June 20, 1961 F. M. EVANS 2,989,003

LIQUID FUEL PUMPS FOR INTERNAL COMBUSTION ENGINES

Filed Sept. 18, 1959 2 Sheets-Sheet 1

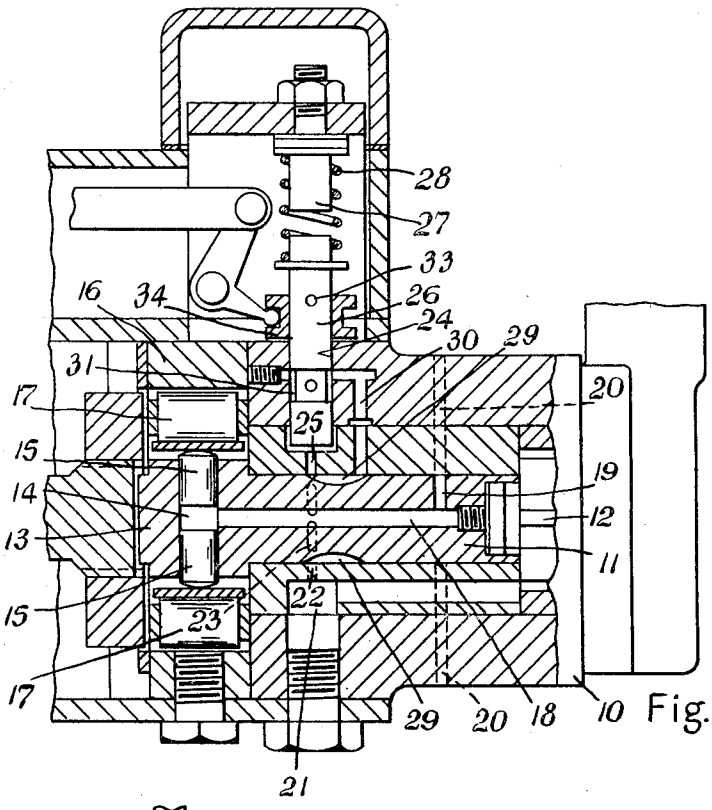


Fig. 1

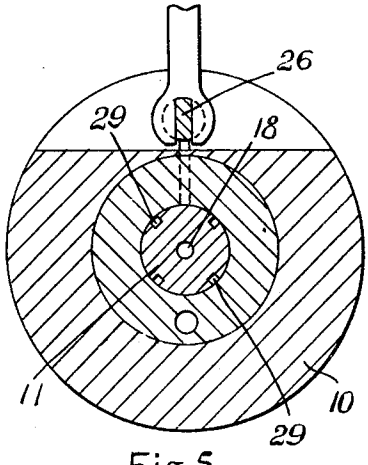


Fig. 5

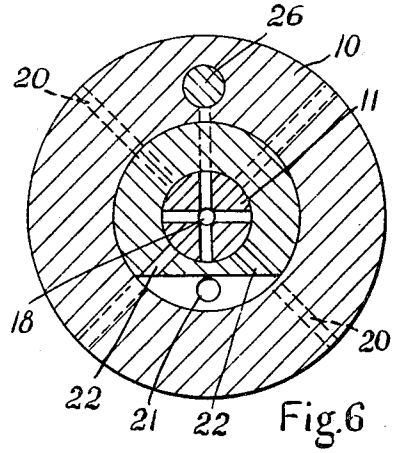


Fig. 6

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LIQUID FUEL PUMPS FOR INTERNAL COMBUSTION ENGINES

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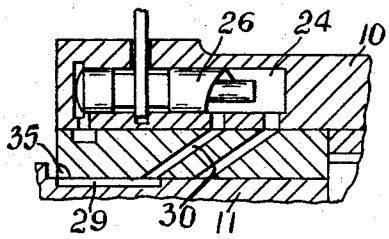


Fig.4

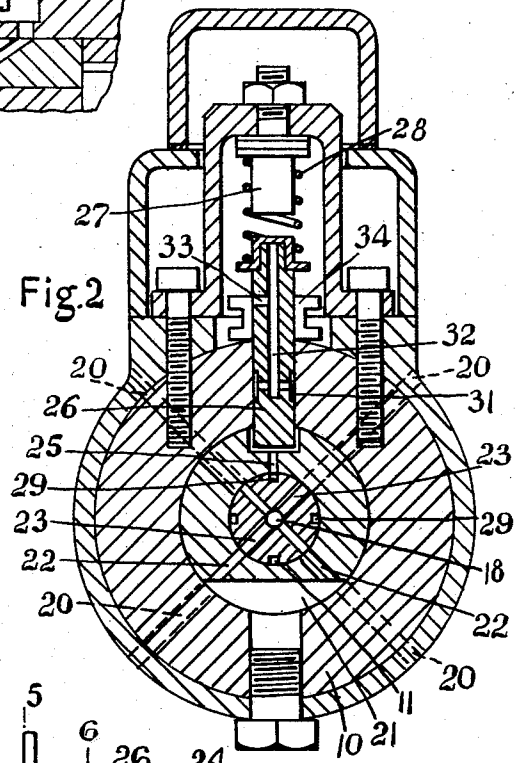


Fig.2

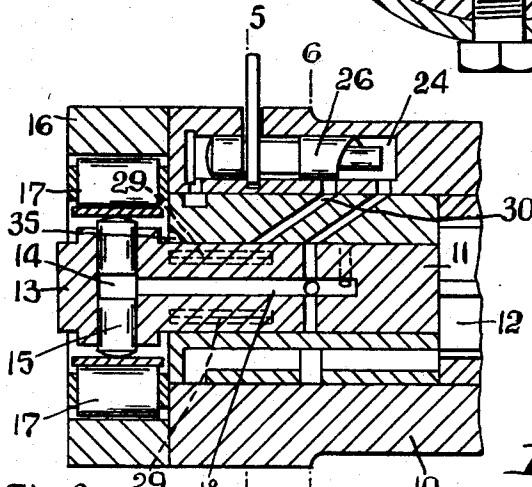


Fig.3

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United States Patent Office 2,989,003 Patented June 20, 1961

2,989,003

LIQUID FUEL PUMPS FOR INTERNAL COMBUSTION ENGINES

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Filed Sept. 18, 1959, Ser. No. 840,875
Claims priority, application Great Britain Sept. 25, 1958
5 Claims. (Cl. 103—41)

This invention relates to liquid fuel pumps for internal combustion engines, of the kind comprising an injection pump for supplying the fuel to the engine, and a rotary distributor for conveying the fuel from the injection pump to each in turn of the engine cylinders.

The object of the present invention is to provide convenient means whereby the quantity of fuel delivered to the engine by the injection pump can be varied.

According to the invention a liquid fuel pump of the kind specified comprises in combination a cylinder which at one end is in communication with the injection pump during the injection stroke thereof, a piston in the cylinder, said piston being movable away from said end of the cylinder by the action of fuel fed to the cylinder by the injection pump, a relatively fixed stop for limiting movement of the piston away from said end of the cylinder, means urging the piston towards said end of the cylinder, a spill passage which is placed in communication with said end of the cylinder after each injection stroke of the injection pump, and adjustable means for closing said spill passage at a predetermined position of the piston in the cylinder

In the accompanying drawings FIGURE 1 is a sectional side view, and FIGURE 2 is a cross-section of one example of the invention, FIGURES 3 and 4 are fragmentary sectional side views of a modification showing the piston and distributor in two alternative positions, FIGURE 5 is a cross-section in the line 5—5 of FIGURE 3, and FIGURE 6 is a cross-section on the line 6—6 of FIGURE 3.

Referring to FIGURES 1 and 2 a known form of pump to which the invention is applicable comprises a body part **10** in which is contained a rotary cylindrical distributor **11**. At one end of the distributor is the rotary part of a feed pump **12** which has inlet and outlet pasages which may be interconnected by a spring loaded relief valve so as to limit the pressure which can be generated by this pump.

At the other end of the distributor is a fuel injection pump comprising a rotary head **13** having a transverse bore **14** in which is contained a pair of plungers **15**. Each plunger **15** is movable inwardly by the interaction of a stationary cam **16** and a roller **17** at appropriate positions as the head **13** rotates.

The rotary parts of the two pumps are interconnected by the distributor **11** and are adapted to be driven as a unit by the engine. Moreover, in the distributor is an axial passage **18** which at one end is in communication with the bore **14**, in the head, and at another position is in communication with a radial passage **19** in the distributor which, as the distributor rotates, communicates in turn with each of a plurality of passages **20** in the body part leading to the different cylinders of the engine.

The feed pump **12** is adapted to deliver fuel to a chamber **21** in the body part which is in communication through ports **22** as the distributor rotates, with each in turn of a plurality of further and angularly spaced passages **23** in the distributor, these passages **23** each opening into the axial passage **18**.

In action, as the rotary pump parts rotate fuel is fed to the axial passage **18** by the feed pump **12** and is discharged to the engine cylinders in turn by the inward movements of the plunger or plungers **15** of the injection pump.

In applying the invention to such a pump, in the body

part **10** is formed a control cylinder **24** which at its inner end is in communication through a short passage **25** with each in turn of the passages **23** as the distributor rotates, a communication between the cylinder and each passage **23** being established during the inward injection strokes of the plunger **15** of the injection pump. Within the cylinder **24** is a piston **26** which is movable outwardly in the cylinder into contact with a relatively fixed but adjustable stop **27** by the action of fuel fed to the cylinder by the injection pump. Moreover, the piston is urged towards the inner end of the cylinder by a spring **28**.

In the periphery of the distributor at positions between the passages **23** are formed axially extending grooves **29**. The grooves (as the distributor rotates) in turn serve to connect the inner end of the cylinder with a spill passage **30** formed in the body part. The spill passage opens into a part of the cylinder which is at all times occupied by a part of the piston incorporating a peripheral circumferential recess **31**. The recess communicates through radial passages with an axial passage **32** in the piston, and opening from this axial passage **32** at a position outside the cylinder is a radial outlet **33** in the piston. Moreover, around the part of the piston outside the cylinder is a sleeve **34** which is axially adjustable relative to the piston either manually, or by a governor or other automatic means. The axial setting of the sleeve **34** determines the position of the piston **26** at which the outlets will be covered to prevent escape of fuel from the spill passage, and thereby determines the permitted inward movement of the piston.

In action, assuming that the cylinder **24** is empty, then on the first injection stroke of the injection pump fuel will be fed to the cylinder until the piston **26** contacts the fixed stop **27**, at which instant injection to the appropriate engine cylinder commences. This condition corresponds to the minimum fuel supply position. After injection of fuel to the engine cylinder, and during the time fuel is being fed to the injection pump by the feed pump, the inner end of the control cylinder is in communication through one of the grooves **29** with the spill passage **30**. As a result the piston will move inwardly and fuel will escape from the inner end of the cylinder until the outlet **33** in the piston is covered by the sleeve **34**.

It will be understood that the amount by which the piston is permitted to move inwardly to exhaust fuel from the inner end of the cylinder will determine the quantity of fuel which can be supplied to the control cylinder on the next injection stroke of the injection pump, and will therefore determine the quantity of fuel supplied to the next engine cylinder. Thus maximum fuel supply to the engine is provided when the outlet **33** in the piston is covered by the sleeve when the piston is against the fixed stop **27**.

In a modification, instead of a sleeve the piston may be angularly adjustable either manually, or by a governor, or other automatic means, and may have a circumferential recess intermediate its ends, one side of this recess being defined by a helical edge. This edge serves to determine the axial position of the piston within the cylinder at which escape of fuel from the spill passage through the recess to an outlet in the body part is cut-off. In other respects the action of this modification may be as previously described.

The control cylinder **24** may be disposed radially relative to the distributor as seen in FIGURES 1 and 2, or may extend parallel thereto as shown in FIGURES 3 to 6.

In the further modification illustrated in FIGURE 3 the grooves **29** may be axially positioned in the distributor to effect communication between the spill passage **30** and an outlet **35** in the body part. In this case the spill

passage opens into the control cylinder at a position in which it can be uncovered by the inner edge of the piston 26 which hedge is of helical form. Also the piston is angularly adjustable to determine the axial position of the piston in the cylinder at which the said edge will cover the spill passage, and thereby prevent further escape of fuel from the inner end of the cylinder. Moreover, in this modification the piston is urged inwardly by the action of fuel fed to the outer end of the cylinder 24 from the feed pump instead of by a spring and the outer end of the cylinder serves as the fixed stop. In other respects the action of this modification may be as before described.

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

1. A device for supplying liquid fuel to a multi-cylinder internal combustion engine, comprising in combination a stationary hollow body, a liquid fuel injection pump carried by the hollow body and having a rotary driving member, a rotary distributor mounted in the hollow body and rigid with the driving member of the injection pump, passages in the rotary distributor and hollow body for conveying fuel from the injection pump to each in turn of the engine cylinders, a cylinder in the hollow body, additional passages in the rotary distributor and hollow body for establishing communication between one end of the cylinder in the hollow body and the injection pump during each delivery stroke of the latter, a piston slidable in the cylinder away from the said end thereof in response to the pressure of fuel admitted under the control of the rotary distributor to the said end of the cylinder from the injection pump, a stop for limiting sliding movement of the piston away from the said end of

the cylinder, means for urging the piston away from the stop towards the said end of the cylinder, a spill passage which is formed in the hollow body, and through which fuel from the said end of the cylinder is dischargeable under the control of the rotary distributor after each delivery stroke of the injection pump, and adjustable means for preventing discharge of fuel through the spill passage in the hollow body when the piston occupies a predetermined position in the cylinder.

2. A device according to claim 1, wherein the means for urging the piston away from the stop towards the said end of the cylinder has the form of a spring acting on the piston.

3. A device according to claim 1 wherein the means for urging the piston away from the stop towards the said end of the cylinder is constituted by a feed pump for supplying liquid fuel to the injection pump, the feed pump serving also to supply fuel to the other end of the cylinder.

4. A device according to claim 1, wherein the adjustable means comprises a sleeve axially movable on the piston which is provided with an outlet for co-operating with the sleeve, the outlet being in communication with the spill passage in the hollow body.

5. A device according to claim 1, wherein the piston is angularly adjustable about its axis and has a helical edge for determining the position of the piston in the cylinder at which discharge of fuel through the spill passage is prevented.

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