Aug. 28, 1962 K. A. W. KEMP 3,051,154

LIQUID FUEL PUMPS

Filed Aug. 28, 1961 2 Sheets-Sheet 1

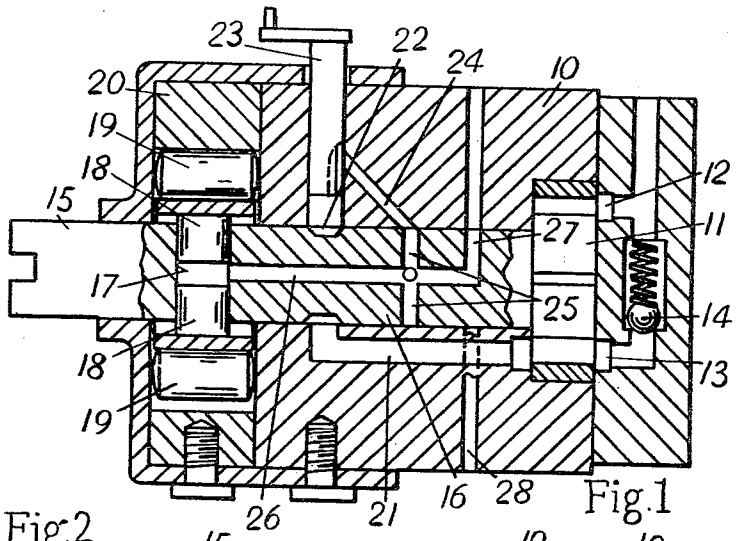
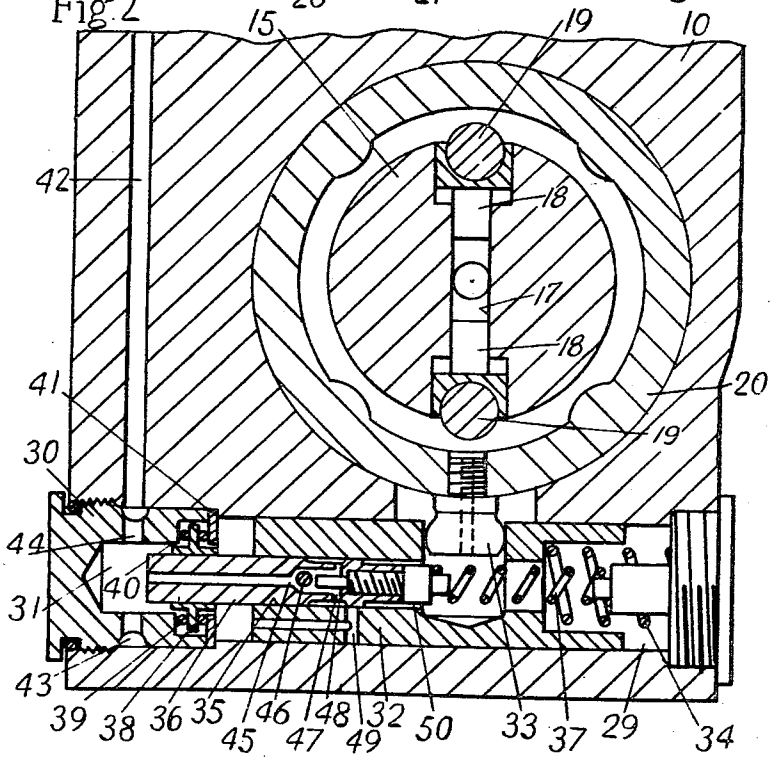


Fig.1

Fig.2



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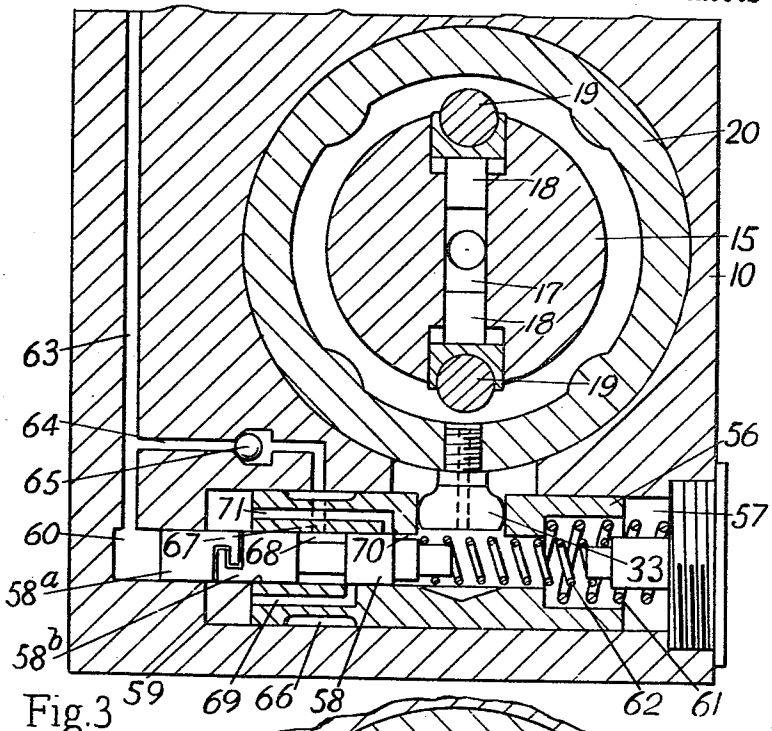


Fig.3

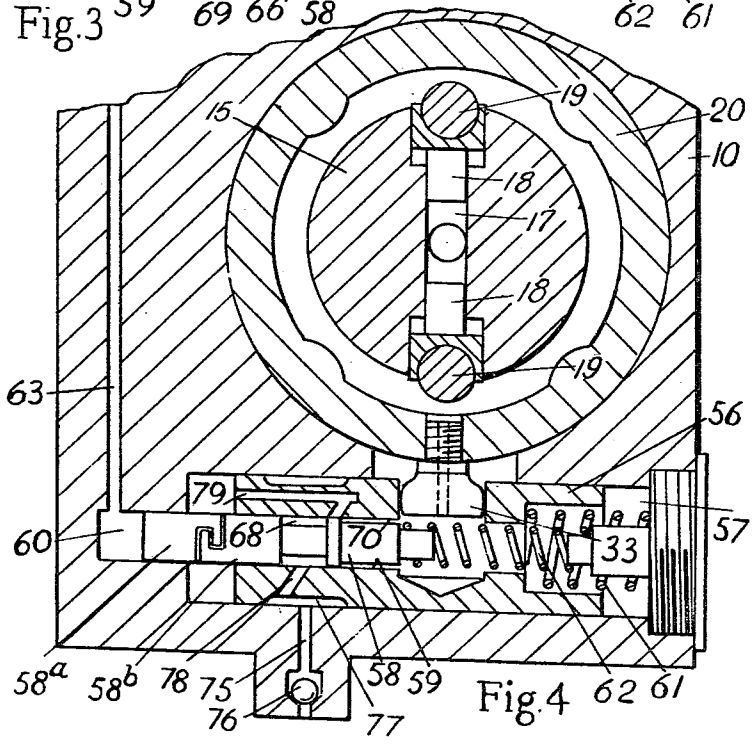


Fig.4

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3,051,154

LIQUID FUEL PUMPS

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5 Claims. (Cl. 123—139)

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 extending parallel to a tangent to the annular cam and accommodating the fluid operable piston, said piston having a cylindrical bore, a cylindrical valve member occupying the bore in the piston and engaging in an extension of the chamber in the manner of a piston, a first spring acting on the piston in a direction to move it towards the extension of the chamber, a second spring loading the valve member in the same direction, a supply passage through which fuel at a pressure at least in part dependent upon the speed of the engine can enter the extension to act on the valve member, further passages whereby fluid can enter the annular space surrounding the valve member within the chamber adjacent the extension when the valve member and piston are at a predetermined relative axial position, a non-return valve for preventing flow of fluid from said annular space to its source of pressure, and an exhaust passage through which fluid can flow from said annular space to an outlet from the chamber when the valve member and piston occupy another predetermined relative axial position.

In the accompanying drawings FIGURE 1 is a diagrammatic longitudinal section through a known form of pump to which the invention can be applied, and FIGURES 2, 3 and 4 respectively illustrate diagrammatically three alternative examples of the invention as applied to such a pump, FIGURES 2, 3 and 4 representing alternative cross-sections through the injection pump of FIGURE 1.

Referring to FIGURE 1 of the drawings there is provided a body part 10 which at one end contains a feed pump 11 of the kind comprising a rotary impeller provided with vanes. The inlet 12 and the outlet 13 of this pump are interconnected through a relief valve 14 which regulates the feed pressure in a manner dependent on the speed of this pump. At the other end of the body part 10 is contained the fuel injection pump comprising a rotary head 15 formed at one end of a distributor 16 serving to interconnect the rotary parts of the feed and injection pumps. In the head 15 is a transverse bore 17 containing a pair of reciprocatory plungers 18 which through rollers 19 at their outer ends co-operate with a surrounding annular cam 20.

Fuel from the feed pump 11 is fed through a passage 21 in the body part to an annular groove 22 in the periphery of the distributor 16 and thence by way of a throttle valve 23 to a further passage 24 in the body part which

registers in turn, as the distributor rotates, with a plurality of radially disposed passages 25 in the distributor. The passages 25 in the distributor are in communication with an axial passage 26 in the distributor which opens at one end into the bore 17. Also leading from the axial passage 26 is a radial passage 27 which is adapted to register in turn, as the distributor rotates, with a plurality of ports 28 in the body part 10 which are adapted for connection 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 11 is fed intermittently by way of the throttle valve 23 to the axial passage 26 and thus serves to move the plungers 18 of the injection pump outwardly. At appropriate instants in the cycle the plungers are moved inwardly by the action of the cam 20, and thereby serve to discharge fuel in turn to the engine cylinders.

Referring now to FIGURE 2 of the drawings, a cylindrical chamber 29 is formed in the body part 10 adjacent the injection pump with its axis extending parallel to a tangent to the annular cam 20. One end of the chamber 29 is closed by means of a hollow screw plug 30 the interior of which constitutes an extension 31 of the chamber 29. In the chamber 29 is a piston 32 in which is a gap accommodating a short arm 33 extending radially from the annular cam 20, the arrangement being such that axial movement of the piston 32 will impart angular movement to the cam. The piston is axially spring loaded by means of a coiled compression spring 34 towards the plug 30. Moreover, the piston has a central bore 35 accommodating one end of a cylindrical valve member 36 which is separately spring loaded towards the plug 30 by means of a coiled compression spring 37. The other end of the valve member 36 is accommodated in a peripherally flanged sleeve 38. The flange of the sleeve 38 is clamped between a pair of sealing rings 39 in an annular recess defined by an annular shoulder 40 in the extension 31 and an annular plate 41 which is located between the end of the plug 30 and an annular shoulder on the chamber 29. By this arrangement the sleeve 38 is located against axial movement but is allowed a limited amount of lateral movement, to compensate for small misalignments in the axes of the extension 31 and the bore 35, whilst leakage of fluid from one side of the sleeve to the other is prevented. The extension 31 is connected through a supply passage 42 and a circumferential groove 43 and radial passages 44 to the output side of the feed pump 11 so that the pressure in this space will be dependent upon engine speed. In the valve member 36 is an axial passage 45 incorporating a non-return valve 46 and terminating in radial passages 47 which communicate with an annular groove 48 in the periphery of the valve member. At a predetermined relative axial setting of the valve member 36 and piston 32 a radial passage 49 in the latter communicates with the groove 48 and serves to establish communication between the groove and the annular space surrounding the valve member in the end of the chamber 29 adjacent the extension 31. The purpose of the non-return valve 46 is to prevent return flow of fuel from the annular space to the supply passage 42 as a result of the increase in pressure due to the reaction on the annular cam 20 when struck by the rollers 19. The passage 49 is also arranged to be uncovered at another predetermined axial setting of the valve member 36 relative to the piston 32, whereupon fuel can flow from the annular space through the passage 49 and a clearance 50 between the valve member and the bore 35 to a drain (not shown) at the end of the chamber 29 remote from the extension 31.

In operation, with increase of the control pressure the valve member 36 will be moved against the spring 37 until

it assumes the predetermined position relative to the piston 32 in which the control pressure is applied to the annular space. The effect of this will be to move the piston 32 and thereby effect an angular adjustment of the cam 20 so as to make an appropriate adjustment of the timing of the injection to the engine, the piston movement following the movement of the valve member in both directions.

Referring now to FIGURE 3 of the drawings there is a piston 56 in a cylindrical chamber 57 in the body part 10. One end of a cylindrical valve member 58 is accommodated in a bore 59 in the piston 56, while the other end of the valve member fits in the manner of a piston within an extension 60 of the chamber 57; the extension is concentric with the chamber but is of smaller diameter. The piston 56 is loaded towards the extension by means of a spring 61, and the valve member 58 is loaded in the same direction by means of a spring 62.

The extension 60 is in communication with a supply passage 63 which is connected to the output side of the pump 11. The supply passage 63 is in communication through a passage 64 incorporating a non-return valve 65 with a circumferential groove 66 of substantial axial length in the periphery of the piston 56. The groove 66 is in communication through a radial passage 67 in the piston with a circumferential groove 68 in the periphery of the valve member 58. At a predetermined axial setting of the piston 56 relative to the valve member 58 the groove 68 registers with a port in the piston. This port is connected through a passage 69 to the annular space surrounding the valve member 58 at the end of the chamber 57 adjacent the extension 60. Thus at the predetermined setting, the annular space is connected to the supply passage 63. At another predetermined relative axial setting of the valve member 58 and piston 56 the annular space is in communication through a clearance 70 between the valve member and the bore 59, and a passage 71 in the piston, with a drain (not shown) at the end of the chamber 57 remote from the extension 60.

The operation of this example is analogous to that of the example shown in FIGURE 2. The non-return valve 65 in this example serves the same purpose as the non-return valve 46 in FIGURE 2.

Referring lastly to FIGURE 4 of the drawings, the arrangement of the piston 56 and valve member 58 in the chamber 57 and extension 60 is the same as in the example shown in FIGURE 3. A passage 75 incorporating a non-return valve 76 and connected to the output side of the engine lubricating oil pump replaces the passage 64 of the example shown in FIGURE 3. The passage 75 communicates with the groove 68 of the valve member through a circumferential groove 77 of substantial axial length in the periphery of the piston and a substantially radial passage 78. The passages 69 and 71 of the example shown in FIGURE 3 are replaced by a single passage 79 which connects a port in the bore 59 to the annular space surrounding the valve member 58 at the end of the chamber 57 adjacent the extension 60. At one predetermined setting of the valve member 58 relative to the piston 56, the annular space is connected through the groove 68 and passages 75 and 79 to the outlet side of the lubricating oil pump. At another predetermined relative setting of the valve member and piston the annular space is connected through the passage 79 and clearance 70 to a drain (not shown) at the end of the chamber 57 remote from the extension 60.

In operation, the axial position of the valve member 58 is dependent upon the output pressure of the feed pump 11 which is itself dependent upon the speed of the engine. The piston 56 is motivated by the engine lubricating oil pressure but it follows the movement of the valve 58. The position of the piston 56 is therefore independent of the output pressure of the lubricating oil pump. In other respects the operation is the same as that of the example shown in FIGURE 3.

In the example shown in FIGURES 3 and 4 the valve member 58 may be formed in two parts 58^a and 58^b located in the extension 60 and the bore 59 respectively, and these two parts may be interconnected by means which will allow of slight misalignment of their axes to compensate for misalignment in the axes of the bore 59 and extension 60.

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

1. A liquid fuel pump of the kind specified for supplying fuel to an internal combustion engine, and comprising in combination a body part provided with a cylindrical bore, a fuel inlet passage leading to one side of said bore at a position intermediate the ends thereof, and a plurality of angularly spaced delivery ports extending outwardly from said bore at other positions, feed means for supplying fuel under pressure to said fuel inlet passage, a rotary cylindrical distributor which is mounted in said bore and is adapted to be driven by the engine, and which is provided with an axial passage, a plurality of angularly spaced fuel inlet passages extending outwardly from said axial passage at positions for enabling said angularly spaced fuel inlet passages to communicate in turn with the fuel inlet passage in said body part during rotation of said distributor, and a fuel outlet passage extending outwardly from said axial passage at another position for enabling said outlet passage to communicate in turn with the fuel delivery ports in said body part during rotation of said distributor, a head provided on one end of said distributor so as to be rotatable therewith, and having a transverse bore in constant communication with the adjacent end of the axial passage in said distributor, at least one plunger mounted in said transverse bore, an annular cam which surrounds said head, and through the medium of which said plunger is movable inwardly during rotation of said distributor, a cylindrical chamber situated parallel with a tangent to said annular cam, and provided at opposite ends respectively with a coaxial extension and a drain, a fluid-pressure operable piston slidably mounted in said cylindrical chamber, and provided with a coaxial bore, means interconnecting said piston and said annular cam so that movement of said piston serves to impart angular movement to said annular cam about the axis thereof, a cylindrical valve member slidably mounted in said coaxial bore, and extending from one end thereof into slidable engagement with the coaxial extension of said cylindrical chamber, the portion of said cylindrical valve member between said piston and the coaxial extension of said chamber being surrounded by an annular space within said chamber, a first spring acting on said piston in the direction for moving said piston towards the coaxial extension of said chamber, a second spring acting on said valve member in the same direction as said first spring acts on said piston, a supply passage through which fluid at a pressure variable with the speed of the engine is admissible to the coaxial extension of said chamber for acting on the adjacent end of said valve member, further passages through which fluid under pressure is admissible to said annular space surrounding said cylindrical valve member when the latter and said piston occupy predetermined relative axial positions, a non-return valve for preventing return flow of fluid from said annular space through said further passages, and an exhaust passage through which fluid can flow from said annular space to said drain when said valve member and said piston occupy other predetermined relative axial positions.

2. A liquid fuel pump according to claim 1, wherein at least one of said further passages is formed in said piston, and said cylindrical valve member is provided with a peripheral groove through which the last mentioned further passage communicates with another of said further passages when said valve member and said piston occupy their first mentioned predetermined relative axial positions.

3. A liquid fuel pump according to claim 1, and including means for compensating slight misalignments of the axes of the extension of said cylindrical chamber and the bore in said piston.

4. A liquid fuel pump according to claim 1, wherein said further passages are arranged so that when said valve member and said piston occupy their first mentioned relative axial positions the said annular space surrounding a portion of said valve member is in communication with said supply passage.

5. A liquid fuel pump according to claim 1, and having a second pressure-fluid supply passage leading to said cylindrical chamber, said further passages being arranged so that when said valve member and said piston occupy their first mentioned relative axial positions the said annular space surrounding a portion of said valve member is in communication with said second pressure-fluid supply passage.

No references cited.