June 3, 1969 M. DRORI 3,447,520

LIQUID FUEL PUMPING APPARATUS

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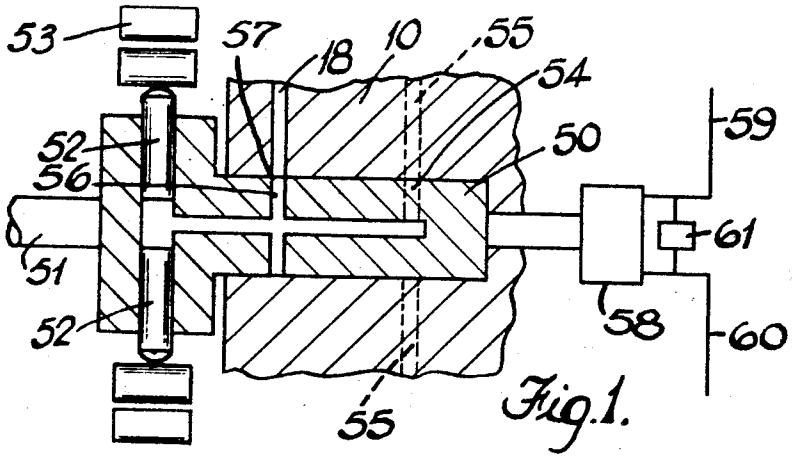


Fig. 1.

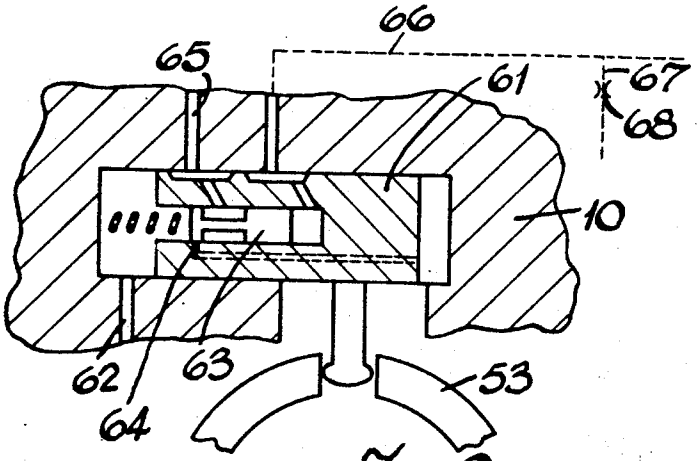


Fig. 2.

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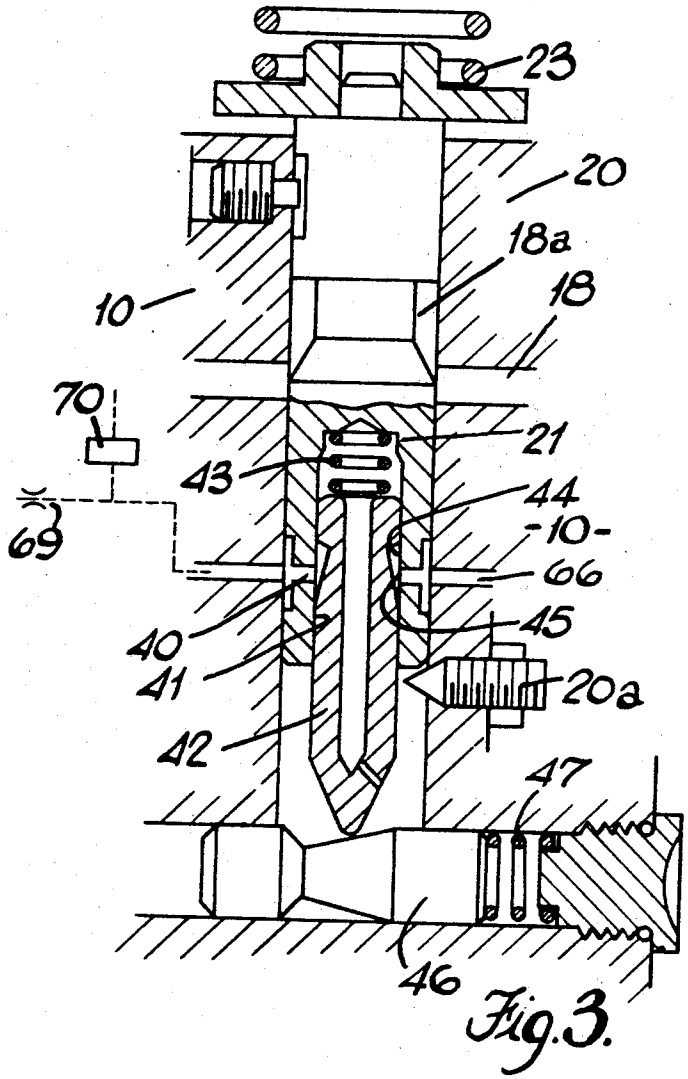


Fig. 3.

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LIQUID FUEL PUMPING APPARATUS

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U.S. Cl. 123—139 7 Claims

ABSTRACT OF THE DISCLOSURE

A fuel injection apparatus has an axially adjustable throttle member for controlling the flow of fuel through a passage to an injection pump. A bore formed in the throttle member contains a relatively movable member. The throttle member defines passage means through which pressure from a constant pressure source can be applied to a fluid pressure operated device which determines the timing of injection of fuel to an engine. The relative position of the throttle member and the movable member determines the effective area of said passage means, thereby enabling the pressure which is applied to the fluid pressure operated device to be varied in accordance with the setting of the throttle member.

This invention relates to liquid fuel pumping apparatus for supplying fuel to an internal combustion engine and comprising an injection pump including a pumping plunger and a cam for imparting motion to the pumping plunger, a fluid pressure operable member for controlling the setting of the cam to vary the timing of the delivery of fuel, a feed pump for supplying fuel under pressure to the injection pump, and an axially movable cylindrical throttle member for controlling the quantity of fuel flowing to the injection pump from the feed pump.

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

In the accompanying drawings:

FIGURE 1 is a diagrammatic view of part of one example of a liquid fuel pumping apparatus in accordance with the invention,

FIGURE 2 is a view similar to FIGURE 1 of another part of the apparatus shown in FIGURE 1, and

FIGURE 3 is a view of a further part of the apparatus shown in FIGURE 1.

Referring to the drawing there is provided a body part **10** in which is mounted a rotary cylindrical distributor member **50**. The distributor member is arranged to be driven in timed relationship through a shaft **51** with the engine with which the apparatus is associated and at one end of the distributor there is provided a transversely extending bore. Within the bore is mounted a pair of pumping plungers **52** which are arranged to be moved inwardly as the distributor member rotates, by means of a surrounding annular cam **53** having inwardly directed pairs of diametrically disposed cam lobes (not shown) formed on the internal periphery thereof. The transverse bore is in communication with a longitudinal passage formed in the distributor member and at one point the passage is in communication with a radially disposed delivery passage **54** which is arranged to register as the distributor rotates, with each in turn of a plurality of outlet ports **55** formed in the body part. The outlet ports in use, are connected to the injection nozzles respectively of the associated engine. At another point the longitudinal passage is in communication with a plurality of radially disposed and equi-angularly spaced inlet passages **56** which are arranged to register in turn and as the distributor rotates, with an inlet port **57** formed in the body part. The registration of the inlet port **57** with one of the inlet passages **56** is arranged to occur during the time when the plungers **52** are permitted to move outwardly by the cam lobes and the registration of the delivery passage **54** with one of the outlet ports **55** is arranged to occur during the time when the plungers are being moved inwardly. The inlet port is in communication with a source of fuel as will be described and in this manner fuel is fed to the outlet ports in turn as the distributor rotates.

Drivingly engaged with the other end of the distributor **50** is a vane type feed pump **58**. The feed pump is provided with an inlet **59** and an outlet **60** the former being in use, connected to a source of fuel and the inlet and outlet are interconnected by a relief valve **61** of any convenient form. This valve may take the form of a spring loaded plunger or alternatively it may have the form of a centrifugally operable member. In either case the output pressure of the feed pump is controlled in a manner such that it varies with the speed at which the distributor member and hence the associated engine, is rotating. The inlet port is connected to the outlet of the feed pump by way of a passage **18** formed in the body part **10** and for controlling the flow of fuel through this passage there is provided a metering valve **20**. As shown the metering valve comprises a cylindrical member **21** slidable within a complementary bore formed in the body part, the member **21** having a recess **18***a* which forms part of the passage **18** and as the metering valve is moved upwardly as shown in the drawing the flow of fuel through the passage **18** is reduced. The metering valve is biased by means of a governor spring **23** to a position in which the maximum flow of fuel through the passage **18** can occur and this setting is determined by an adjustable stop member **20***a* located in the body part. The lower end of the metering valve is exposed to the outlet pressure of the feed pump so that as this pressure increases and for a given setting of the governor spring, the metering valve will move to reduce the rate of flow of fuel through the passage **18**. In this manner the metering valve acts as a governor.

In order to vary the timing of the delivery of fuel to the engine the annular cam **53** in known manner, is mounted within the body part **10** for limited angular movement therein about the axis of rotation of the distributor. In order to move the cam angularly a fluid pressure operated piston **61** is provided this being contained within a complementary cylinder formed in the body part.

One end of the cylinder containing the piston **61** is open to a drain passage **62** and extending inwardly from the adjacent face of the piston is a blind bore. Slidable within the bore is a spring loaded valve element **63** having a groove formed intermediate its ends. The outer land of the valve element controls the opening of a port **64** to either the groove in the valve element or to said one end of the cylinder. Moreover, the port **64** is in communication with the opposite end of the cylinder containing the piston by way of a passage formed in the piston. The groove on the valve element is in communication with the outlet **60** of the feed pump by way of a passage **65** formed in the body part and extending through the piston, and the blind end of the bore containing the valve element is in communication with a passage **66** formed in the body part. Moreover, extending from this passage is a branch passage **67** which is provided with a restrictor **68**, the passage **67** extending to a drain. The pressure of fuel which acts on the valve element **63** in opposition to its spring is controlled by the metering valve in a manner to be described and as the valve element moves the port **64** will be uncovered by the outer land of the valve element to permit liquid fuel to flow into or out of the other end of the cylinder containing the piston **61**. The piston will therefore move and take up a new position in which the

port **64** is covered by the aforesaid land of the valve element.

The fuel under pressure for effecting movement of the valve element is derived from the outlet **60** of the feed pump and passes through a restrictor **69** to a port **40** which opens out into a bore **41** formed in the end of the metering valve **20**. The pressure of fuel which is fed to the port **40** is maintained at a substantially constant value by a constant pressure valve **70**. Within the bore **41** is mounted a cylindrical member **42** which is loaded in an outward direction with respect to the metering valve by means of a coiled compression spring **43**. Moreover, the portion of the counter bore which contains the spring **43** is in communication with the space underneath the metering valve by way of a bore formed within the member **42**. In this manner the fluid pressures acting on the member **42** are completely balanced. Formed in the periphery of the member **42** is an annular groove **44** which is shaped in a manner to give the required characteristic as will be described. Diametrically opposite the port **40** is a further port **45** which communicates with the passage **66**.

Considering the case first of all where the member **42** is fixed. As the metering valve is moved in accordance with variations in the load on the engine then the effective size of the ports **40** and **45** will be varied and hence the flow of fuel through these ports will also be varied. Owing to the presence of the restrictor **68** downstream of these ports the pressure acting on the valve element **63** will also be varied and in this manner the setting of the piston **61** and annular cam **53** will be adjusted in accordance with the setting of the metering valve. By shaping the sides of the groove **44** the relationship between the setting of the metering valve and the setting of the piston can be varied.

As is shown in the drawing the setting of the member **42** can also be adjusted by means of a stop member **46** which is contained within a bore disposed at right angles to the cylinder in which the metering valve is mounted. The stop member is loaded by a coiled compression spring **47** in one direction and is movable in opposition to the spring by means of fuel pressure applied to the other end of the stop member. This pressure is derived directly from the outlet of the feed pump and therefore varies in accordance with speed. Thus by this arrangement the setting of the member **42** can be made to vary in accordance with the speed of the distributor and hence the engine so that the setting of the piston is also dependent upon the speed.

It will be appreciated that for a different speed characteristic as described above it is merely necessary to change the member **42** for one having a different profile on its periphery. If it is required that the setting of the annular cam should not vary in accordance with the speed then the stop member **46** is replaced by a fixed member.

In a modification the ports **40** and **45** can be replaced by a graduated series of ports in the wall of the throttle member **20**, these ports being positioned so that the flow of fuel therethrough is adjusted as the relative setting of the throttle member and the cylindrical member **42** varies.

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 comprising an injection pump including a pumping plunger and a cam for imparting motion to the pumping plunger, a fluid pressure operated member for controlling the setting of the cam to vary the timing of the delivery of fuel, a feed pump for supplying fuel under pressure to the injection pump, an axially movable cylindrical throttle member for controlling the quantity of fuel flowing to the injection pump from the feed pump, a bore formed in the throttle member, a member located within the bore and slidable relative to the throttle member, a passage defined in said throttle member the effective size of said passage being determined by the relative axial setting of the throttle member and said member, the upstream end of said passage being in communication with a source of fuel at constant pressure, and the downstream end of said passage being connected so that the pressure existing at the downstream end of the passage is applied to said fluid pressure operated member whereby as the axial setting of the throttle member is altered the pressure acting on said fluid pressure operated member will also be varied.

2. A liquid fuel pump as claimed in claim **1** including valve means for controlling the output pressure of the feed pump in a manner so that the pressure varies in accordance with the speed at which the apparatus is driven, said constant pressure source comprising a first restrictor intermediate the upstream end of said passage means and the outlet of the feed pump and a constant pressure valve for maintaining the fuel pressure intermediate the restrictor and the upstream end of the passage substantially constant.

3. A liquid fuel pump as claimed in claim **2** including a second restrictor through which fuel can escape from intermediate the downstream end of the passage and the fluid pressure operated member.

4. A liquid fuel pump as claimed in claim **3** in which the member is spring loaded in a direction out of the bore, and its extended end bears upon a cam surface defined upon a fluid pressure operated member movable transversely relative to the axis of the throttle member.

5. A liquid fuel pumping apparatus as claimed in claim **4** in which said fluid pressure operated member is arranged to be moved against the opposition of a spring by the pressure developed at the outlet of the feed pump.

6. A liquid fuel pumping apparatus as claimed in claim **5** in which said passage means comprises a pair of ports formed in the throttle member in communication with said bore, the member having a shaped grooved for cooperation with said ports.

7. A liquid fuel pumping apparatus as claimed in claim **5** in which the passage means comprises a series of graduated ports which are arranged to be covered progressively as relative movement occurs between the throttle member and said member.

References Cited

UNITED STATES PATENTS

2,660,992	12/1953	Roosa.
2,877,754	3/1959	Roosa.
3,147,746	9/1964	Hoefer.
3,207,140	9/1965	Roosa.
3,308,799	3/1967	Bessiere.

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U.S. Cl. X.R.

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