Jan. 28, 1958 V. D. ROOSA 2,821,183

FUEL INJECTION MEANS FOR INTERNAL COMBUSTION ENGINES

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FIG. 1

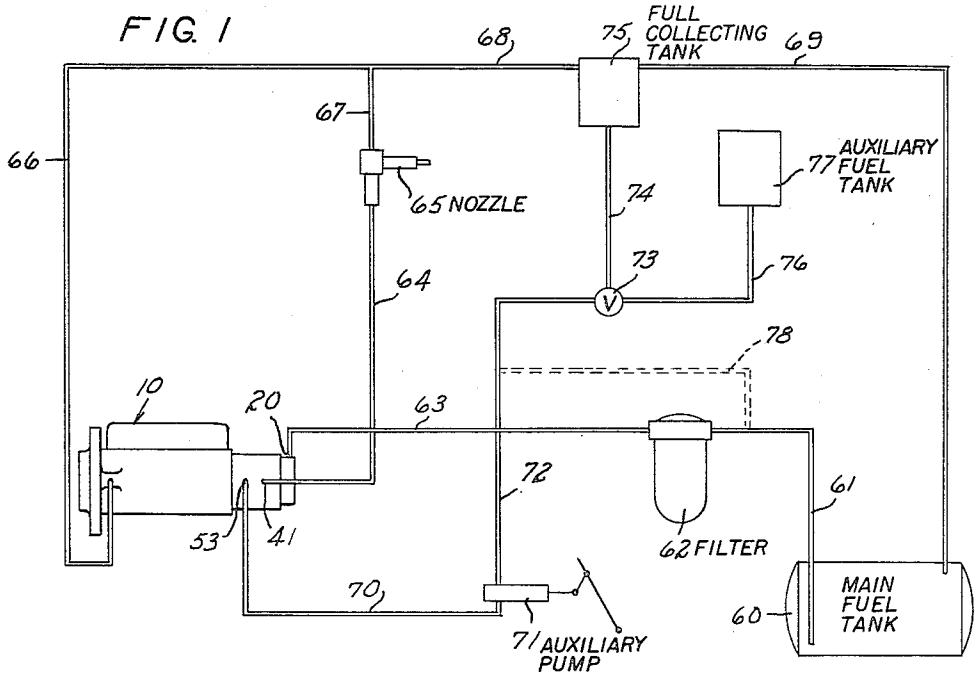
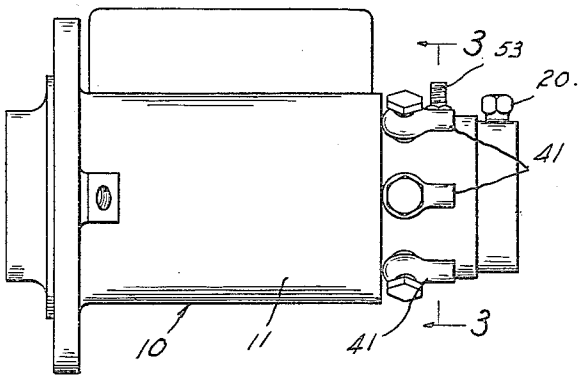


FIG. 2



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FIG. 3

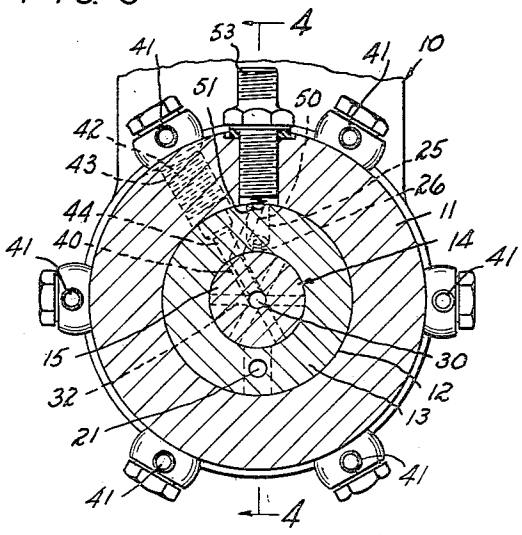
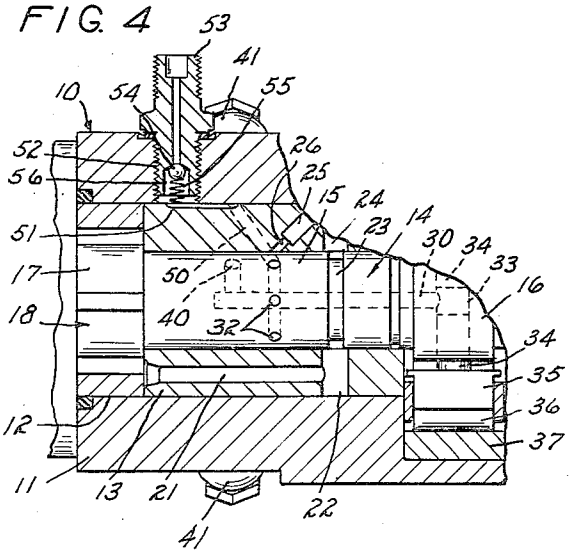


FIG. 4



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FUEL INJECTION MEANS FOR INTERNAL COMBUSTION ENGINES

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15 Claims. (Cl. 123—139)

The present invention relates to fuel injection mechanisms for internal combustion engines and, more particularly, to an auxiliary fuel injection system for use with a fuel pump and distributor to facilitate fuel injection particularly during starting.

In fuel injection systems of the type to which the present invention relates, fuel from a supply tank is fed by gravity or a feed pump to an injection pump driven by the engine which in turn ejects the fuel under high pressure through a distributor to injection lines connected to fuel nozzles at the engine cylinders. While such a system is entirely adequate and satisfactory during normal operation, conditions may occur which temporarily interfere with proper fuel injection and running of the engine. This is particularly likely to occur during so-called "cold starting" after the engine has been shut off for an extended period of time. After a lengthy shut down, all or part of the fuel injection system may be empty of fuel or at least it may contain air locks so that considerable cranking is required just to fill up the fuel injection system and before any effective injection to the engine cylinders takes place. In addition, the cranking rate even under the most favorable conditions is quite slow compared to the normal minimum running speed of the engine so that the amount of fuel and the pressure at which it is conveyed to the fuel injection nozzles by a conventional fuel injection system is greatly decreased. Since conventional fuel injection nozzles are spring loaded, there is a minimum pressure necessary to cause injection to take place and for quick starting the amount and pressure of the injected fuel should be at a maximum. These disadvantages are particularly marked when the ambient temperature is low and the engine is provided with a weak battery.

It thus is an object of the present invention to provide a fuel injection system having auxiliary means which can be brought into operation whenever conditions arise, such as discussed above, which interfere with normal fuel injection. Included in this aim is the provision of auxiliary means which will insure the delivery of fuel to the engine cylinders in adequate amount and at adequate pressure independently of engine cranking speed.

A further object of the invention is to provide auxiliary fuel injection means using in large part the existing elements of the principal fuel injection system whereby the expense and installation and space requirements of the auxiliary means are kept at a minimum. Included in this object is the provision of auxiliary means which is simple and convenient to operate and which will not interfere with or adversely affect the operation of the principal fuel injection system once normal operation conditions have been established.

Another aim of the invention is to provide such an auxiliary fuel injection means which is susceptible of use, if desired, to inject quick starting fuels into the system to further facilitate starting of the engine.

Other objects will be in part obvious, and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawings:

Fig. 1 is a schematic diagram of an exemplary fuel system embodying the present invention;

Fig. 2 is an enlarged side view of the fuel pump included in the system of Fig. 1;

Fig. 3 is an enlarged fragmentary transverse sectional view of the fuel pump of Fig. 2 taken along the line 3—3 thereof; and

Fig. 4 is a fragmentary longitudinal sectional view of the fuel pump taken on the line 4—4 of Fig. 3.

Referring to the drawings, the fuel pump assembly shown therein and denoted by the reference numeral 10 is similar to that disclosed and claimed in my prior Patent No. 2,641,238 granted June 9, 1953. As best shown in Figs. 3 and 4, the fuel pump assembly 10 comprises an outer cylindrical housing 11 having an axial bore 12 in which is fixed a cylindrical sleeve 13. Rotatably mounted in the sleeve 13 is a rotor 14 comprising a distributor section 15 and an enlarged injection pump section 16. The left-hand end of the rotor, as viewed in Fig. 4, is connected to the rotary member 17 of a fuel feed or pick-up pump designated generally at 18. As will be understood, the rotor 14 is connected to the engine with which the fuel pump assembly is associated so that the rotor is rotated in timed relationship with the engine.

In the operation of the fuel pump assembly 10, fuel is admitted to the pick-up pump 18 through the inlet 20 (Fig. 2), and this fuel is transferred by the rotation of the rotary member 17 of the feed pump through a longitudinally extending passageway 21 in the sleeve 13 to a transverse port 22 in the sleeve, which in turn communicates with a circumferential groove 23 in the rotor 14. Opposite from the port 22 is a passageway 24 which in turn communicates with a diagonal passageway 25 having a feed port 26 at the periphery of the rotor 14. A fuel control valve (not shown) may be provided between passageways 24 and 25.

The rotor 14 has an axial passageway 30 provided with a plurality of inlet ports 32 extending radially outwardly therefrom in angularly spaced relationship for cooperation with the feed port 26, the number of inlet ports 32 corresponding to the number of cylinders of the engine with which the fuel pump assembly is associated (six in the specific embodiment). Accordingly, as the rotor is rotated, the axial passageway 30 receives a charge of fuel from the pick-up pump each time that one of the inlet ports 32 registers with the feed port 26.

The longitudinally extending passageway 30 communicates at its right-hand end, as viewed in Fig. 4, with a transverse chamber 33 formed in the enlarged section 16. Contained in this transverse chamber 33 is a pair of opposed plungers 34 which are adapted to slide in and out in opposite directions to create a pumping action. The outer end of each of the plungers 34 is engaged by a shoe 35 carrying a roller 36 which in turn engages a circumferential cam 37. The cam 37 is contoured so that, as the rotor is rotated and one of the inlet ports 32 registers with the feed port 26, the plungers are permitted to move outwardly to receive a supply of fuel from the pick-up pump and then, when the inlet port is moved out of registry with the feed port 26, the plungers 34 are moved inwardly in opposing relationship so as to eject the fuel therebetween outwardly through the axial passageway 30.

At the end of the passageway 30 adjacent the inlet

ports 32 is a single outlet port 40 for establishing communication sequentially with outlet connections or couplings 41 which in turn are adapted to have attached thereto the fuel injection lines going to the individual cylinders of the engine. One of the connections 41 is shown in detail in dotted lines in Fig. 3. Each connection 41 has a threaded shank 42 received in a tapped opening 43 in the housing 11 which in turn communicates with a port 44 in the sleeve 13. The ports 44 are equally spaced around the sleeve 13 in the plane of rotation of the outlet port 40 and are so located that when the rotor has been rotated to move an inlet port 32 out of registry with the feed port 26 and the plungers 34 are moved together to cause a fuel injection, the outlet port will register with a port 44 thus transmitting the fuel injection to the proper engine cylinder.

As thus far described, the fuel pump assembly 10 is essentially the same as disclosed in my prior Patent No. 2,641,238. In accordance with the present invention, the fuel pump assembly 10 has been modified by adding an additional port 50 to the sleeve 13 which has its open end in the plane of rotation of the inlet ports 32 but which is radially spaced from the feed port 26 so that it communicates with one of the inlet ports 32 at the same time that the outlet port 40 registers with one of the ports 44 going to the injection line couplings 41. For convenience of manufacture and assembly, the port 50 is diagonally arranged in the sleeve 13 so as to communicate with a groove 51 in the outer surface of the sleeve which in turn communicates with a threaded inlet 52 in the housing 11. Disposed in the threaded inlet 52 is a nipple 53 having a one-way valve consisting of a ball 54 and spring 55 received in the counterbore 56.

The manner of connecting the modified fuel pump assembly 10 of the present invention in an engine fuel injection system is shown diagrammatically in Fig. 1 of the drawings. As shown in Fig. 1, fuel from a main tank or reservoir 60 is conveyed by conduit 61 to a filter 62 and thence by conduit 63 to the inlet coupling 20 of the feed pump 18. In an actual installation, of course, all of the outlet connections 41 would be connected by fuel injection lines to the proper engine cylinders, but for simplicity of presentation, only one of the fuel injection lines is shown in Fig. 1, this being the conduit 64 extending between one of the couplings 41 and the fuel injection nozzle 65. As is conventional in such systems, the fuel pump assembly 10 and the fuel injection nozzle 65 are provided with bleed or leak-off lines 66 and 67, respectively connected to return conduit 68 for returning leakage or excess fuel to the reservoir or main tank 60.

In accordance with the present invention, the nipple 53 is connected by conduit 70 to an auxiliary pump 71 shown diagrammatically for illustrative purposes as a foot-operated pump although it could just as well be a pump operated by hand or by power such as, for example, by the engine battery. The pump 71 is connected by conduit 72 to a three-way valve 73 which is connected by conduit 74 with a fuel collecting tank 75 situated in the return line 68. The valve 73 is also connected by conduit 76 to an auxiliary tank 77 which may contain a quick starting fuel such as those of ether base more easily ignitable than regular fuel. Alternately, the conduit 72 may be connected by conduit 78, shown in dotted lines in Fig. 1, directly to the main fuel feed line 61 between the filter and the main tank 60.

When it is desired to utilize the auxiliary fuel injection apparatus of the present invention as, for example, when starting the engine, all that the operator has to do during the cranking period is to actuate or energize the auxiliary pump 71. As a result of operation of the auxiliary pump 71, fuel from either the collecting tank 75 or main tank 60 or a quick starting fuel from the auxiliary tank 77, depending on which way the pump is

connected up is forced under high pressure directly via the rotor distributor 15 in timed relationship to the proper engine cylinder, thus bypassing the filter, pick-up pump and injection pump. Since the pressure and amount of fuel thus injected is not dependent upon or limited by cranking speed, it will be appreciated that the engine will be supplied with fuel under optimum conditions for quick starting. After the motor is in operation and the principal fuel injection system is functioning properly, the actuation of the auxiliary pump 71 may be discontinued, whereupon the principal fuel injection system will take over. The presence of the auxiliary inlet port 50 will not interfere with the normal operation of the fuel pump assembly 10 because of the one-way ball valve 54 which effectively prevents any reverse flow of the ejected fuel to the line 70.

It thus will be seen that there has been provided in accordance with the invention a simple and economical arrangement for providing optimum fuel injection when the principal fuel injection system is inadequate as in engine starting, which requires only very minor and economical changes in the fuel pump assembly 10 presenting no interference with the normal operation of the fuel pump, and which requires, in addition, only the auxiliary pump 71 and connecting lines.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. In a fuel injection system, a plurality of fuel injection lines for connection to an engine, fuel distributing means connected to the fuel injection lines including a rotary distributor adapted to be driven by the engine forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, first means for supplying fuel under pressure to the rotary distributor for transfer to the fuel injection lines, and auxiliary means for supplying fuel under pressure to the rotary distributor to facilitate starting the engine.

2. In a fuel injection system, a plurality of fuel injection lines for connection to an engine, fuel distributing means connected to the fuel injection lines including a rotary distributor adapted to be driven by the engine forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, a fuel injection pump for supplying fuel under pressure to the rotary distributor for transfer to the fuel injection lines, auxiliary means for supplying fuel under pressure to the rotary distributor to facilitate starting the engine, and means for preventing reverse flow of fuel from the rotary distributor to said auxiliary means.

3. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the engine, fuel distributing means connected to the fuel injection lines including a rotary distributor forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, a fuel injection pump driven by the engine for supplying fuel under pressure to the rotary distributor for transfer to the fuel injection lines, and auxiliary means for supplying fuel under pressure to the rotary distributor to facilitate starting the engine.

4. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the

engine, fuel distributing means connected to the fuel injection lines including a rotary distributor driven by the engine forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, a fuel injection pump driven by the engine for supplying fuel under pressure to the rotary distributor for transfer to the fuel injection lines, and an auxiliary pump operable independently of the engine for supplying fuel under pressure to the rotary distributor in addition to that supplied by the fuel injection pump.

5. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the engine, fuel distributing means connected to the fuel injection lines including a rotary distributor driven by the engine forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, a fuel injection pump driven by the engine for supplying fuel under pressure to the rotary distributor for transfer to the fuel injection lines, an auxiliary fuel pump operable independently of the engine, and means connecting the auxiliary pump to the rotary distributor including a one-way valve permitting fuel to enter the distributor from the auxiliary pump but preventing reverse flow from the distributor to the auxiliary pump.

6. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the engine, fuel distributing means connected to the fuel injection lines including a rotary distributor driven by the engine having an outlet port forming a fluid passageway to the fuel injection lines in sequence as the distributor is rotated, a fuel injection pump associated with the rotary distributor and operated by the engine in timed relationship with the rotation of the rotary distributor to pump charges of fuel to the rotary distributor during communication of said outlet port with a fuel injection line, means including a first auxiliary pump for feeding fuel to the fuel injection pump when the outlet port is out of communication with a fuel injection line, and means including a second auxiliary pump for feeding fuel to the distributor when the outlet port is not in communication with a fuel injection line.

7. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the engine, fuel distributing means connected to the fuel injection lines, means forming a fuel feed passageway to the fuel distributing means, a rotary distributor in the fuel distributing means driven by the engine having an outlet and inlet ports for forming a fluid path alternately to the feed passageway and the injection lines in sequence as the distributor is rotated, a fuel injection pump connected to the rotor to alternately receive fuel from the inlet port and eject the fuel through the outlet port in timed relationship with the rotation of the rotary distributor, and means for injecting fuel directly to said outlet port comprising an auxiliary pump and an auxiliary fuel feed passageway located to register with an inlet port while the outlet port is in communication with an injection line.

8. In a fuel injection system, an internal combustion engine, a plurality of fuel injection lines connected to the engine, a body having a plurality of spaced apart outlet passageways connected to the fuel injection lines, a rotor in said body having an outlet port for registration intermittently and sequentially with said outlet passageways as the rotor is rotated, fuel supply means including an inlet passageway in said body, said rotor having inlet port means for registration with said inlet passageway alternately to registration of the outlet port with an outlet passageway, a fuel injection pump mounted in the rotor for receiving fuel from the inlet port means and ejecting the fuel from the outlet port in timed relationship with rotation of the rotor, means for driving the rotor from the engine, an auxiliary pump operable independently of the engine, and means connecting the auxiliary pump for transfer of fuel to the rotor including a one-way valve and an auxiliary inlet passageway in the body located to register with the inlet port means during registration of the outlet port with an outlet passageway.

9. In a fuel injecton system, an internal combustion engine, a reservoir of fuel, a plurality of fuel injection lines connected to the engine, a body having a plurality of spaced apart outlet passageways connected to the fuel injection lines and having a fuel inlet passageway, a fuel feed pump driven by the engine and connected to transfer fuel from the reservoir to the said fuel inlet passageway, a rotor in the body having an outlet port for communication sequentially with the outlet passageways and having inlet port means for communication alternately with the fuel inlet passageway as the rotor is rotated, a fuel injection pump in the rotor operated in timed relationship with rotation of the rotor to receive fuel when the inlet port means is in communication with the fuel inlet passageway and to eject fuel when the outlet port is in communication with an outlet port, said body having an auxiliary fuel inlet passageway located to communicate with the inlet port means while the outlet port is in communication with an outlet passageway, an auxiliary fuel pump operable independently of the engine and connected to the auxiliary fuel inlet passageway, and a one-way valve between the auxiliary fuel inlet passageway and the auxiliary pump to prevent fuel flow outwardly from the rotor through the auxiliary fuel inlet passageway.

10. The combination set forth in claim 6 and including an auxiliary fuel reservoir connected to the auxiliary fuel pump.

11. In a fuel pump, a body having a plurality of fuel outlet passageways for connection to fuel injection lines and a fuel inlet passageway for connecton to a fuel supply, a rotor in the body adapted to be driven by an associated engine having an outlet port and inlet port means for alternately communicating with the fuel inlet passageway and a fuel outlet passageway in sequence as the rotor is rotated, a fuel injection pump associated with the rotor for operation in timed relationshp therewith to receive fuel from the inlet port means during communication of the inlet port means with the fuel inlet passageway and to eject fuel during communication of the outlet port with a fuel outlet passageway, and means forming an auxiliary fuel inlet passageway disposed for communication with said inlet port means while the outlet port is in communication with a fuel outlet passageway.

12. A fuel pump comprising a casing having fuel inlet and outlet passages, a cylinder rotatably mounted in said casing having fuel inlet port means and an outlet port adapted to communicate in sequence during the rotation of said cylinder with the respective inlet and outlet passages of said casing to permit alternate admission and discharge of fuel to and from the interior of said cylinder, piston means carried by the cylinder and operable in response to rotation of the cylinder to receive fuel from the inlet port means and eject fuel through the outlet port, means forming an auxiliary fuel feed passageway to the cylinder which is open while the outlet port is in communication with an outlet passageway, and a one-way valve in said auxiliary fuel feed passageway to prevent fuel flow outwardly therethrough from the cylinder.

13. In a fuel pump, the combination of a pump body having a cylindrical cavity therein and provided with fuel inlet and fuel outlet passageways communicating with said cavity, a cylinder rotatably mounted in said cavity, said cylinder having a longitudinal fluid passageway provided with ports for communicating with said inlet and outlet passageways in sequence as the cylinder is rotated and having a pump chamber communicating with said longitudinal fluid passageway, reciprocal piston means slidably mounted in said pump chamber, cam means for actuating the piston means as the cylinder is rotated in timed relationship therewith to alternately receive fuel from said inlet passageway and eject fuel through said

outlet passageways, and means forming an auxiliary fuel inlet passageway communicating with said ports during an ejection stroke of the piston means.

14. In a fuel pump, the combination of a pump body having a cylindrical cavity and provided with a plurality of fuel outlet passageways disposed in spaced apart relationship in a radial plane of the cavity and a pair of separate fuel inlet passageways spaced from said radial plane of the cavity, a cylinder rotatably mounted in said cavity having a longitudinal fluid passageway provided with an outlet port for periodically communicating with the fuel outlet passageways in sequence as the cylinder is rotated and inlet port means for communicating with one of the fuel inlet passageways while the outlet port is in communication with a fuel outlet passageway and for communicating with the other fuel inlet passageway while the outlet port is out of communication with a fuel outlet passageway, said cylinder having a pump chamber communicating with said longitudinal fluid passageway, reciprocal piston means slidably mounted in said pump chamber, and cam means for actuating the piston means as the cylinder is rotated.

15. Fuel injection means comprising a pump body having a cylindrical cavity and provided with a plurality of fuel outlet passageways disposed in spaced apart relationship in a first radial plane of the cavity and a pair of separate fuel inlet passageways in a second radial plane of the cavity, a cylindrical rotor rotatably mounted in said cavity having a longitudinal fluid passageway provided with an outlet port for periodically communicating with the fuel outlet passageways in sequence as the cylinder is rotated and provided with a plurality of inlet ports forming a communication with one fuel inlet passageway while the outlet port is between fuel outlet passageways and forming a communication with the other fuel inlet passageway while the outlet port is in communication with a fuel outlet passageway, a fuel feed pump connected with said one fuel inlet passageway, an auxiliary fuel feed pump connected with said other fuel inlet passageway, a one-way valve in said other fuel inlet passageway, a fuel injection pump carried by the rotor in communication with said longitudinal fluid passageway, and means for actuating the injection pump in timed relationship with rotation of the rotor.

No references cited.