the electromagnetic valve 7 is in the position I to prepare for a next fuel injection. A signal for actuating the electromagnetic valve may be obtained by conventional means such as means for obtaining rotary phase of the cam shaft of the pump. In this position, as the plunger of the fuel generating device 15 is raised and the passage hole 15f is closed between the notches 15c and 15d of the plunger 15b, the fuel is supplied to the servopiston chamber 14 so that the fuel in the plunger chamber 12 is injected through the injection nozzle 13. When the amount of the fuel injected is less than that supplied to the injection nozzle 13 by the servopiston in the full stroke, the servopiston 11 comes to a lower end position before the pressure generating device 15 cuts off the fuel supply and thus the pressure in the ser-

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vopiston chamber 14 may rise higher than it is necessary. Therefore, in order to prevent the rise of the pressure is provided the relief valve 16 which is operated to communicate the fuel under pressure to the fuel tank 1 so as to prevent the excessive rise of the pressure. When the passage hole of the pressure generating device is communicated to the notch 15d of the plunger, the pressure generating device interrupts the fuel supply and thus the fuel injection is completed. In order to prepare a next fuel supply the plunger 15b moves downwards. Then, while the passage hole 15f is closed between the notches 15c and 15d, pressure down in the servopiston chamber 14 is prevented by the fuel in the fuel tank 1 flowing into the pressure generating device through the check valve 17. When the notch 15c in the plunger 15b of the pressure generating device 15 moves downwards to the position lower than the passage hole 15f, the servopiston chamber 14 and the fuel tank 1 may be communicated. Thereafter the electromagnetic valve is in the position II. The above operation is repeated to continue the fuel injection.

As mentioned above, the pressure source serving to move the servopiston 11 downwards for the fuel injection is obtained by a combination of the cam and the plunger. The cam is operated in synchronism with rotation of an engine so that the injection of the plunger will increase higher with increase of rotation of the engine.

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Many variations may be effected without departing from the spirit of this invention. It is to be understood that this, together with other variations in details, are anticipated by the appended claims.

I claim:

1. A fuel injection device for Diesel engines comprising a body including a large diameter portion and a small diameter portion of a servopiston to define a piston chamber, a counter piston chamber and a plunger chamber, a pressure generating device having a relief valve at the outlet side thereof and connected to said piston chamber, said pressure generating device including a plunger with inclined notches determining period and time of pressure generating operable synchronously to rotation of an engine, a fuel tank connected to said counter piston chamber, an injection nozzle in the body connected to said plunger chamber, a check valve preventing fuel from flowing out of said plunger chamber, and electromagnetic valve for closing and opening a passage of fuel under pressure and a fuel supply pump connected at the outlet side thereof through said electromagnetic valve and said check valve to said plunger chamber, whereby said pressure generating device and said electromagnetic respectively control piston strokes in fuel injection direction and fuel intake direction.

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