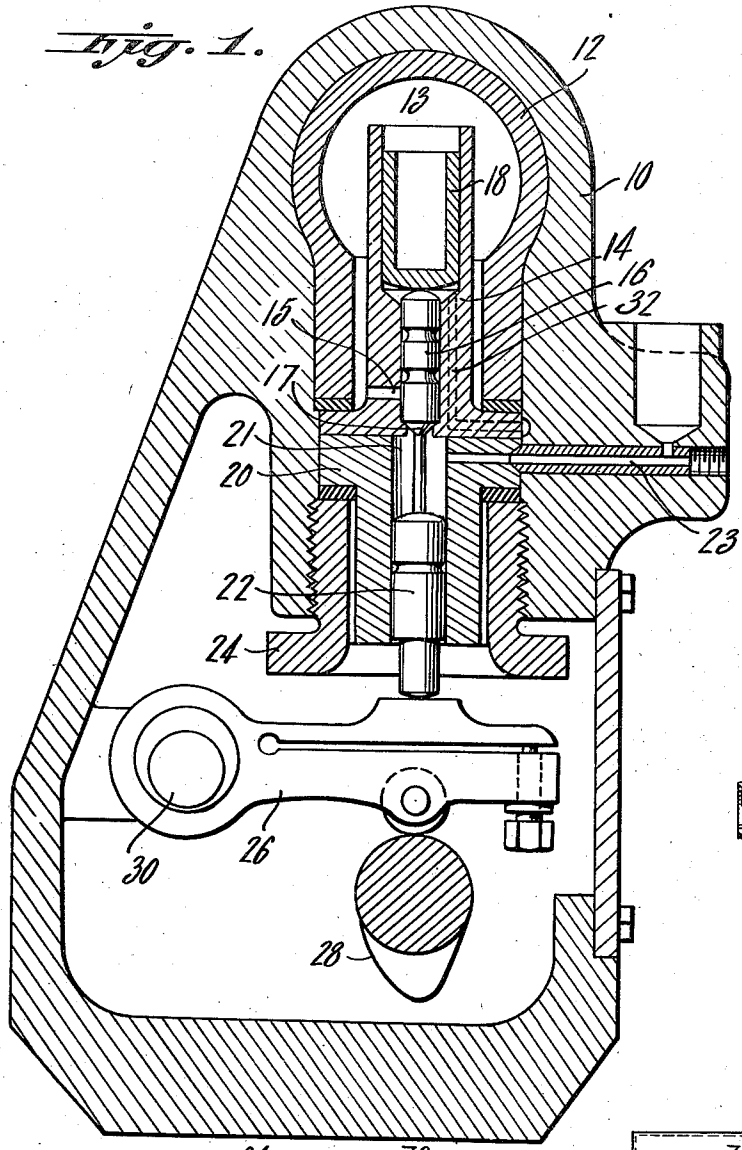
March 16, 1937. L. BEEH 2,073,604

FUEL DISTRIBUTING VALVE

Filed Jan. 12, 1935

Fig. 1.



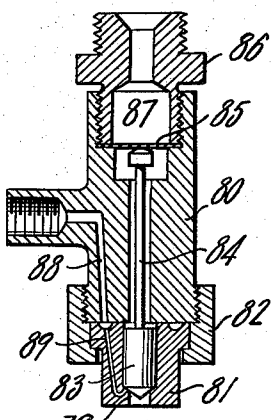


Fig. 3.

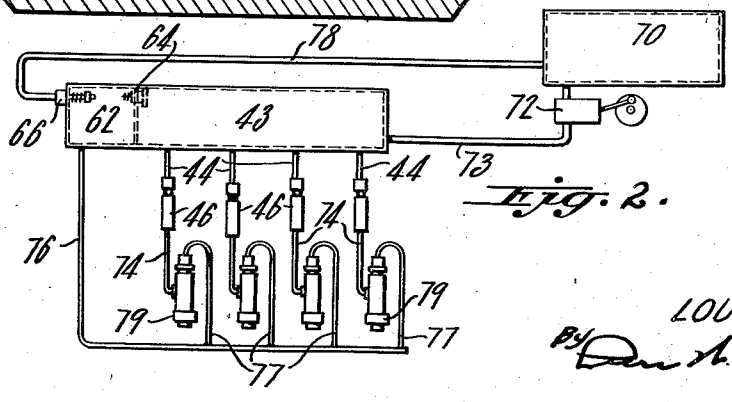


Fig. 2.

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FUEL DISTRIBUTING VALVE

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3 Claims. (Cl. 251—75)

This invention relates to a fuel supply system and more particularly to a fuel supply system for internal combustion engines of the injection type.

In internal combustion engines of this type it has heretofore been proposed to provide a fuel supply chamber common to all cylinders of the engine, which supply chamber is maintained under high pressure and placed in communication with the engine cylinders in proper sequence by means of distributing valves driven in synchronism with the engine.

In such constructions the fuel supply chamber must be a very strong construction to withstand the high pressures, 4000 pounds or more per square inch necessary to provide the desired atomization of the fuel.

Heretofore in some constructions such supply chambers have been formed as a part of the housing of the distributing mechanism. Such construction is desirable in that a unitary structure is provided which is easy of assembly, but such structures are necessarily heavy since all parts are made of material capable of withstanding the high pressure to which the supply chamber is subjected.

It is one of the objects of this invention to provide a light construction in which the distributing mechanism is provided in a unitary structure with the supply chamber, but which structure is of great strength at all points subject to the high pressure of the fuel.

To this end I provide a hollow member of bronze or steel to form the supply chamber and cast the housing for the remaining elements of the system about this member, the casting being of light material, such as aluminum.

A further difficulty experienced with devices of this nature resides in the fact that due to the maintained pressure of the supply chamber it is difficult to reduce pressure at the fuel nozzle sufficiently rapidly to prevent drip. In injection engines of the type in which fuel is supplied to the engine by a separate pump for each cylinder it is possible to completely reduce the pressure in the fuel line at or about the end of the pump's stroke by opening a relief valve. Such a system is not readily available to the present type of injection system, due to the fact that the fuel is continuously under high pressure in the main supply chamber. To provide such systems with some means to prevent drip, it has heretofore been proposed to provide a mechanically actuated piston which withdraws fuel from the supply line after the distributor valve is closed. Such a construction involves additional gearing for the drive of the drip prevention plunger. It is one of the objects of this invention to provide a structure in which this function is performed by the movement of the distributor valve itself.

It is a further object of this invention to provide a structure in which the pressure of the fuel acts as a return spring for all reciprocating parts, thereby avoiding numerous difficulties arising in practice in connection with the use of springs in such structures.

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

To the attainment of the aforesaid objects and ends, the invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will be first fully described in the following detailed description, then be particularly pointed out in the appended claims, reference being had to the accompanying drawing, in which:

Fig. 1 shows a transverse section with parts in side elevation through the housing of one form of distributor constructed in accordance with my invention; Fig. 2 is a diagram showing the complete fuel supply circuit; Fig. 3 shows a longitudinal section, with parts in side elevation, of the preferred form of the fuel injector.

Referring to Fig. 1, reference numeral 10 indicates a housing which is preferably a casting of light alloys, such as aluminum. In this housing is cast a high pressure metal insert 12 which may be made out of bronze or steel alloys. It will be understood that in the manufacture of the device, either the insert 12 may be formed first and the housing 10 cast thereabout, or where desired the housing 10 may be first cast and the insert 12 subsequently cast in the preformed housing. In either case a unitary, integral structure is formed. The object of this feature is to create an apparatus light in weight and strong in pressure resisting qualities.

The insert 12 is hollow, defining a high pressure supply chamber 13 in which fuel is maintained under high pressure in a manner which will be hereinafter described. Mounted into the insert 12 is a valve housing 14 containing the valve 16 and the valve seating plunger 18. Adjacent to this valve housing 14 is mounted the housing 20 of the valve actuating plunger 22. Both the valve housing 14 and the plunger housing 20 are held in position in the housing 10 by a nut 24. The plunger 22 is operated through a lever 26 by the cam 28. The lever 26 is adjustably pivoted on an eccentric shaft 30.

In the operation of the form shown in this

figure, fuel is compressed by any well known means, such as plunger or gear pumps, into the high pressure supply chamber 13. Upon actuation of lever 26 by cam 28, the plunger 22 and valve 16 are lifted until the lower edge of the valve 16 uncovers one end of a passage 15 in the valve housing 14. This permits fuel to flow from chamber 13 through passage 15 to a chamber 21 formed in housing or liner 20 above plunger 22, and thence by way of a passage 23 leading to the fuel injection nozzle. It will be understood that the nozzle may be either of the closed or open type. However, I prefer to use the closed type actuated in a manner to be hereinafter more particularly described.

The period during which valve 16 is in open position, and thus the quantity of fuel supplied to the engine, is controlled by the position of the eccentric 30. The eccentric may be manually or governor controlled as desired. The injection is terminated by the downward movement of the valve 16 closing the passage 15 and it will be observed that after this closure the valve 16 moves downwardly for some distance before it comes to rest on seat 17. This permits retraction of the plunger 22 for some distance after the fuel supply from chamber 13 has been cut off, thus reducing pressure in chamber 21 and consequently withdrawing fuel from passage 23 and the connecting passages leading to the fuel nozzle, causing a quick closure thereof and preventing drip therefrom.

It will be observed that no springs are utilized for the closing movement of valve 16, this motion being effected by pressure of the fuel in chamber 13 acting upon the valve seating plunger 18 which is reciprocative in valve housing 14, and which rests upon the upper end of valve 16. A passage 32 is provided in the valve housing 14 connecting the space below the plunger 18 with a fuel tank under atmospheric pressure so that the pressure in chamber 13 is not resisted by pressure of fuel leaking around plunger 18 to the lower side thereof. It readily will be seen that this construction eliminates the necessity for springs, thereby entirely avoiding the difficulty of adjusting these elements for wear and also avoiding trouble arising from crystallization of the metal forming the spring which arises in practice due to the continued flexing thereof.

The disposition of parts in the complete supply system will best be understood by reference to the diagrammatic disclosure of the same in Fig. 2. Referring to this figure, reference numeral 70 indicates the main supply tank which may be at atmospheric pressure and from which fuel is drawn by a high pressure pump, one of the cylinders of which is indicated at 72. Fuel is forced by the pump 72 through pipe 73 to the high pressure chamber 43. From thence it passes by way of passages 44 to the distributor valves 46 and thence by way of passages 74 to the nozzles 79 which are mounted in the usual manner on the engine. The chamber 43 is also in communication by way of reduction valve 64 with a low pressure chamber 62 in such a manner that when the pressure in chamber 43 is maintained at about 4000 pounds per square inch, the pressure in the low pressure chamber will preferably be about 1000 pounds per square inch. Pressure in excess of this is relieved by valve 66 which conducts the excess fuel by way of pipe 78 to the supply tank 70. The low pressure chamber 62 communicates by way of pipe 76 having branches 77 with the outer end of each of the injection valves 79.

The injection valve, details of which may be seen in Fig. 3, consists of a housing 80 and a nozzle member 81 connected therewith by means of a nut 82. A valve 83 is seated in the nozzle member 81 and provided with a stem 84 extending through the housing 80. A diaphragm 85 closes the outer end of the housing 80 and is held in position by a nipple 86 which is adapted to be connected to pressure branch 77 of pressure line 76 connected with the low pressure chamber 62. In operation fuel supplied from the high pressure tank 43 and controlled in synchronism with the engine by distributor valves 46 is conducted to the nozzle 79 by way of pipes 74 connected to passages 88 and 89 in the housing 80 and nozzle member 81 to the seat of the valve 83. The pressure at this point being greater than the pressure of the fuel acting in the chamber 87 above the diaphragm 85, the valve is lifted and fuel is injected through the nozzle at high velocity. Upon closure of the valves 46 the supply of fuel to the nozzle member ceases and immediately thereafter is withdrawn by further downward movement of the valve member in the manner previously described. The constant pressure in chamber 87 now acts as a spring to force the valve 83 tightly upon its seat.

It will be understood that in practice the injection valves may be mounted on the cylinders of the engine to inject the fuel directly thereinto or they may be mounted to inject fuel into the air intake manifold. In the appended words "injection engine" are intended to include all types of engines having an injector to which fuel is supplied under pressure.

In connection with engines of either type the advantages described above are desirable though it will be obvious that the feature of preventing drip is especially useful in connection with the engines of the direct injection type.

It will thus be seen that my invention provides a fuel supply system which is free from springs throughout. It will likewise be seen that drip is effectively prevented in a fuel supply system of the common rail type; that a drop in the fuel supply pressure during the injection period is automatically prevented by the opening movement of the control valve itself or of parts connected therewith; and that a light, strong, compact and easily assembled structure is provided.

While there has been hereindescribed but one specific embodiment of my invention other embodiments and modifications within the scope of the appended claims will be obvious to those skilled in the art.

Having described the invention, what is claimed is:

1. In a fuel injection engine; a fuel distributing valve, said valve including a cylindrical member reciprocative in a bore having a lateral passage adapted to communicate with a source of fluid under pressure, said bore having a reduced portion spaced from said lateral passage and providing a stop for said cylindrical member; actuating means for said valve including a plunger; a second bore of larger diameter than said cylindrical member in which said plunger reciprocates; a discharge passage leading from said second bore; and a stem connecting said plunger and said cylindrical member of lesser diameter than the reduced portion of said bore, whereby when said valve is in open position fluid flows from said source through said lateral passage, said first mentioned bore, said reduced portion, said second bore and thence to said discharge passage, and

whereby upon closure of said lateral passage further movement of said plunger reduces the pressure in said discharge passage.

2. In a fuel injection engine, a fuel distributing device including a pair of cylindrical members of different diameters, cylinder bores in which said members reciprocate, a passage adapted to communicate with a source of fluid under pressure, said passage opening into the smaller of said bores at a point which is normally closed by one of said members, a discharge passage leading from the space of the other of said bores beyond the innermost point of travel of the member therein, and means effective during an intermediate portion of one stroke of said members for establishing communication between said first mentioned passage and said space, said difference in diameters of said cylindrical members causing a reduction of pressure in said space on the reverse stroke thereof.

3. In a fuel injection engine, a distributing valve, said valve including a cylindrical member, a bushing having a bore in which said member reciprocates, a passage adapted to communicate with a source of fluid under pressure opening into said bore and positioned to be opened during an intermediate portion of the stroke of said valve, a second cylindrical member of larger diameter than said first cylindrical member, a second bushing providing a second bore in which said second cylindrical member reciprocates, means for actuating said members, means providing communication between said passage and said second bore after a predetermined movement of said valve in one direction, and a discharge passage communicating with said second bore at a point beyond the innermost position of said second cylindrical member.

LOUIS BEEH.