United States Patent [19]

Kemp

[11] **3,802,808**

[45] **Apr. 9, 1974**

[54] **LIQUID FUEL INJECTION PUMPING APPARATUS**

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[22] Filed: **July 31, 1972**

[21] Appl. No.: **276,442**

[52] **U.S. Cl.** **417/462**

[51] **Int. Cl.** **F04b 29/00**

[58] **Field of Search** 417/462, 251, 625.3

[56] **References Cited**

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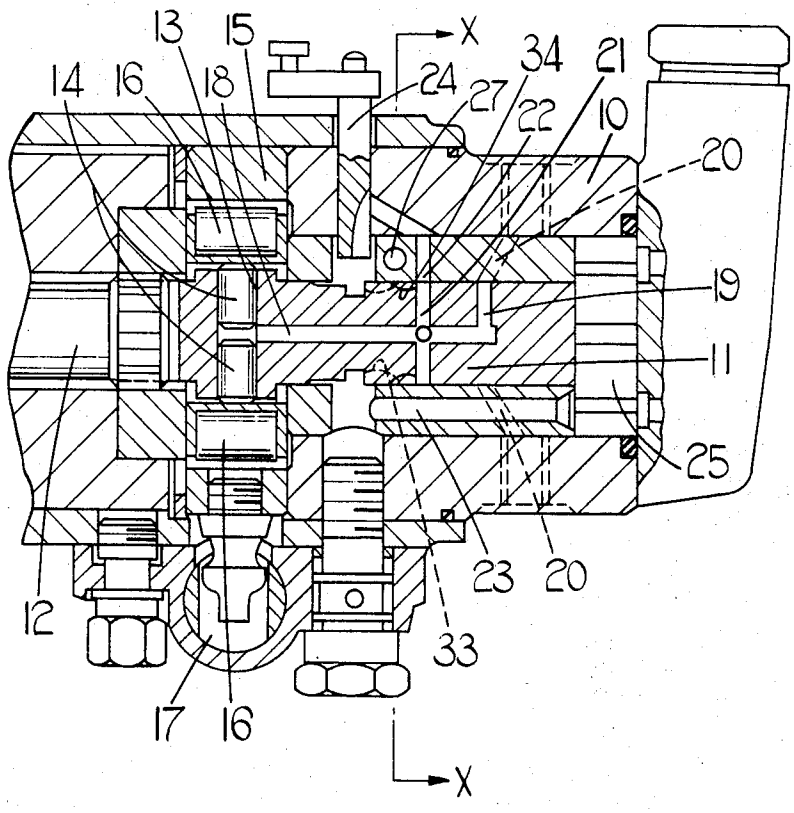
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[57] **ABSTRACT**

A fuel pumping apparatus for supplying fuel to an internal combustion engine includes a distributor member having a longitudinal bore through which fuel flows to an outlet of the pump. There is also provided a shuttle accommodated in a bore to one end of which fuel is supplied during the initial portion of the injection period and from the other end of which escapes fuel to a low pressure source. The process is reversed on the next injection stroke and the permitted movement of the shuttle is determined by an adjustable stop.

3 Claims, 2 Drawing Figures



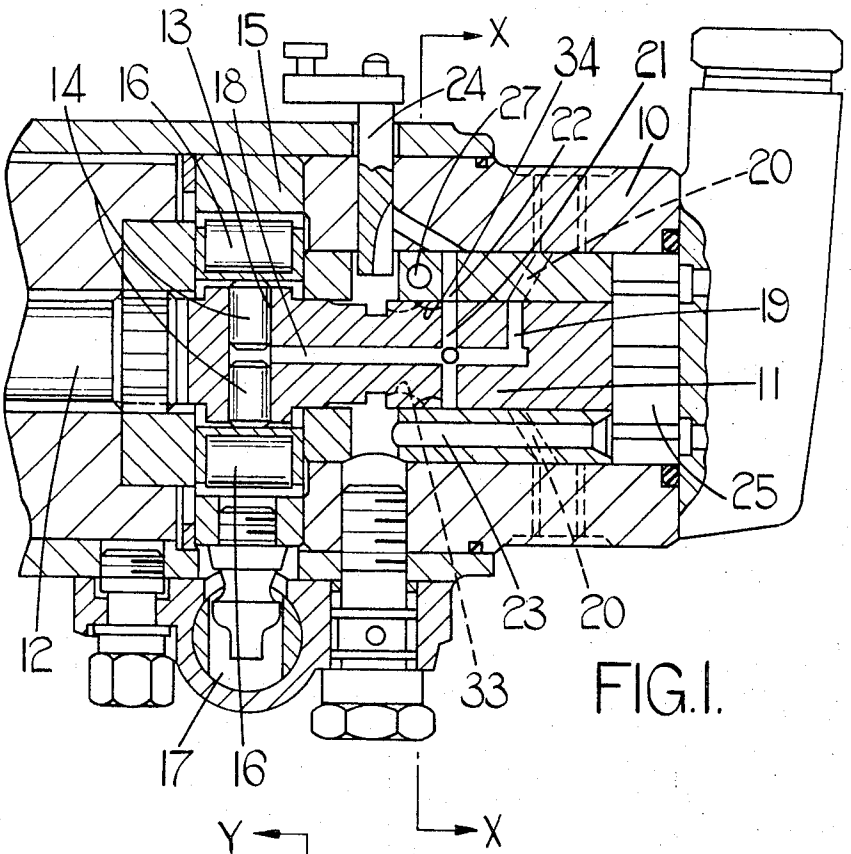

13
15
X
34
21
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X

FIG.1.

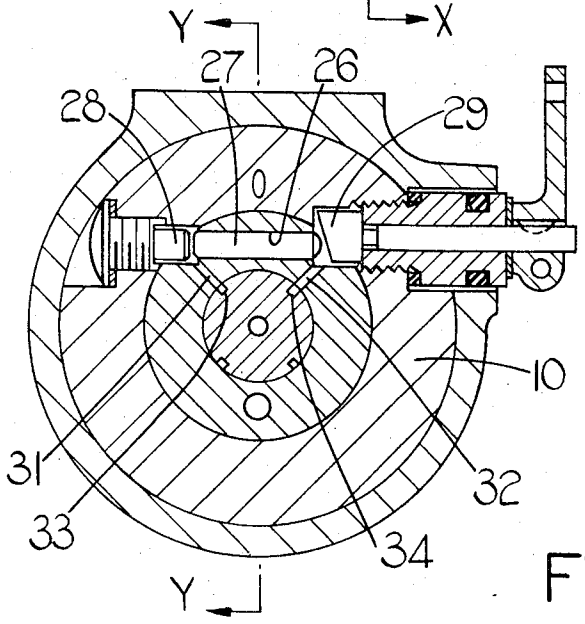

Y
27
26
28
29
10
31
32
33
34
Y

FIG.2.

LIQUID FUEL INJECTION PUMPING APPARATUS

This invention relates to liquid fuel injection pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising in combination, an injection pump having an outlet communicating with a passage communicating in turn and during successive delivery strokes of the injection pump with a plurality of outlet ports formed in a body mounting the distributor member and communicating in use, with the injection nozzles respectively of an associated engine, and means for supplying fuel to the injection pump during an inlet stroke thereof.

With such apparatus it is necessary to be able to control the maximum amount of fuel which can be supplied at each delivery stroke of the pump and the object of the present invention is to provide such an apparatus in a simple and convenient form.

According to the invention an apparatus of the kind specified comprises a shuttle slidable within a bore formed in the body, port means whereby the opposite ends of said bore are placed in communication alternately with said passage during successive delivery strokes of the injection pump, further port means through which said ends of the bore can be placed in communication alternately with a source at low pressure during successive delivery strokes of the injection pump and means for controlling the extent of movement of the shuttle, the arrangement being such that during one delivery stroke said passage is in communication with one end of said bore so that at the start of the delivery stroke the shuttle is moved away from said one end of the bore, fuel being allowed to escape from the other end of the bore, and at the next delivery stroke the passage communicates with the other end of the bore so that the shuttle is moved in the opposite direction and fuel escapes from said one end of the bore to said source.

One example of a pumping apparatus in accordance with the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a sectional side elevation of the apparatus and taken on the line Y—Y of FIG. 2, and

FIG. 2 is a sectional end elevation taken on the line X—X of FIG. 1.

Referring to the drawings there is provided a two body part **10** in which is mounted a rotary cylindrical distributor member **11.** The distributor member **11** is coupled by means of a shaft **12** to an internal combustion engine so that it rotates in synchronism therewith.

The distributor member is provided with a transversely extending bore **13** in which are mounted a pair of pumping plungers **14** which are moved inwardly as the distributor member rotates, by means of cam lobes formed on the internal periphery of an annular cam ring **15,** there being provided intermediate the plungers **14** and the cam lobes, rollers **16.** The angular setting of the cam ring **15** within the body part can be varied in known manner, by means of a fluid pressure operable device **17.**

The plungers **14,** the rollers **16** and the cam ring **15** constitute an injection pump the outlet of which communicates with a longitudinally extending passage **18** formed in the distributor member. The passage **18** communicates with a radially disposed delivery passage **19** and which as the distributor member rotates, registers in turn with a plurality of outlet ports **20** formed in the body part and communicating respectively with the injection nozzles of an associated engine.

The longitudinal passage **18** also communicates with a plurality in this case **4,** of inlet passages **21,** which extend to the periphery of the distributor member and which register in turn during the inlet strokes of the injection pump, with an inlet port **22** formed in the body part. The port **22** communicates with a fuel supply gallery **23** by way of an adjustable throttle member **24.** The throttle member in use, is connected to a governor which is responsive to the speed at which the associated engine is operating. The fuel supply gallery **23** communicates with the outlet of a feed pump **25** and in the position shown, the port **22** is in register with an inlet passage **21** so that fuel is flowing into the passage **18** to effect separation of the plungers **14.** As the distributor member continues to rotate a passage **21** is moved out of register with the port **22** and the passage **19** moves into register with a port **20.** When this has occurred inward movement of the plungers due to the action of the cam lobes effects delivery of fuel to the associated engine.

The amount of fuel which is supplied to the engine is controlled by the setting of the throttle member **24** however, it is essential to ensure that the maximum quantity of fuel which is supplied to the engine is strictly controlled in order to avoid exceeding the allowed quantity of smoke in the engine exhaust. For this purpose there is provided in the body part a bore **26** in which is mounted a shuttle **27.** The axis of the bore extends at right angles to the axis of rotation of the distributor member. One end of the bore **26** is closed by a fixed stop **28** and the other end of the bore is closed by a plug **29** having a contoured face presented to the shuttle **27.** The angular setting of the plug **29** is adjustable from the exterior of the apparatus and the form of the face presented to the shuttle is such that the extent of movement allowed to the shuttle before it contacts the face of the plug **29** depends upon the angular setting of the plug.

The opposite ends of the bore **26** communicate with ports **31,32** which break out onto the periphery of the distributor member. Moreover, formed on the distributor member are two pairs of axial slots **33, 34** the slots of each pair of slots being diametrically disposed. The slots **34** communicate with a pair of the inlet passages **21** whilst the slots **33** extend to a circumferential groove formed on the distributor and which cummunicates with the supply gallery **23.** In other words the slots **33** communicate with a drain or source of fuel at low pressure.

In use, one of the slots **34** communicates with either of the ports **31, 32** and one of the slots **33** communicates with the other of these ports during the time when the plungers **14** are moving inwardly under the action of the cam lobes. As shown in FIG. **2** of the drawings, a slot **34** communicates with the port **32** and a slot **33** communicates with the port **31.** FIG. **2** shows the position of the various parts of the apparatus at the start of a pumping period and it will be seen that during inward movement of the plungers **14** fuel will be displaced from the passage **18** via a slot **34** and the port **32** into the end of the bore containing the plug **29.** Movement of the shuttle **26** towards the stop **28** will therefore take place and the fuel will be displaced from the end of the bore containing the stop **28** by way of the port **31** and

a slot 33. When the shuttle 27 strikes the stop 28 further flow of fuel will cease and the remaining quantity of fuel displaced by the plungers 14 will flow to the associated engine. At the next delivery stroke following a filling stroke, a slot 34 will register with the port 31 and a slot 33 will be in register with the port 32 so that as fuel is displaced by the injection pump fuel will flow into the end of the bore containing the stop and movement of the shuttle will take place in the direction towards the plug 29*a*. When the shuttle contacts the stop 29, the flow of fuel will cease and the remaining quantity of fuel displaced by the plungers 14 will flow to the associated engine. In this manner the maximum quantity of fuel which can be delivered to the engine can be varied by adjusting the angular setting of the plug 29. Moreover, the plug 29 can be adjusted so that an excess of fuel can be supplied to the engine for starting purposes. In this instance the shuttle 27 will be restrained from moving within its bore.

The particular apparatus shown is for supplying fuel to a four cylinder compression ignition engine however, it will be appreciated that slight modification only is required to enable the apparatus to supply fuel to an engine having an odd number of cylinders.

I claim:

1. A liquid fuel injection pumping apparatus for supplying fuel to an internal combustion engine comprising in combination, a pump body, an injection pump located within the body, a distributor member rotatably mounted in the body, the injection pump and distributor member being driven in timed relationship with the associated engine, a passage formed in the distributor member and communicating with the injection pump, a plurality of outlet ports formed in the body, said passage registering in turn with said outlet ports during successive delivery strokes of the injection pump, the outlet ports in use, communicating respectively with the injection nozzles of the associated engine, means for supplying fuel to the injection pump during the filling strokes of the injection pump, a bore formed in the pump body, a shuttle slidable within said bore, a pair of further passages communicating with the opposite ends of said bore, said further passages opening onto the distributor member at angularly spaced points, first groove means on the distributor member communicating with said passage whereby said further passages in turn are placed in communication with said passage during successive delivery strokes of the injection pump, second groove means on the distributor member, said second groove means communicating with a source of fuel at low pressure, said second groove means registering with said further passages in turn during successive delivery strokes of the injection pump and means for controlling the extent of movement of the shuttle, the arrangement being such that during one delivery stroke said passage is in communication with one end of said bore through one of the further passages and the first groove means so that at the start of the delivery stroke the shuttle is moved away from said one end of the bore, fuel being allowed to escape from the other end of the bore through the other of said further passages and the second groove means, and at the next delivery stroke the passage communicates with the other end of the bore so that the shuttle is moved in the opposite direction and fuel escapes from said one end of the bore to said source.

2. An apparatus as claimed in claim 1 in which said means comprises a fixed stop at one end of the bore and an adjustable stop at the other end of the bore.

3. An apparatus as claimed in claim 1 in which the axis of the bore extends at right angles to the axis of rotation of the distributor member.

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