April 22, 1969 M. DRORI 3,439,621

LIQUID FUEL PUMPING APPARATUS

Filed April 14, 1967 Sheet 1 of 3

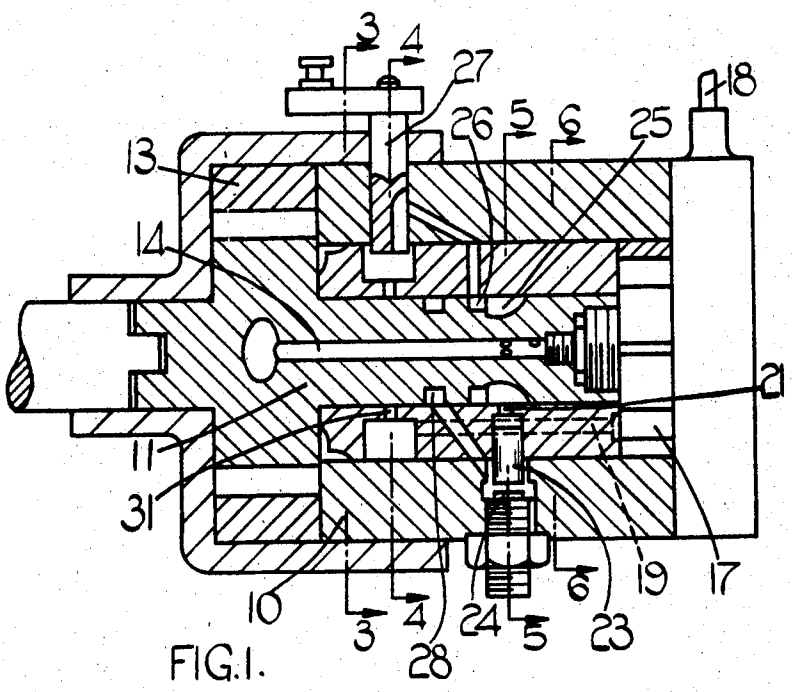


FIG.1.

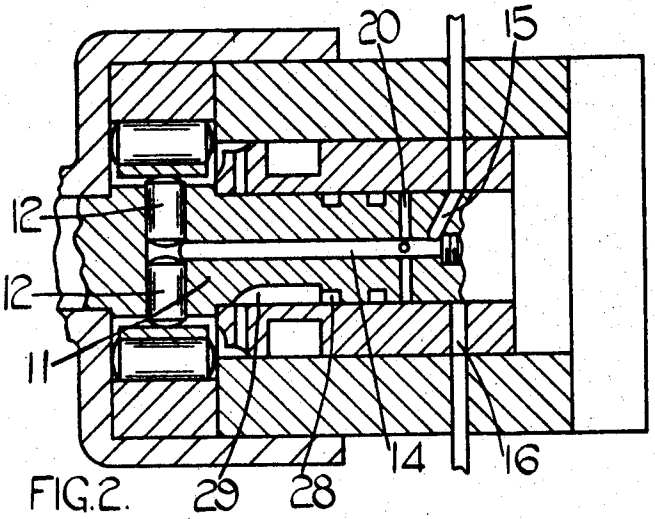


FIG.2.

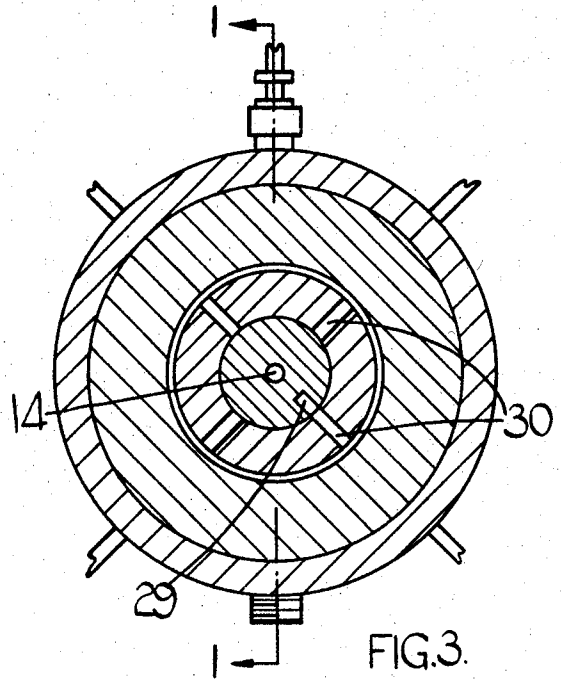


FIG.3.

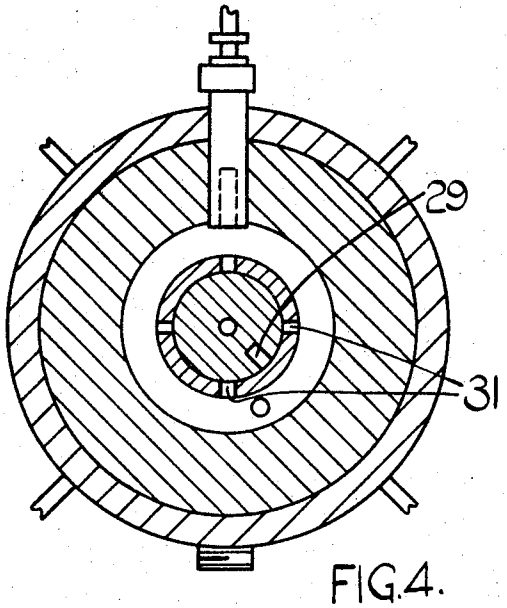


FIG.4.

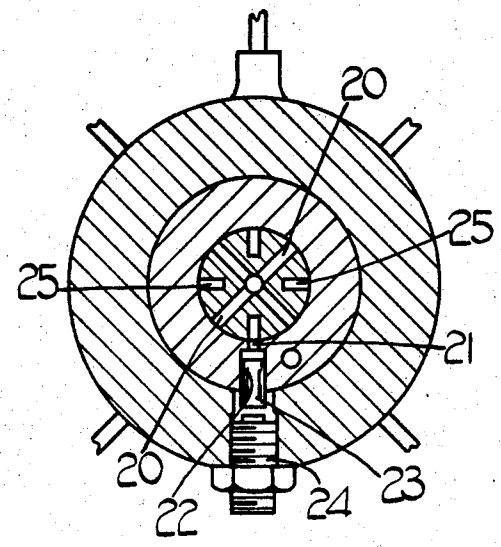


FIG.5.

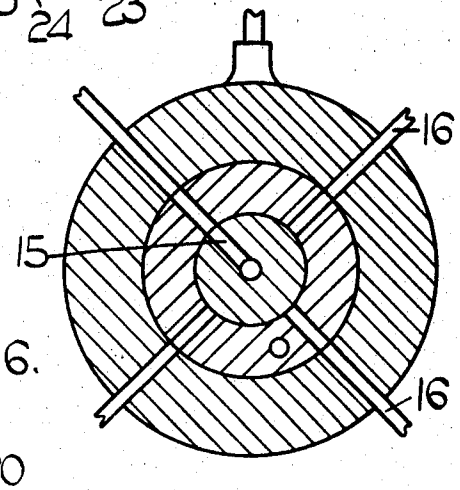


FIG.6.

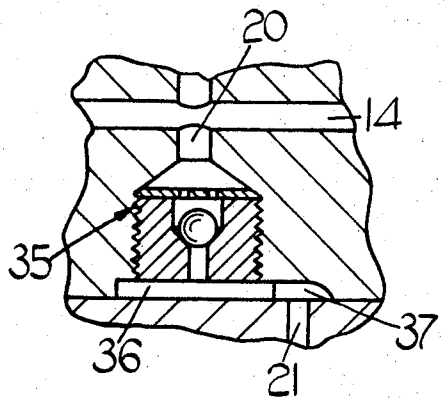


FIG.7.

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LIQUID FUEL PUMPING APPARATUS

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U.S. Cl. 103—2 5 Claims

ABSTRACT OF THE DISCLOSURE

A liquid fuel pumping apparatus for supplying fuel to internal combustion engines having an injection pump and a passage through which the injection pump is placed in communication with one end of a cylinder during the filling stroke, the cylinder containing a shuttle which is moved into contact with an abutment, a one way valve being provided in said passage, the valve permitting the flow of fuel to the injection pump and being positioned to trap cavities formed in the fuel when the shuttle strikes the abutment, so that said cavities are not collapsed suddenly when the injection pump delivers fuel.

This invention relates to liquid fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising in combustion, an injection pump which is arranged to be driven in timed relationship with the engine, and a shuttle movable within a cylinder, one end of said cylinder serving to store a quantity of fuel which during a filling stroke of the injection pump is displaced to the injection pump by moving the shuttle towards said one end of the cylinder, and an abutment for limiting the movement of the shuttle towards said one end of the cylinder.

With such apparatus it has been found that when the shuttle strikes the abutment a cavity is formed in the passage which connects said one end of the cylinder and the injection pump. Following a filling stroke of the injection pump this passage is closed at a point adjacent said one end of the cylinder with the result that at the start of the injection stroke the cavity is rapidly closed thereby resulting in erosion of the passage at the position of the cavity.

The object of the present invention is to provide such an apparatus in a simple and convenient form in which the risk of erosion as described taking place is minimised.

In the accompanying drawings:

FIGURE 1 is a sectional side view of one example of a pumping apparatus to which the invention can be applied and showing the apparatus during the injection stroke the section being taken on the line 1—1 of FIGURE 3,

FIGURE 2 is a sectional side view of the apparatus in the same position taken on the line 2—2 of FIGURE 3,

FIGURE 3 is a section on the line 3—3 of FIGURE 1,

FIGURE 4 is a section on the line 4—4 of FIGURE 1,

FIGURE 5 is a section on the line 5—5 of FIGURE 1,

FIGURE 6 is a section on the line 6—6 of FIGURE 1, and

FIGURE 7 is a fragmentary section to an enlarged scale of part of the apparatus shown in FIGURE 1 in accordance with the present invention.

Referring to the drawings there is provided a body part 10 in which is mounted a rotary cylindrical distributor 11 which is adapted to be driven in timed relationship with the engine with which the apparatus is associated. At one end of the distributor is provided a transversely disposed bore in which is mounted a pair of reciprocable pumping plungers 12 which are arranged to be moved inwardly as the distributor rotates, by a plurality of cam lobes which

are formed on the internal periphery of an annular cam ring 13 which surrounds the distributor 11 at this point. The transverse bore defines between the pumping plungers, a pumping chamber which is in communication with one end of a longitudinal passage 14 formed in the distributor. The other end of this passage is in communication with a radially disposed delivery passage 15 which is adapted to register in turn and as the distributor rotates, with a plurality of outlet ports 16 formed in the body part. The outlet ports are connected respectively to injection nozzles (not shown) associated with the combustion spaces of the engine and the registration of the delivery passage 15 with one of the outlet ports 16 is arranged to occur whilst the plungers 12 are being moved inwardly by the cam lobes. In this manner fuel contained within the pumping chamber is displaced to a combustion space of the engine.

At the other end of the distributor is mounted the rotary part 17 of a feed pump which has an inlet 18 and an outlet in the body part, the outlet being connected to a supply conduit 19 disposed within the body part. The inlet of the feed pump in use, is connected to a source of fuel so that as the distributor rotates, fuel will be supplied under pressure to the supply conduit 19. The inlet and outlet of the feed pump are interconnected by a convenient relief valve located within a housing secured to the body part 10 whereby the pressure of fuel delivered by the feed pump is controlled.

At another point the longitudinal passage is in communication with a plurality of radially disposed inlet passages 20 which break out on the periphery of the distributor and which are adapted to register in turn and as the distributor rotates, with an inlet port 21 formed in the body part. The communication of an inlet passage 20 with the inlet port 21 is arranged to occur whilst the delivery passage 15 is out of register with a delivery port 16 and also during the time when the plungers 12 are permitted to move outwardly by the cam lobes. The inlet port 21 is formed at one end of a cylinder 22 which is defined in the body part and which contains a reciproachable shuttle 23. The movement of the shuttle towards said one end of the cylinder is limited by its abutment with the end of the cylinder and the movement of the shuttle in the opposite direction is limited by a stop 24 which conveniently is adjustable from the exterior of the apparatus. Formed on the periphery of the distributor and in a position to register in turn with the inlet port is a first series of longitudinal groove 25. The grooves are disposed intermediate the inlet passage 20 and are in communication at one end with a first circumferential groove 26 formed in the periphery of the distributor. This groove is in communication with the supply conduit 19 by way of an adjustable throttle 27 the setting of which can be controlled manually or by means of a governor and the arrangement is such that when one of the first series of grooves 25 registers with the inlet port 21, fuel will flow to said one end of the cylinder thereby causing the shuttle to be moved away from the inlet port. During this movement fuel is expelled from the other end of the cylinder to a convenient drain. For this purpose the other end of the cylinder is in communication with a second circumferential groove 28 formed in the periphery of the distributor and from which extends a second longitudinal groove 29. This groove is arranged to register in turn as the distributor rotates with a plurality of spill ports 30 thereby allowing fuel to escape from the other end of the cylinder. In an alternative arrangement a plurality of grooves 29 are provided and a single spill port 30.

When the inlet port 21 registers with one of the inlet passages 20 fuel under pressure is adimtted to the other end of the cylinder to move the shuttle towards said one end thereof and into contact with an abutment, thereby

to displace the fuel contained in said one end of the cylinder **22** to the longitudinal passage **14** and the pumping chamber. For this purpose the second groove is arranged to register in turn with a plurality of supply ports **31**, formed in the body part and in communication with the supply conduit **19**.

In use, fuel which is contained within the pumping chamber is delivered to a combustion space of the engine during an injection stroke of the apparatus and whilst this is occurring fuel for subsequent delivery is being metered to said one end of the cylinder. The maximum quantity of fuel which can be delivered by the apparatus is determined by the movement of the shuttle **23** and this quantity can be adjusted by varying the setting of the stop **24**.

Whilst such pumps function very satisfactorily in use, it has been found that when the shuttle strikes an abutment at said one end of the cylinder cavitation of the fuel within the connected inlet passage **20** may occur. During the next injection stroke of the apparatus the cavity or cavities are violently collapsed by the action of the increased fuel pressure within the inlet passage. Unfortunately, the clearing of the cavity or cavities in this manner causes erosion of the passage with the result that the life of the apparatus is reduced. It has been found that the cavity or cavities form at or near the outer ends in the inlet passages **20** and in order to overcome the problem one way vales **35** (shown for clarity only in FIGURE 7) are provided in each of the inlet passages **20** adjacent their inner ends. These valves are disposed so as to permit fuel to flow from the inlet port to the longitual passage but to prevent flow of fuel in the opposite direction. For convenience and in order to increase the volume in which the cavity or cavities can form the outer ends of the inlet passages are in communication with an annular groove **36** formed on the periphery of the distributor and from which extend a plurality of equi-angularly spaced grooves **37** which are arranged to register in turn with the inlet port **21**. These in fact constitute parts of the inlet passages and if desired only one of the inlet passages as previously described need be provided. If this is the case then only one one-way valve is provided usually however two such passages and valves will be provided in order to maintain balance.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a liquid fuel pumping apparatus for supplying fuel to an internal combustion engine comprising in combination an injection pump adapted to be driven in timed relationship with the engine and having a rotatable distributor member; a body housing said pump and member; a passage through said member by which said injection pump is placed in communication with one end of a metering cylinder during the filling stroke of said pump to receive a predetermined amount of fuel; further passages adapted to carry said fuel from said injection pump to injection nozzles; an inlet metering shuttle movable within said cylinder, said one end of said cylinder adapted to store said pre-determined amount of fuel which is displaced to said injection pump during its filling stroke by moving said shuttle towards said one end of said cylinder; an abutment located at said one end of said cylinder for limiting the movement of said shuttle; and a one-way valve positioned between said abutment and said injection pump in said passage communicating with said injection pump to allow fuel to flow to said injection pump but being so placed that any cavities formed in said passage as a result of said shuttle striking said abutment will be located between said one-way valve and said abutment.

2. An apparatus as claimed in claim **1** further comprising a port formed in said body and in communication with said one end of said cylinder, during the filling of said injection pump said port registers with said passage in said member.

3. An apparatus as claimed in claim **2** wherein said passage includes at least one radially disposed portion in which said valve is mounted.

4. An apparatus as claimed in claim **3** wherein said distributor member is provided with a circumferential groove on its periphery having a lateral groove in communication therewith for registration with said port, said grooves forming part of said passage and acting as in increased volume in which said cavities can form.

5. An apparatus as claimed in claim **4** wherein two radially disposed portions are provided, each having a one-way valve and each communicating with said grooves.

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U.S. Cl. X.R.

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