ABSTRACT OF THE DISCLOSURE

A precharged fuel injection pump providing pilot and main injection.

This invention relates to a fuel injection pump of the distributor type and particularly to a pump providing both precharging and pilot injection.

In a precharging fuel injection pump, precharge pressures such as 50 pounds per square inch by a pump plunger 31 has been known. However, a precharging plunger 31 is held open by a spring 32 so that oil pressures in the pump chamber 33 are equalized to the supply oil pressure.

The present invention provides a means of improving the fuel injection pump so that it has precharging as well as pilot injection.

The pump plunger 31 is reciprocated and rotated in a conventional manner to cyclically deliver fuel under pressure to the delivery passages 22. The plunger 31 has a precharging portion 32 disposed in a high pressure chamber 33 at the end of the plunger 31 and a precharging portion 36 disposed in the bore 24 adapted to cyclically connect the high pressure chamber 33 to the delivery passages 22 by way of main delivery port 37 and pilot delivery port 38. The central fuel supply passage 39 in plunger 31 not only serves to supply fuel from the supply chamber 12 to the high pressure chamber 33, but also serves to connect the high pressure chamber to delivery ports 37 and 38. As explained in the above mentioned copending patent application, Ser. No. 405,189, Precharged Fuel Injection Pump, the control sleeve 41 operates with the plunger 31 to determine the effective stroke of the plunger and the timing of fuel delivery to the delivery passages 22.

In the distributor portion 36 of the plunger 31, which portion may be considered to be valve means, a pair of radially opposite precharging recesses 42, 43 are provided which are connected in free fluid communication with the supply chamber 12 by axially extending grooves 44, 46. The recesses 42, 43 and grooves 44, 46 form passageways cyclically registrable with the delivery passages 22 as the plunger 31 is rotated, to effect equalizing of pressure in the delivery passages 22 to that in the supply chamber between intervals when the delivery passages 22 are being employed to effect pilot or main quantity injection.

The pilot delivery port 38 includes a restricted radial opening or bore 51 and an axially extending recess 52 at the periphery of the plunger diametrically opposite to the main port 37. The amount of fuel delivery by way of pilot port 38 is substantially less than fuel delivery by way of main port 37. By providing a pair of radially opposite precharging passageways in the valve or distributor portion 36 of the plunger 31 and by providing main and pilot ports 37, 38 opening on the plunger periphery at peripheral lands 53, 54, respectively, I have created a plunger that rotates, each delivery passage is sequentially and cyclically connected to main port 37, precharging recess 43, pilot port 38 and precharging recess 42.

The my invention is particularly useful in four cycle engines and when so employed, the pilot injection occurs at the time the exhaust valves are closing, at which time the intake valves have just opened. In other words pilot injection occurs at the beginning of the intake stroke. In my illustrated pump design, a delivery valve is not used and thus the usual delivery valve retraction problems are avoided. Heretofore, the ending of pilot injection, through a delivery valve designed for that purpose, characteristics, was not satisfactory and irregularity in pilot injection quantity was a problem. Precharging prior to both main and pilot injection in accordance with my present invention eliminates irregularities in both pilot and main injection.

The pilot opening 51 may be sized to properly propor-
tion the pilot delivery to main delivery. Different engines may require different pilot quantities and the opening 51 may be proportioned accordingly.

It will be noted that pilot injection can only take place during the time that land 54 is covering the delivery passage 22. Pilot injection will not commence prior to edge 61 of land 54 passing by the opening 22 and will continue only until edge 62 of land 54 exposes passage 22 to recess 42. Therefore the duration of the pilot injection will be independent of the main injection above a quantity predetermined by the circumferential distance between edges 61 and 62. Since the passage 51 acts as the restriction for the pilot injection, main injection is essentially unaffected by the establishment of communication between opening 51 and recess 42 by way of registering passage 22.

The embodiments of the invention for which an exclusive property or privilege is claimed are defined as follows:

1. In a distributor type fuel injection pump the combination comprising:
   a pump housing including:
   a bore, a plurality of delivery passages communicating at angularly spaced intervals with said bore adapted for connection to fuel delivery lines, respectively,
   an injection pressure chamber at one end of said bore, and
   a supply chamber for supplying fuel to said injection pressure chamber,
   means supplying fuel to said supply chamber and maintaining the latter at a pressure substantially above atmospheric pressure,
   a reciprocable pump plunger in said bore for pressurizing fuel in said injection pressure chamber, and rotating valve means in said housing between said injection pressure chamber and said delivery passages defining a pilot port and a main port cyclically connecting said delivery passages two at a time to said injection pressure chamber during the pumping stroke of said plunger to deliver a main quantity of fuel through said main port to one of said two passages and a relatively smaller quantity of fuel through said pilot port to the other of said two passages and defining precharging passage means cyclically connecting said delivery passages in free flow fluid communication with said supply chamber during a major portion of the time they are disconnected from said injection pressure chamber.

2. The pump set forth in claim 1 wherein said bore opens at its other end into said supply chamber, wherein said pump plunger is rotatable and wherein said rotating valve means includes a valve portion formed on said pump plunger and disposed between said injection pressure chamber and said supply chamber.

3. The pump set forth in claim 2 wherein said valve portion includes a main delivery port and a smaller pilot delivery port circumferentially spaced from one another and opening on the periphery thereof and passage means placing said ports in fluid communication with said injection pressure chamber.

4. The pump set forth in claim 3 wherein said valve portion includes a pair of radially opposite precharging recesses circumferentially intermediate said ports and cyclically registrable with said delivery passages and further comprising means placing said recesses in free flow fluid communication with said supply chamber.

5. A fuel injection pump for a four cycle engine comprising:
   a housing including:
   a high pressure chamber, a supply chamber, a bore extending between said chambers, and a plurality of delivery passages opening into said bore between said chambers and at equally spaced circumferential intervals,
   means maintaining said supply chamber at an intermediate pressure, a rotatable and reciprocable pump plunger in said bore having a radially opening main port cyclically registrable with said passages one at a time during rotating of said plunger, a radially opening pilot port spaced circumferentially from said main port and cyclically registrable with said passages one at a time during rotation of said plunger,
   means connecting said ports in fluid receiving relation to said high pressure chamber, and means connecting said delivery passages to said supply chamber during a portion of the time they are out of registry with said ports including a passageway in said plunger opening on the periphery thereof between said ports and cyclically registrable with said delivery passages, said portion of time being greater than the time required for one of said ports to rotate through one of said circumferential intervals.

6. The pump set forth in claim 5 wherein, during rotation of said plunger, said passageway connects said delivery passages to said supply chamber between their registration with said pilot and main ports.

7. The pump set forth in claim 5 wherein said means connecting said delivery passages to said supply chamber further includes a second passageway in said plunger cyclically registrable with said delivery passages, said passageways being circumferentially on opposite sides of said ports so as to effect precharging of said delivery passages at said intermediate pressure prior to registration with said pilot and main ports during operation of said pump.

References Cited
UNITED STATES PATENTS
2,544,561 3/1951 Meyer 103—154
2,871,796 2/1959 Dreisin et al. 123—32.61

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