

April 22, 1969

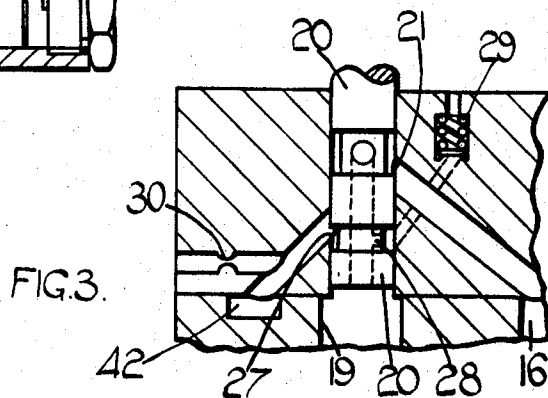
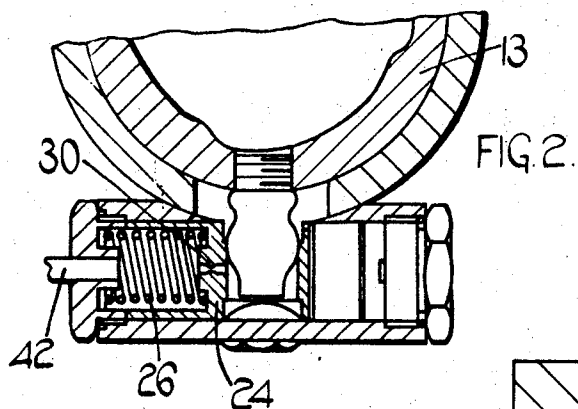
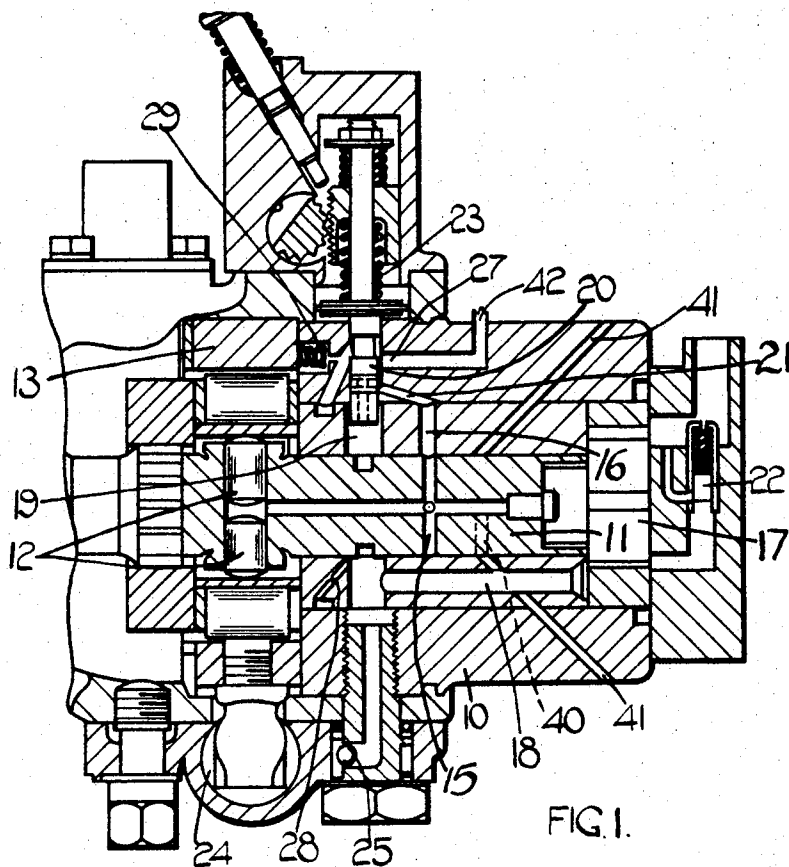
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LIQUID FUEL PUMPING APPARATUS

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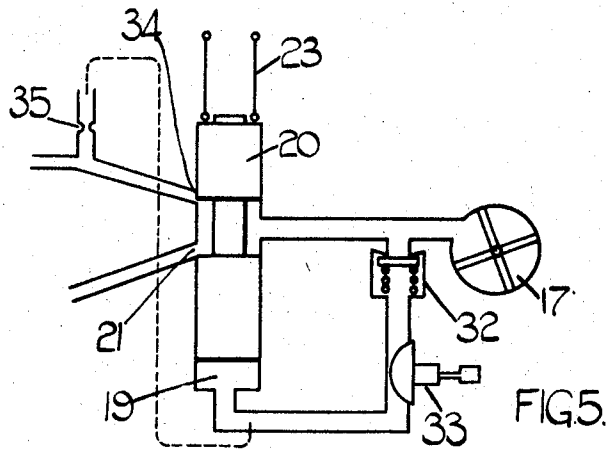
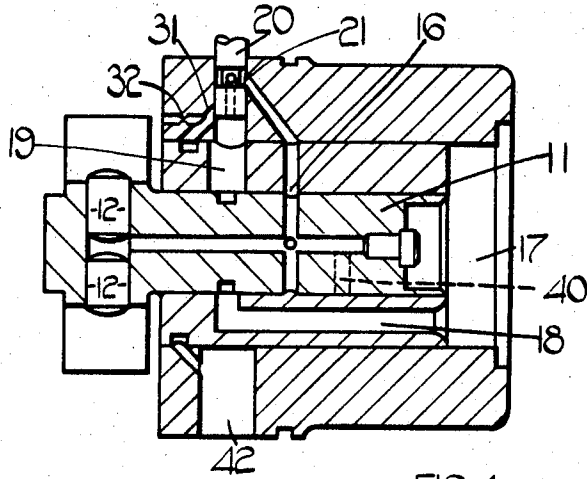
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LIQUID FUEL PUMPING APPARATUS

Paul Edgar Glikin, London, and Ivor Fenne, Greenford, England, assignors to C.A.V Limited, London, England

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5 Claims

This invention relates to liquid fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising an injection pump, a fluid pressure operable member the setting of which determines the timing of delivery of fuel to the engine, and an adjustable throttle member for controlling the quantity of fuel supplied by the apparatus to the engine.

The object of the invention is to provide such an apparatus in which the timing of injection of fuel is varied in accordance with the setting of the throttle member.

In the accompanying drawings:

FIGURE 1 is a sectional side elevation of one example of a pumping apparatus in accordance with the invention.

FIGURE 2 is a cross sectional view of part of the apparatus shown in FIGURE 1, and

FIGURES 3, 4 and 5 are diagrammatic views showing modifications to the fuel circuit of the apparatus.

Referring to the drawings there is provided a body part 10 in which is mounted a rotary distributor member 11.

At one end of the distributor member is formed a transverse bore in which is mounted a pair of reciprocable plungers 12 which are arranged to be moved inwardly as the distributor is rotated by an annular cam 13. The distributor is provided with a longitudinal bore 14 from which extend a plurality of radially disposed inlet passages 15 and a single radially disposed delivery passage 40. The inlet passages are arranged to register in turn, with an inlet port 16 during part of the time when the plungers 12 can move outwardly and during the inward movement of the plungers the delivery passage registers with one of a plurality of outlet passages 41 these being in communication with the combustion spaces of an associated engine respectively. During outward movement of the plungers fuel flows from the inlet port 16 to the pumping chamber defined between the plungers 12 and during the inward movement of the plungers fuel is displaced from the pumping chamber to one of the combustion spaces of the engine.

Fuel is supplied under pressure to the inlet port 16 from a vane type feed pump 17, the rotary part of which is mounted on the distributor and flows by way of a passage 18 in the body to one end of a radially disposed cylinder 19 also formed in the body part. In this cylinder is an axially movable throttle member 20 which is provided with a pair of axially spaced circumferential grooves. The lower groove communicates with the cylinder 19 and hence with the outlet of the feed pump 17 by way of a passage formed in the throttle member. In the wall of the cylinder 19 is a port 21 which communicates with the inlet port 16 and by varying the axial setting of the throttle member the opening of the port 21 is controlled. In this manner the quantity of fuel which can be delivered by the pump is controlled.

The output pressure of the feed pump 17 is controlled by a spring loaded relief valve 22 and since the pump is arranged to deliver fuel at a rate which is proportional to speed and also at a rate which is greatly in excess of the rate at which fuel is supplied to the engine, the output pressure of the feed pump varies in accordance with the speed. This pressure is applied to one end of the throttle member 20 and acts to move the latter against

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the action of a coil spring 23 to reduce the size of the port 21. Thus the combination of spring and throttle member acts as an hydraulic governor to control the speed of the engine.

In order to vary the timing of injection the cam 13 is movable angularly about the axis of rotation of the distributor member and for this purpose as shown in FIGURE 2 there is provided a fluid pressure operable piston 24 which is contained within a cylinder disposed tangentially to the cam. One end of the cylinder is connected to the passage 18 by way of a check valve 25 and the other end of the cylinder contains a coiled compression spring 26 and the arrangement is such that as the pressure at the outlet of the feed pump increases the piston 24 will be moved against the action of the spring thereby to vary the timing of injection in accordance with the speed of the engine.

The pressure in the end of the cylinder containing the spring 26 is also arranged to be varied and for this purpose this end of the cylinder is in communication with a port 27 formed in the wall of the cylinder containing the throttle member 20 by way of a passage 42. The size of the port 27 varies in accordance with the setting of the throttle member. Fuel is supplied to the upper groove of the throttle member from the passage 18 and a restriction 28 therebetween. Moreover, the pressure of fuel supplied to the groove is controlled by a constant pressure valve 29. Furthermore, a restriction 30 is provided in the piston 24 and this places the end of the cylinder containing the spring 26 in communication with a drain. In use, as the throttle member 20 is moved to counteract variations in loads on the engine the size of the port 27 varies with the result that the pressure in the end of the cylinder containing the spring 26 varies. In a particular instance if the speed remains constant and the load increases i.e. the throttle member is moved downwardly the pressure in the cylinder containing the spring 26 will increase and the piston 24 will be moved to the right.

The purpose of the check valve 25 is to prevent the reaction of the plungers on the cam lobes moving the cam and when this happens the valve closes to trap fuel in the end of the cylinder remote from the spring 26.

In the arrangement shown in FIGURE 3 the restrictions 28 and 30 are defined respectively in the throttle member 20 and the body part of the pump. Moreover, the output pressure of the pump does not act directly on the piston 24 as in the first example, to move the piston against the action of its spring. However the passage 42 communicates with the end of the cylinder remote from the spring, and the positions of the port 27 is altered so that as the throttle is moved downwardly to increase the quantity of fuel supplied the size of the port 27 is reduced and in this manner the piston 24 will move in the same direction but will not be responsive to variations in the speed of the engine.

In a further arrangement shown in FIGURE 4 the metering valve is provided with a single land to which fuel is fed directly from the passage 18. The axial setting of the metering valve determines the size of the port 21 as in the previous examples and also the size of a further port 31. This port communicates with the end of the timing cylinder remote from the spring and a restriction 32 is provided through which a point intermediate the port 31 and the cylinder containing the piston 24 is in communication with a drain. In this arrangement the setting of the piston is dependent both on the speed of and the load on the engine.

An alternative arrangement is shown in FIGURE 5, in which the feed pump 17 supplies fuel under pressure to the land of the throttle member 20 and the size of the

port 21 varies the rate at which fuel is supplied to the engine as in the previous arrangements. Also provided is a constant pressure valve 32 which communicates with the outlet of the feed pump and through which fuel under pressure passes to act on the throttle member in opposition to the spring 23. The pressure of fuel acting on the throttle member is controlled by a centrifugal regulator 33 which is mounted in the distributor member 11 of the pump and which controls the pressure by spillage of fuel in a manner proportional to the square of the speed at which the distributor rotates. Also provided is a port 34 the size of which is controlled by the throttle member and which communicates with the end of the cylinder containing the piston 24. Furthermore a point intermediate the port 34 and the cylinder containing the piston is in communication by way of a restriction 35, with a point intermediate the centrifugal regulator 33 and the cylinder 19. In use, the pressure at the outlet of the feed pump is controlled to a pressure which is equal to the pressure controlled by the centrifugal regulator plus the pressure drop across the constant pressure valve 32. This pressure is applied to the piston 24 and is controlled by the size of the orifice 34 thus this pressure always lies between the output pressure of the feed pump and a lower pressure determined by the setting of the constant pressure valve. This pressure is dependent both upon the speed of the engine and the setting of the throttle valve and by this means the setting of the piston 24 is responsive both to the speed of and the load on the engine.

Having thus described our invention what we 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 comprising a body part, an injection pump mounted within the body part said pump being adapted to be driven in timed relationship with an engine to which the apparatus supplies fuel, a fluid pressure operable member the setting of which determines the timing of delivery of fuel by the injection pump, a feed pump for supplying fuel under pressure, valve means for controlling the output pressure of the feed pump in a manner so that it varies in accordance with the speed at which the apparatus is driven, conduit means through which fuel flows from the feed pump to the injection pump, an axially adjustable throttle member for controlling the flow of fuel through said conduit means, resilient means biasing the throttle member in a direction to increase the flow of fuel through the conduit means, said throttle member being subjected to a variable speed dependent pressure so that its axial setting will depend upon the speed at which the apparatus is driven, a flow path communicating with the outlet of the feed pump, the flow of fuel through said flow path being controlled by said throttle member, a restric-

tion in said flow path downstream of said throttle member and passage means for applying the pressure at a point in said flow path intermediate the throttle member and said restriction to said fluid pressure operable member, whereby variation in the setting of the throttle member will produce variations in the pressure at said point thereby to vary the setting of said fluid pressure operable member.

2. An apparatus according to claim 1 including a further restriction in said flow path, said further restriction being disposed intermediate the outlet of the feed pump and said throttle member and a pressurising valve for maintaining the pressure in said flow path intermediate the further restriction and the throttle member at a substantially constant value.

3. An apparatus according to claim 2 in which said fluid pressure operable member comprises a piston movable within a cylinder, one end of said cylinder being connected by said passage means to said flow path and the other end of the cylinder being connected to the outlet of the feed pump.

4. An apparatus according to claim 3 including resilient means acting on said piston in opposition to the force exerted by the outlet pressure of the feed pump acting on the piston.

5. An apparatus according to claim 1 including a constant pressure drop valve arranged in a branch path from said flow path intermediate the feed pump and the throttle member, a centrifugally operable regulator valve disposed in said branch path downstream of said constant pressure drop valve, said regulator valve being driven at a speed proportional to the speed at which the apparatus is driven and the regulator valve serving to control the pressure downstream of the constant pressure drop valve in a manner so that it varies as a function of the speed at which the regulator valve is driven, the flow path downstream of the restriction being connected to said branch path downstream of the constant pressure drop valve, and the throttle member being subjected to the pressure downstream of the constant pressure drop valve.

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50 LAURENCE M. GOODRIDGE, *Primary Examiner*.

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