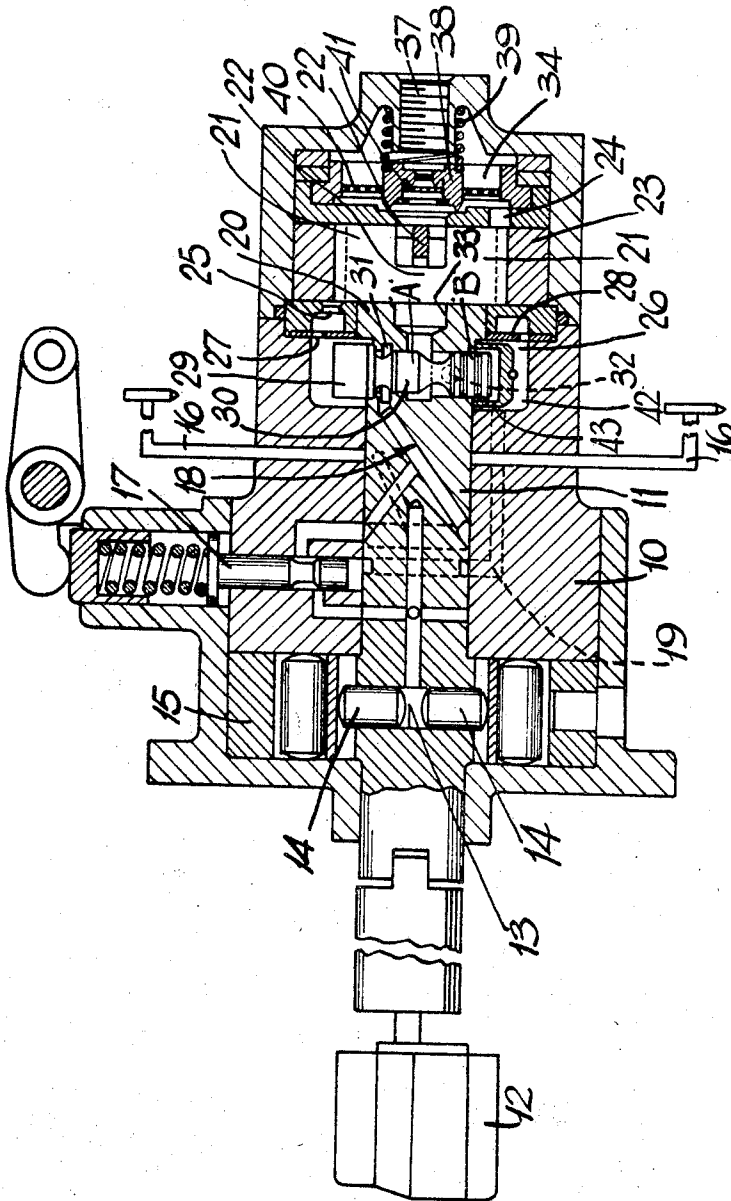


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LIQUID FUEL PUMPING APPARATUS FOR SUPPLYING FUEL
TO INTERNAL COMBUSTION ENGINES
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LIQUID FUEL PUMPING APPARATUS FOR SUPPLYING FUEL TO INTERNAL COMBUSTION ENGINES

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5 Claims

ABSTRACT OF THE DISCLOSURE

Fuel injection apparatus of the rotary distributor type and incorporating a feed pump which supplies fuel to the injection pump of the apparatus. The output pressure of the feed pump being controlled by a valve member which is movable under the action of centrifugal force to close a spill port from the outlet of the feed pump, and which is movable in the opposite direction by a force developed by the output pressure of the feed pump. A pressurizing valve is provided downstream of the spill port to prevent the flow of fuel therethrough until the output pressure of the feed pump attains a predetermined value.

This invention relates to liquid fuel pumping apparatus for supplying fuel to internal combustion engines and of the kind comprising in combination, an injection pump which is adapted to be driven in timed relationship with an engine with which the apparatus is associated, the injection pump serving during a delivery stroke to cause fuel to be delivered to the engine, a feed pump for supplying fuel to the injection pump and a valve member the setting of which determines the area of a spill port by which means the output pressure of the feed pump is controlled, said valve member having a surface against which the output pressure of the feed pump acts in opposition to centrifugal force acting upon a mass which is adapted to be rotated in timed relationship with the engine whereby the output pressure of the feed pump is controlled in a manner so that it varies with the speed of the engine, the valve member also serving to control the flow of fuel from the feed pump to the injection pump so that in the event that the output pressure of the feed pump falls below a value determined by the speed at which the engine is operating the valve member will move to cut off the supply of fuel to the injection pump.

Such an apparatus is described in Patent No. 3,289,590 of Hutcheon. In this specification the mass is urged by springs in a direction so that when the apparatus is at rest the spill port is closed. In this manner the output pressure of the feed pump can build up quickly as the engine is started, unfortunately however the provision of the springs means that the supply of fuel to the injection pump is prevented valve member. If the springs are omitted then owing to the effect of gravity and the fact that at the normal cranking speed of the engine the centrifugal force is small the valve member can oscillate between a position in which the flow of fuel to the injection pump is prevented and a position in which the

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maximum spillage of fuel through the spill port occurs thereby making it difficult to supply sufficient fuel to the engine for starting purposes. Moreover the output pressure at cranking speeds would be too small to fill the injection pump particularly if the plungers therein stick.

The object of the present invention is to provide such an apparatus in a form in which the starting of the engine is facilitated.

According to the invention in an apparatus of the kind specified additional valve means is provided to prevent the flow of fuel through said spill port until the output pressure of the feed pump attains a predetermined value.

According to a further feature of the invention damping means is provided to reduce the amplitude of oscillation of the valve member.

One example of a pumping apparatus in accordance with the invention will now be described with reference to the accompanying sectional side elevation. The apparatus includes a body part 10 in which is mounted a rotary distributor 11 which is arranged to be driven in timed relationship with the engine 12 with which the apparatus is associated. At one end of the distributor a transverse bore 13 is provided in which are mounted a pair of pumping plungers 14 which are arranged to be moved inwardly as the distributor rotates by a cam surface formed on the internal periphery of an annular cam ring 15 mounted in the body part. Moreover, the distributor is provided with passages through which fuel displaced from the transverse bore can flow in turn to outlet ports 16 formed in the body part. The apparatus is also provided with an hydraulic governor 17 the setting of which is dependent upon the outlet pressure of a feed pump and the governor spring loading. The governor controls the quantity of fuel which is admitted to the transverse bore 13 during the permitted outward movement of the pumping plungers. This fuel is obtained from a feed pump but flows through a separate passage indicated at 18 on the accompanying drawing, the output pressure of the feed pump controls the setting of the governor and this fuel is applied to the governor through a passage such as is indicated at 19 in the accompanying drawing. The portion of the apparatus so far described operates in a well known manner but for a better understanding reference can be made to our copending application previously mentioned.

At the end of the distributor 11 remote from the transverse bore 13 is mounted the feed pump which includes a rotary part 20 formed as an extension of the distributor. The rotary part has mounted thereon four vanes 21 which are radially disposed and equiangularly spaced relative to the axis of rotation of the rotary part 20. Moreover, diametrically opposite blades are interconnected by bridge portions 22. The vanes are accommodated within the bore of a ring 23 and bear upon the internal periphery thereof. The ring is secured within an extension of the body part and the bore thereof is eccentrically disposed relative to the axis of rotation of the rotary part. By this arrangement a vane pump is formed and which is provided with an inlet 24 and an outlet 25.

The outlet 25 of the feed pump discharges into an annular chamber 26 defined in the body part by way of a plurality of holes 27 formed in a diffuser ring 28, the holes serving to even the flow of fuel into the chamber. The passage 19 extends from the chamber 26 and with-

in the chamber rotates a mass in the form of a head 29 of a valve member 30 which is mounted within a diametrical bore formed in the distributor. Near one end of the bore there is formed a circumferential groove 31 which communicates with the passage 18. Moreover, near the opposite end of the bore is formed a passage which is tangential to the axis of rotation of the distributor and which opens into the bore accommodating the valve member 30 at a pair of spill ports 32 only one of which is seen because of the section. The other end of this passage opens into the chamber 26. Intermediate the ports 32 and the groove 31 the bore is enlarged and is in communication with a passage 33 extending through the rotary part 20 and which communicates with an inlet chamber 34 to which fuel can be supplied through an inlet port 37.

As shown in the drawing the valve member 30 is provided with two lands A and B the diameter of land A being larger than the diameter of land B. When the valve member is moved outwardly due to the action of centrifugal force acting on the head 29, land B moves to reduce the area of the ports 32 whilst land A will move to reduce the annular area of the circumferential groove 31 which is exposed to the bore. Also in use fuel pressure will act on the head 29 and valve member 30 but in view of the difference in diameter of the two lands the force produced by the fuel pressure will act in opposition to the centrifugal force. In use an equilibrium position will be attained in which the ports 32 are partially closed and the groove 31 fully open so that fuel can flow without hindrance through the passage 18 to the injection pump.

When the flow of fuel from the chamber 26 to the injection pump increases or decreases without a variation in speed then the valve member will move to effect compensation and the result is that the fuel pressure will vary in accordance with the speed irrespective of the quantity of fuel supplied by the injection pump to the engine. In the event that the fuel pressure in the chamber 26 falls below a value determined by the speed at which the engine is operating due for instance to a blocked inlet or air entering the inlet, the valve member will move outwardly under the action of centrifugal force and the flow of fuel through the passage 18 will be reduced or prevented. In the latter case no more fuel will be supplied to the injection pump and the engine to which fuel is being supplied by the apparatus will stop.

This arrangement prevents engine "run away" which might otherwise occur when the pressure of fuel controlling the setting of the governor 17 falls. The device operates very satisfactorily when the engine has started and sufficient speed has been attained however, when starting the engine, the effect of gravity particularly when the axis of the valve member 30 is vertical, coupled with the fact that the centrifugal force and the fuel pressure are very low permits the valve member to oscillate between its two extreme positions. In one of these positions the spill ports 32 are effectively fully open whilst in the other position the groove 31 is blocked off and the spill ports are closed. In said one position the build up of fuel pressure is very small whilst in the other position no fuel can reach the injection pump.

In the apparatus described in the specification of Patent No. 3,289,590 springs are provided to urge the valve member towards the position in which the spill ports are closed. The provision of the springs means that the output pressure/speed characteristic of the combination of feed pump and regulator valve which is a square low is altered. In the present apparatus springs are not provided to bias the valve member instead, a pressurizing valve is provided to enable the fuel pressure in the chamber 26 to be built up quickly. The pressurizing valve includes a valve member 38 having an annular sealing lip which is adapted to seal against a sealing surface defined

about the point of entry of the passage 33 into the chamber 34. The valve member 38 is loaded by a spring 39 in a direction to seal the passage 33 and is supported by a flexible diaphragm 40 which also is perforated to define a fuel filter for the fuel passing through the inlet 37. Conveniently the valve member 38, the diaphragm 40 and a support ring surrounding the diaphragm are formed integrally from nylon or some other suitable material. By this means before fuel can be spilled through the spill ports 32 the pressure in the chamber 26 must have attained a pressure sufficient to overcome the effect of the spring 39. In this manner sufficient output pressure will be built up quickly to move the valve member (if necessary) and rapid starting of the engine will be achieved. The valve member 38 also incorporates a non-return valve 41 which when the apparatus is in use is closed but which when the apparatus is primed by pumping fuel under pressure through the inlet port 37, opens to allow fuel to flow into the interior passages of the apparatus.

In order to damp the oscillation of the valve member a dashpot is provided this having the form of a cup member 42 which is retained relative to the distributor 11 and into which the free end of the valve member 30 extends in the manner of a loose fitting piston. The cup member is provided with an aperture or apertures 43 by which means the interior of the cup member is placed in restricted communication with the chamber 26, and by this means the amplitude of oscillation of the valve member which occurs as the distributor rotates is reduced. The damping effect of the dashpot must not be too high otherwise the valve member will be unable to move quickly enough to perform its control function outlined above.

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 internal combustion engines and comprising in combination, an injection pump which is adapted to be driven in timed relationship with the engine with which the apparatus is associated, a feed pump for supplying fuel under pressure, conduit means through which fuel flows from the outlet of the feed pump to the injection pump, a spill path from the outlet of the feed pump, valve means for controlling the flow of fuel through said spill path whereby the pressure at the outlet of the feed pump can be controlled, a surface defined on said valve means, said surface being exposed to the outlet pressure of the feed pump, the force developed acting to urge the valve means in one direction to permit a larger flow of fuel through the spill path, centrifugally operable means acting on the valve means to urge the valve means in the opposite direction to reduce the flow of fuel through the spill path, said centrifugally operable means being driven in timed relationship with the apparatus, and a valve mounted in said spill path and operable to prevent the flow of fuel through the spill path irrespective of the setting of said valve means, until the outlet pressure of the feed pump has attained a predetermined value.

2. A liquid fuel pumping apparatus according to claim 1 in which said valve is positioned in the spill path downstream of the valve means.

3. A liquid fuel pumping apparatus according to claim 2 including dashpot means operatively connected to said valve means for restricting the rate of movement thereof.

4. A liquid fuel pumping apparatus according to claim 3 including hydraulic pressure operable governor means for controlling the flow of fuel through said conduit means thereby to control the quantity of fuel delivered by the injection pump to the engine, the hydraulic pressure for operating the governor means being obtained from the outlet of the feed pump.

5. A liquid fuel pumping apparatus according to claim 4 in which said valve means additionally controls the flow

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of fuel through said conduit means, the valve means when urged fully in said opposite direction serving to prevent the flow of fuel through the conduit means.

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