

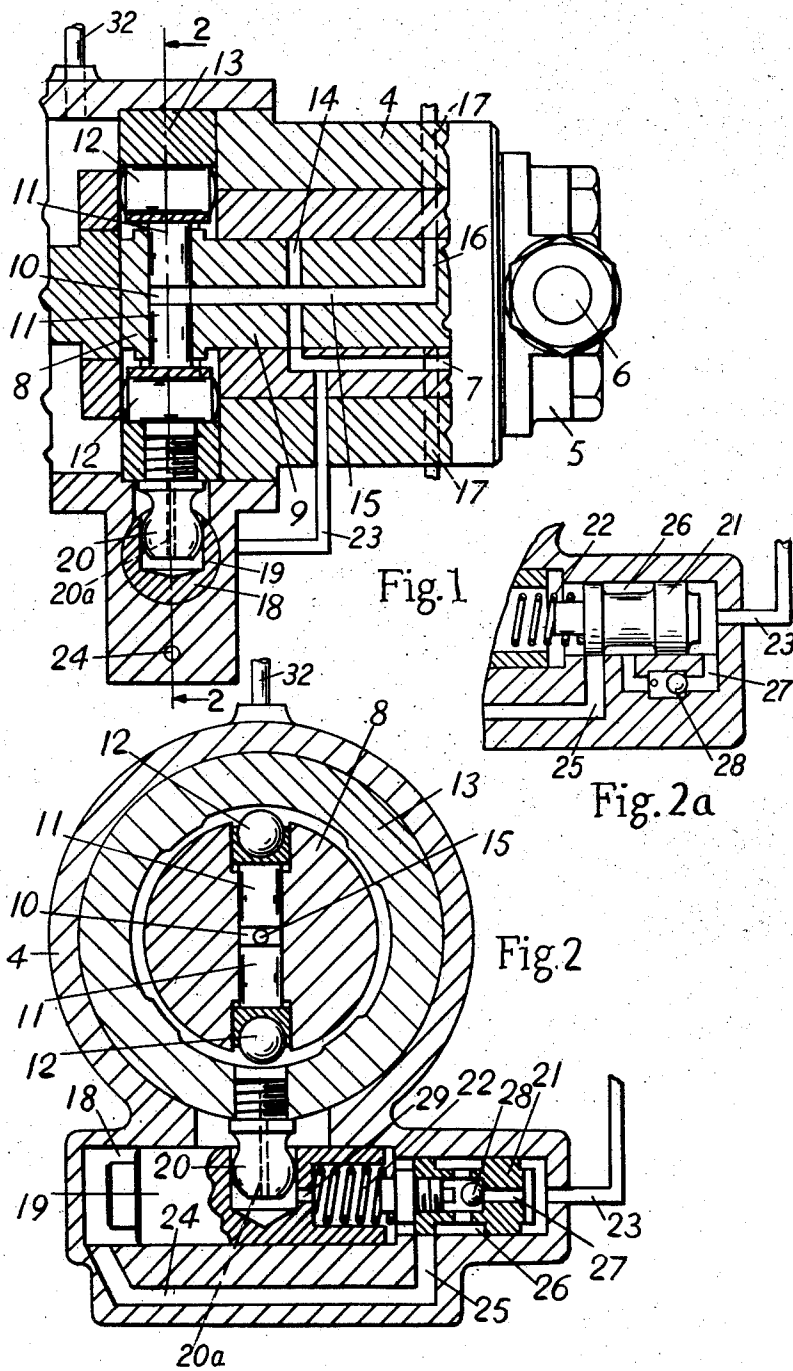
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LIQUID FUEL PUMPS

3,101,078

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2 Sheets-Sheet 1



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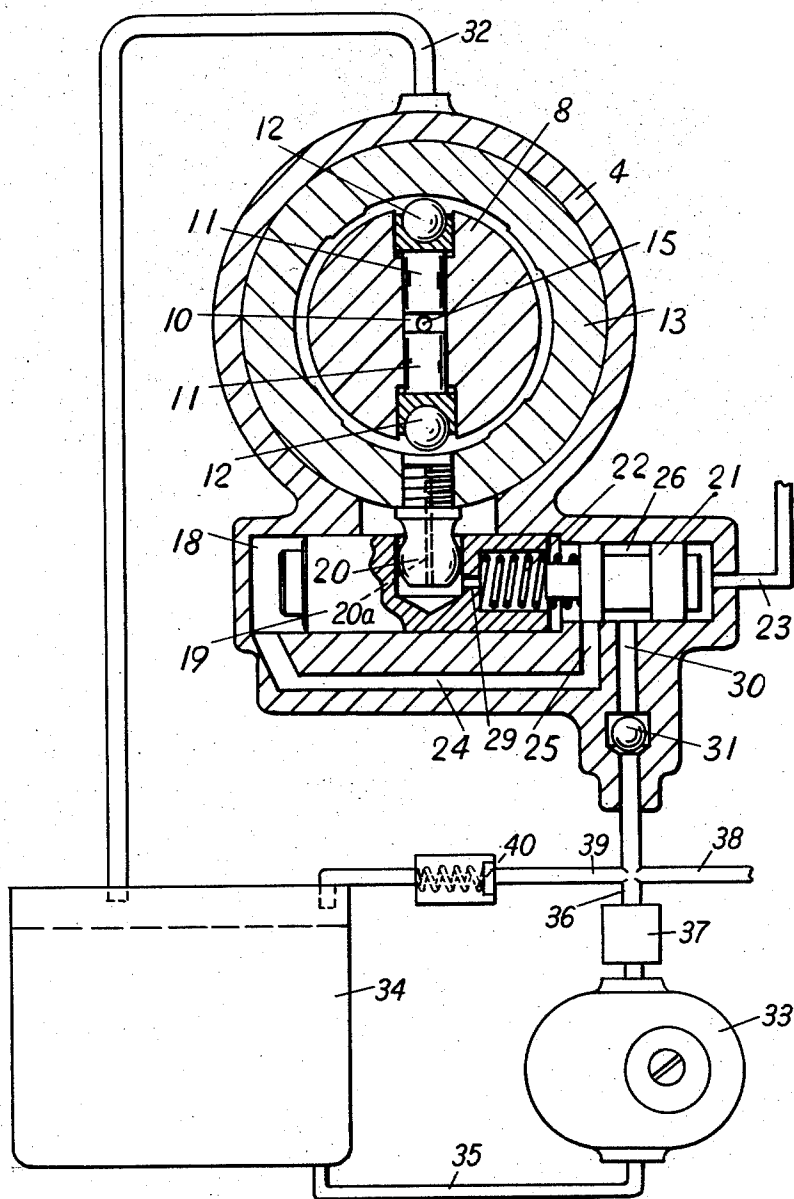
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Fig. 3



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## LIQUID FUEL PUMPS

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This invention relates to liquid fuel pumps for internal combustion engines, and of the kind comprising in combination a rotary distributor adapted to be driven by the engine, a head at one end of the distributor, said head having therein a transversely extending bore, at least one plunger in the bore, means for feeding fuel intermittently as the distributor rotates to the bore in the head so as to move the plunger outwardly, an annular cam surrounding the head and adapted to impart inward movements to the plunger as the head rotates and thereby deliver fuel through the distributor to the engine cylinders in turn, and a fluid operable piston for imparting angular movements to the cam to vary the timing of the delivery of fuel to the engine.

The object of the present invention is to provide such a pump in an improved form.

According to the invention a pump of the kind specified comprises in combination a cylindrical chamber in which the fluid operable piston is accommodated, a cylindrical valve member in the chamber, a compression spring acting between the piston and valve member, a supply passage through which fuel at a pressure at least in part dependent upon the speed of the engine can enter the one end of the chamber to act on the valve member, a further passage controlled by the valve member whereby the other end of the chamber can be placed in communication with a source of liquid under pressure when the pressure in the supply passage rises, and whereby said other end of the chamber can be exhausted when the pressure in the supply passage falls.

In the accompanying drawings:

FIGURE 1 is a sectional side view of a pump incorporating one example of the invention,

FIGURE 2 is a part sectional view on the line 2—2 of FIGURE 1,

FIGURE 2a is a fragmentary sectional view of a modification, and

FIGURE 3 is a view similar to FIGURE 2 but showing another modification.

Referring first to FIGURES 1 and 2 of the drawings there is provided a hollow body part 4 which at one end contains a feed pump 5 of the kind comprising a rotary impeller provided with vanes. The inlet 6 and outlet (which is connected to the passage 7 in the body part) of the feed pump are interconnected through a relief valve (not shown) which regulates the feed pressure in a manner dependent on the speed of this pump. In the other end of the hollow body part is contained a fuel injection pump comprising a rotary head 8 formed on one end of a cylindrical distributor 9 which serves to interconnect the rotary parts of the feed and injection pumps, and which is rotatable in a conventional manner by a multicylindrical internal combustion engine. In the head 8 is a transverse bore 10 containing a pair of reciprocating plungers 11 which through rollers 12 at their outer ends co-operate with a surrounding annular cam 13.

The passage 7 in the body part registers in turn, as the distributor 9 rotates, with a plurality of radially disposed passages 14 in the distributor. The passages 14 are in communication with an axial passage 15 in the distributor which opens at one end into the bore 10 in the head. Also leading from the axial passage 15 is a radial passage 16 which is adapted to register in turn, as the distributor

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rotates, with a plurality of ports 17 in the body part, the ports 17 being adapted for connection respectively to the injection nozzles of the engine cylinders.

The pump so far described is well known and operates in the following manner. Fuel from the feed pump 5 is fed intermittently to the axial passage 15 in the distributor and thus serves to move the plungers 11 of the injection pump outwardly. At appropriate instants in the cycle the plungers are moved inwardly by the action of the cam 13, and thereby serve to discharge fuel in turn to the engine cylinders through the ports 17.

In applying the present invention to a pump as above described, a stepped cylindrical chamber 18 is formed in the body part 4 adjacent the injection pump with its axis extending parallel with a tangent to the annular cam 13, and which has two coaxial parts, one of the said parts being wider than the other. In the wider part of the chamber 18 is slidably mounted a piston 19 which is provided with a radial gap accommodating the outer end of a short arm 20 extending radially from the annular cam 13, the arrangement being such that axial movement of the piston will impart angular movement to the cam. In the narrower part of the chamber is slidably mounted a cylindrical valve member 21, whilst acting between the valve member and the piston is a coiled compression spring 22.

The narrower end of the chamber 18 is connected through a supply passage 23 and the passage 7 to the outlet of the feed pump 5 so that the pressure at this end of the chamber will be dependent on engine speed. Moreover, the wider end of the chamber is connected through a passage 24 to a port 25 opening into the wall of the narrower part of the chamber, the port 25 being arranged to be covered by the valve member 21 when the latter is in an equilibrium position (as shown in FIGURE 2).

In the periphery of the valve member is a circumferentially extending groove 26 to which fuel from the supply passage 23 can flow by way of a passage 27 in the valve member incorporating a non-return valve 28.

Assuming that the valve member is in the equilibrium position and the pressure of fuel at the narrower end of the chamber rises, as a result of an increased speed of the engine driving the rotary distributor 9 and the rotary parts of the feed pump and the injection pump, then the valve member 21 will be moved towards the piston 19 against the action of the spring 22. The effect of this is to cause the peripheral groove 26 in the valve member to register with the port 25, thereby permitting fuel to flow from the supply passage 23, to the wider end of the chamber. As a result the piston 19 is moved towards the narrower end of the chamber until the pressure on the spring 22 balances the supply pressure and moves the valve member back to the equilibrium position. During this movement of the piston the annular cam 13 is moved angularly to advance the instants of injection of fuel through the ports 17. Moreover, during the time the wider end of the chamber is in communication with the supply passage 23 the non-return valve 28 prevents reverse flow of fluid as might otherwise happen as a result of the reaction of the annular cam 13 as it is contacted by the rollers 12. When, on the other hand the pressure in the supply passage 23 falls, the valve member moves towards the narrower end of the chamber thereby placing the wider end of the chamber in communication with the space between the piston and the valve member. Fuel can escape from this space to the reservoir or the inlet side of the feed pump through a passage 29 in the piston 19, a passage 20a in the short arm 20, the interior of the hollow body part 4, and a pipe 32 extending from the hollow body part, with the result that the piston moves towards the wider end of the chamber until the valve member re-assumes the equilibrium position.

It will be understood that the passage 27 in the valve member 21 could be replaced by a passage 27 which is provided in the body part as shown in FIGURE 2a, and which incorporates a non-return valve 28, and serves to interconnect the narrower end of the chamber with the circumferentially extending groove 26 in the periphery of the valve member.

In the modification illustrated in FIGURE 3 the passage 27 is omitted, but a further passage 30 is provided as shown in the body part 4, and extends outwardly from one side of the narrower part of the stepped cylindrical chamber 18 at a position intermediate the ends of said narrower part. The passage 30 incorporates a non-return valve 31 and is intended to be supplied with lubricating oil under pressure from an oil pump 33 drivable by the engine. The operation of this modification is similar to that of the first example described except that lubricating oil is supplied to, and exhausted from, the wider end of the chamber 18 under the control of the valve member 21 when the latter is removed from its equilibrium position. Thus, when the valve member 21 in the narrower part of the chamber 18 is moved by the pressure of fuel supplied to the narrower end of the chamber through the supply passage 23, as in the first example described, the peripheral groove 26 in the valve member establishes communication between the passage 30 and the port 25, and thereby permits the oil pump 33 to supply oil under pressure through the passage 24 to the wider end of the chamber, whereupon the piston 19 is moved towards the narrower end of the chamber. Moreover, when the fuel pressure in the supply passage 23 falls, the valve member 21 moves towards the narrower end of the chamber 18, and communication is established between the wider end of the chamber and the space between the valve member and the piston 19, whereupon oil can escape from this space to an oil reservoir 34 through a passage 29 in the piston, a passage 29a in the short arm 20, the interior of the hollow body part 4, and the pipe 32 extending from the hollow body part, with the result that the piston moves towards the wider end of the chamber until the valve member re-assumes its equilibrium position. As shown in FIGURE 3, the inlet of the oil pump 33 is connected to the lower end of the oil reservoir 34 by a pipe 35 through which the oil pump, when driven by the engine, receives oil from the oil reservoir. The outlet of the oil pump 33 is connected to the outer end of the passage 30 by a pipe 36 containing a filter 37. Moreover, at a position between the filter 37 and the passage 30, the pipe 36 communicates with one end of another pipe 38 for conducting oil from the oil pump 33 to the engine bearings, and with one end of a further pipe 39 which at its opposite end communicates with the upper end of the oil reservoir 34, and which contains a spring-loaded pressure relief valve 40 for enabling some of the oil delivered by the oil pump 33 to be returned to the oil reservoir when the output pressure of the oil pump exceeds a predetermined amount.

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

1. For use in supplying liquid fuel to injection nozzles in communication respectively with the cylinders of a multi-cylinder internal combustion engine, a liquid fuel pump comprising in combination a hollow body part which is provided with a plurality of ports adapted to be connected respectively to the injection nozzles, a cylindrical distributor rotatably mounted in said hollow body part, and adapted to be driven by the engine, a head rigidly united with one end of said distributor, and provided with a transversely extending bore, at least one plunger slidably mounted in said bore, liquid fuel feed means which is adapted

to be operated by the engine, and from which liquid fuel is intermittently feedable, during rotation of said distributor, through a part the latter to said bore for causing said plunger to move outwardly, an annular cam which surrounds said head, and which serves to impart inward movements to said plunger, during rotation of said head with said distributor, for delivering fuel through said distributor to said ports in turn, a stepped cylindrical chamber which is situated parallel with a tangent to said annular cam, and which has two coaxial parts, one of said coaxial parts being wider than the other, a fluid operable piston slidably accommodated in the wider part of said chamber, means interconnecting said annular cam and said piston so that movement of the latter causes angular movement of said annular cam to vary the timing of the delivery of fuel by said plunger to said ports, a cylindrical valve member slidably accommodated in the narrower part of said chamber, said narrower part being provided with an outwardly extending port which is controllable by said valve member, a compression spring disposed between, and acting on, said piston and said valve member, a supply passage through which fuel from said feed means is admissible to the narrower end of said chamber for acting on said valve member, and a second passage which communicates at its opposite ends respectively with the wider end of said chamber and the outer end of the last mentioned port, and through which liquid under pressure is admissible to, and dischargeable from, the wider end of said chamber under the control of said valve member, the latter having associated therewith a third passage from which liquid under pressure can flow through said second passage to the wider end of said chamber when said valve member is moved in one direction by a rise in the liquid fuel pressure in said supply passage, and said piston being movable towards the narrower part of said chamber by the liquid under pressure admitted to the wider end of said chamber, and having formed therein a fourth passage through which liquid under pressure can flow from said second passage when said valve member is returned to its initial position by said compression spring following a fall of the pressure in said supply passage.

2. A liquid fuel pump according to claim 1, wherein said third passage establishes communication between said supply passage and said second passage when said valve member is moved by a rise of the fuel pressure in said supply passage, so that liquid fuel under pressure flows from said supply passage through said second passage to the wider end of said chamber.

3. A liquid fuel pump according to claim 2, and having in association with said third passage a non-return valve for preventing return flow of fuel from the wider end of said chamber to said supply passage.

4. A liquid fuel pump according to claim 1, and having in combination therewith an oil pump which is drivable by the engine, and from which oil under pressure is admissible through said third passage and said second passage to the wider end of said chamber when said valve member is moved by a rise of the fuel pressure in said supply passage.

5. A liquid fuel pump according to claim 4, and having in said third passage a non-return valve for preventing return flow of oil from the wider end of said chamber to said oil pump.

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