

Jan. 26, 1971

I. FENNE

3,558,241

LIQUID FUEL PUMPING APPARATUS FOR SUPPLYING FUEL
TO INTERNAL COMBUSTION ENGINES
Filed March 4, 1969

FIG. 1

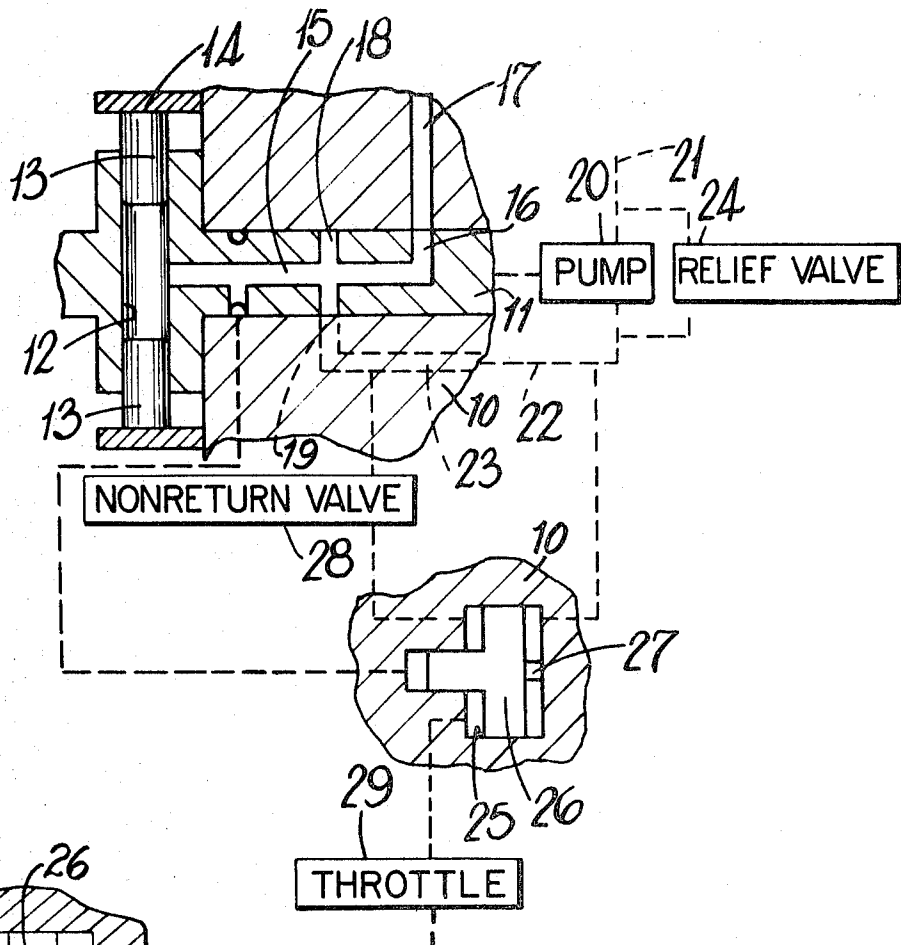
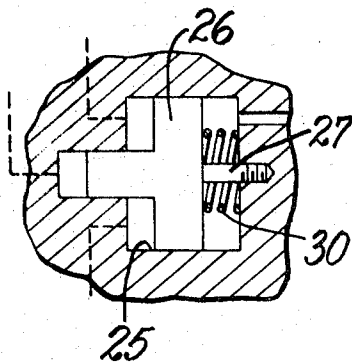


FIG. 2



INVENTOR
Ivor Fenne
BY Holman, Glascock
Downing, Seibold
ATTORNEYS

1

3,558,241

LIQUID FUEL PUMPING APPARATUS FOR SUPPLYING FUEL TO INTERNAL COMBUSTION ENGINES

Ivor Fenne, Greenford, Middlesex, England, assignor to C.A.V. Limited, London, England, a British company
Filed Mar. 4, 1969, Ser. No. 804,082

Claims priority, application Great Britain, Mar. 8, 1968, 11,378/68

Int. Cl. F04b 23/12

U.S. Cl. 417—206

7 Claims

ABSTRACT OF THE DISCLOSURE

A fuel pumping apparatus including a pumping chamber having an outlet through which fuel flows during an injection stroke, a stepped shuttle slidable within a complementary shaped bore, the narrower end of said bore being in communication with the pumping chamber, means acting to urge the stepped shuttle towards the narrower end of the bore and throttle means for controlling the escape of fluid from the portion of the bore defined between the wider portion of the shuttle and the step in the bore during movement of the shuttle towards the narrower end of the bore, whereby the quantity of fuel flowing through the outlet can be controlled.

This invention relates to liquid fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising an injection pump including a reciprocable pumping plunger, a pumping chamber and an outlet from said pumping chamber and through which fuel flows during an injection stroke.

The object of the invention is to provide such an apparatus in a simple and convenient form.

According to the invention, an apparatus of the kind specified comprises in combination, a stepped shuttle slidable within a complementarily shaped bore, the narrower end of said bore being in constant communication with said pumping chamber, means for urging said shuttle in one direction to expel fuel from the narrower end of the bore, stop means for limiting the extent of movement of the shuttle in the other direction and throttle means for controlling the rate of escape of fluid from the portion of the wider part of the bore lying between the wider part of the shuttle and the step in the bore, during movement of the shuttle in said one direction, the arrangement being such that the initial quantity of fuel expelled from the pumping chamber, during an injection stroke, urges the shuttle into contact with said stop means, whereafter the remaining quantity of fuel flows through the outlet and the amount by which the shuttle moves in said one direction is determined by the setting of said throttle means thereby controlling the quantity of fuel flowing through said outlet during the next injection stroke.

FIG. 1 is a fragmentary view partly in elevation and partly in cross-section of the invention.

FIG. 2 is a fragmentary view of another embodiment for effecting movement of the shuttle of FIG. 1.

One example of a liquid fuel pumping apparatus in accordance with the invention and as shown in diagrammatic form in the accompanying drawings. With reference to FIG. 1 of the drawings, there is provided a body part 10 in which is mounted a rotary cylindrical distributor member 11, which is adapted to be driven in synchronism with an engine (not shown) with which the apparatus is associated. At one end of the distributor member there is formed a transversely extending bore 12 in which is mounted a pair of pumping plungers 13 which are adapted to be moved inwardly as the distributor member rotates, by the action of cam lobes formed on the internal periph-

2

ery of an annular cam ring 14 which surrounds the distributor member and which is mounted in the body part.

In communication with the transversely extending bore 12, is a longitudinal passage 15 which, at its end remote from the bore, terminates in a delivery passage 16 which breaks out onto the periphery of the distributor member. Moreover, formed in the body part are a plurality of angularly spaced outlet ports 17 with which the delivery passage registers in turn and during the time when the plungers are being moved inwardly by the action of the cam lobes. The outlet ports, in use, are connected to injection nozzle units respectively, which are mounted to direct fuel into the combustion spaces respectively of the engine. The plungers together with the cam lobes constitutes an injection pump, having a pumping chamber and by the arrangement described a single injection pump serves a plurality of engine cylinders.

At another point, the longitudinal passage is in communication with a plurality of inlet passages 18 which break out onto the periphery of the distributor member at equiangularly spaced points. In the case of an apparatus which is intended to supply fuel to a four cylinder engine, four such inlet passages 18 are provided and also four outlet ports 17. For registration with the inlet passages there is provided, in the body part, an inlet port 19 and through which fuel flows to the inlet passages in turn, during the time when the delivery passage is out of register with the outlet ports.

Mounted on the distributor member is the rotary part of a vane type feed pump 20, the stationary part of which is mounted within the body part. The feed pump is provided with an inlet 21 which, in use, is connected to a source of liquid fuel and also an outlet 22 which is connected to a transfer passage 23 formed in the body part. Moreover, the inlet and outlet of the feed pump are interconnected by a relief valve 24 which controls the outlet pressure of the feed pump. In the present example, the transfer passage is in constant communication with the inlet port.

Formed in the body part is a stepped bore 25 having slidable therein a complementary shaped shuttle 26. The narrower end of the bore is in constant communication with the longitudinal passage 15 formed in the distributor member, and the wider end of the bore is in constant communication with the outlet 22 of the feed pump, so that the shuttle is urged in a direction to expel fuel from the narrower end of the bore. Furthermore, at the wider end of the bore, there is mounted a stop 27 which limits the extent of movement of the shuttle in the opposite direction.

The portion of the wider part of the bore 25 lying between the wider part of the shuttle 26 and the step in the bore, is in communication with the transfer passage 23 by way of a spring loaded non-return valve 28, which is disposed to allow fuel under pressure to flow into the bore and to prevent flow of fuel in the opposite direction. Furthermore, extending from said portion of the bore is a passage in which is mounted an adjustable throttle 29, the setting of which can be determined by an operator.

In use, during an injection stroke, in which position the apparatus is shown when the pumping plungers 13 are moving inwardly, the initial quantity of fuel, which is expelled from the pumping chamber, flows into the narrower end of the stepped bore 25 and urges the shuttle 26 into contact with the stop 27. During this movement no fuel flows through the delivery passage 16 and the outlet port in register therewith, however, as soon as the shuttle contacts the stop, the remaining quantity of fuel, which is expelled from the pumping chamber, flows through the delivery passage and an outlet port to the associated engine. Furthermore, during this movement of the shuttle, fuel flows into the aforesaid portion of

3

the stepped bore by way of the non-return valve 28 and at the end of the injection stroke when the delivery passage 16 has moved out of register with an outlet port and one of the inlet passages 18 has moved into register with the inlet port 19, the outlet pressure of the feed pump acting on the wider end of the shuttle, moves the shuttle in a direction to expel fuel from the narrower portion of the bore 25 into the longitudinal passage and the pumping chamber of the apparatus. The extent of this movement of the shuttle is determined by the setting of the adjustable throttle 29 and it will be appreciated that if the throttle is closed, then no movement of the shuttle can take place. At the end of the filling stroke the pumping chamber of the apparatus is completely filled with fuel and during the next injection stroke the maximum quantity of fuel will be supplied to the engine, since no fuel will be displaced from the pumping chamber into the narrower end of the stepped bore. If the setting of the throttle 29 is such as to allow movement of the shuttle, then the quantity of fuel which is delivered to the engine during the next injection stroke will be correspondingly reduced.

In the above described example the stepped bore and shuttle, are accommodated within the body part 10 of the apparatus, however, they may be positioned within the distributor member. In one modification and shown in FIG. 2, instead of utilizing the output pressure of the feed pump to effect movement of the shuttle during the filling stroke of the apparatus, a coiled compression spring 30 or other resilient means may be located within the wider portion of the stepped bore. In a further modification it can be arranged that the throttle means 29 effects only a limited control over the quantity of fuel which is delivered by the apparatus. In this case further throttling means located upstream of the inlet port would be provided to control the fuel flowing directly from the outlet of the feed pump to the inlet port and the throttle means 29 would be used to control, for instance, the maximum fuel delivery curve of the apparatus.

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

1. A liquid fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising an injection pump including a reciprocable pumping plunger, a pumping chamber and an outlet from said pumping chamber and through which fuel flows during an injection stroke, a stepped shuttle slidable within a complementarily shaped bore, the narrower end of said bore being in constant communication with said pumping chamber, means for urging said shuttle in one direction to expel fuel from the narrower end of the bore, stop means for limiting the extent of movement of the shuttle in the other direction, means connecting the portion of the wider part of the bore lying between the wider part

4

of the shuttle and the step in the bore with the inlet to the pumping chamber and throttle means for controlling the rate of escape of fluid from the portion of the wider part of the bore lying between the wider part of the shuttle and the step in the bore, during movement of the shuttle in said one direction, the arrangement being such that an initial quantity of fuel expelled from the pumping chamber, during an injection stroke, urges the shuttle into contact with said stop means, whereafter the remaining quantity of fuel flows through the outlet and the amount of which the shuttle moves in said one direction is determined by the setting of said throttle means, said movement causing the narrow end of the bore to absorb a certain amount of fuel, which upon the shuttle being shifted in said one direction, causes the shuttle to expel an amount of fuel equal to that absorbed, into the pumping chamber for supplying to the outlet during the next injection stroke.

2. An apparatus as claimed in claim 1 including a fuel feed pump having an outlet and passage means through which fuel can flow from the outlet of the feed pump to the pumping chamber during a filling stroke of the injection pump.

3. An apparatus as claimed in claim 2 including further passage means through which said portion of the bore is in communication with the outlet of the feed pump and a non-return valve mounted in said further passage means to prevent the escape of fuel from said portion of the bore during movement of the shuttle towards the narrower end of the bore.

4. An apparatus as claimed in claim 3 in which the means to urge the shuttle in said one direction in the pressure in the wider end of the bore, which is in communication with the outlet of the feed pump.

5. An apparatus as claimed in claim 3 in which the means to urge said shuttle in one direction is a resilient means acting on the shuttle.

6. An apparatus as claimed in claim 4 including a further throttle means for controlling the flow of fuel through said first mentioned passage means.

7. An apparatus as claimed in claim 5 including a further throttle means for controlling the flow of fuel through said first mentioned passage means.

References Cited

UNITED STATES PATENTS

3,433,160 3/1969 Kemp 103—2.1
3,485,175 12/1969 Kemp et al. 103—2.1

CARLTON R. CROYLE, Primary Examiner

U.S. Cl. X.R.

418—15