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LIQUID FUEL PUMPING APPARATUS

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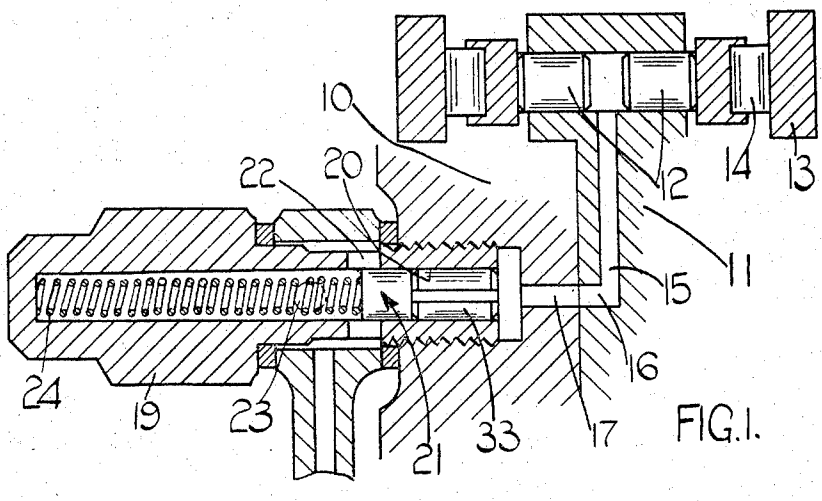


FIG.1.

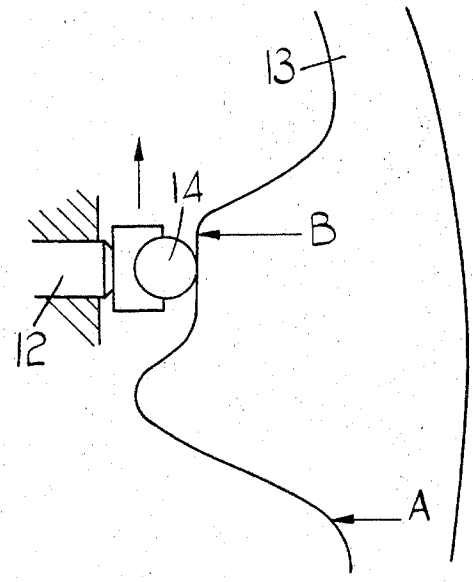


FIG.2.

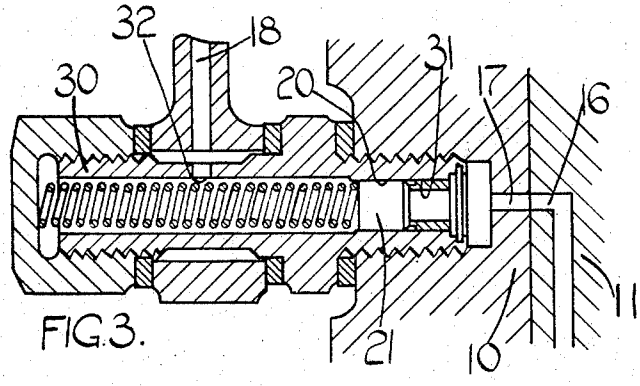


FIG.3.

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LIQUID FUEL PUMPING APPARATUS

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U.S. Cl. 103—2 6 Claims
Int. Cl. F04b *13/02*; F04b *1/10*; F02b *3/10*

ABSTRACT OF THE DISCLOSURE

A liquid fuel pumping apparatus comprising a pumping plunger arranged to be moved inwardly by a cam to deliver fuel to an engine through an outlet port connected by way of a cylinder to a pipeline, the cylinder containing a loosely fitting spring loaded piston which is moved against its spring loading to permit flow of fuel through the pipeline during the inward movement of the plunger, the cam being so shaped that limited outward movement of the plunger occurs followed by a dwell period, the piston serving to return fuel to the outlet to ensure that the piston follows the cam, it being arranged that the communication between the outlet and the pumping chamber associated with the plunger, is broken during the dwell period.

This invention relates to liquid fuel pumping apparatus for supplying fuel to multicylinder internal combustion engines and has for its object to provide such apparatus in a simple and convenient form.

Apparatus in accordance with the invention comprises in combination, a fuel injection pump having a pumping plunger and a cam, relative movement between the plunger and the cam being arranged to occur in timed relationship with an engine with which the apparatus is associated, so that the pump partakes of alternate delivery and filling strokes, a plurality of outlet ports which in use, are connected to delivery nozzles associated with the combustion spaces of the engine respectively, a distributor which is actuated in timed relationship with the engine and which is arranged to distribute the successive deliveries of the pump to the outlet ports in turn, a plurality of resiliently loaded pistons disposed within cylinders respectively the latter forming part of the flow path through the outlets respectively, the pistons being loaded in a direction towards the injection pump and being arranged during a delivery stroke of the latter to move against the action of their resilient loading to allow fuel flow to the nozzle, the cam being so shaped that after the end of a delivery stroke and while communication between the injection pump and an outlet port is still established, a limited movement of the plunger in the direction in which it moves during a filling stroke can occur, which movement is followed by a period during which the plunger is at rest and during which period the communication between the injection pump and the outlet is broken, whereby during said limited movement of the plunger, fuel can flow towards the injection pump to relieve the pressure at the outlet port, with the quantity of fuel returning being determined solely by the cam.

In the accompanying drawings in which each figure is diagrammatic:

FIGURE 1 is a view generally in sectional side elevation of the essential parts of one example of a liquid fuel pumping apparatus in accordance with the invention,

FIGURE 2 is a view of part of the apparatus of FIGURE 1 in end elevation and,

FIGURE 3 is a view in sectional side elevation of a modification of part of the apparatus of FIGURE 1.

Referring now to FIGURE 1 there is provided a body part **10** in which is mounted a rotary distributor **11** which is adapted to be driven in timed relationship with an engine with which the apparatus is associated. At one point in the distributor there is formed a transversely extending bore in which are mounted a pair of pumping plungers **12** and these plungers are arranged to be moved inwardly as the distributor rotates by cam lobes formed on a surrounding annular cam ring **13**. Disposed between each plunger and the cam ring is a shoe which supports a roller follower **14**. The profile of each cam lobe is illustrated in diagrammatic form in FIGURE 2.

The portion of the transversely extending bore which lies between the pumping plungers is in communication with a longitudinal passage **15** formed in the distributor and which at one point is in communication with a radially disposed delivery passage **16**. The delivery passage is arranged to register in turn and as the distributor rotates, with a plurality of outlet ports **17** formed in the body part. The outlet ports are connected to the injection nozzles of the engine respectively by way of pipe lines **18** which are conveniently secured to the body part by a retaining bolt **19**. Within the retaining bolt is formed a cylinder **20** in which is mounted a loosely fitting piston **21**. The inner end of the cylinder is in communication with the outlet port, while axially spaced ports **22** and **23** formed in the wall of the cylinder intermediate its ends, communicate with the pipeline **18**. The piston **21** is loaded towards the outlet port by means of a coiled compression spring **24** which is located within the end portion of the cylinder remote from the outlet port, and at rest abuts against a retainer **33**.

The longitudinal passage **15** is in communication at another point with an inlet passage (not shown) and through which fuel can flow to the transverse bore to move the plungers outwardly when such movement is permitted by the cam lobes. As will be seen from the drawing of the cam lobe, it is so arranged that the outlet port is opened at point A to the transverse bore and remains open for the whole of the inward movement of the plungers and also for a period after such inward movement has finished. During this period, the pumping plungers are permitted a limited outward movement and for the remainder of the period they are held against movement. At or near the end of this period at point B, the outlet port is closed and thereafter the pumping plungers are allowed to be moved outwardly by fuel entering the transverse bore.

In use, when the plungers are moved inwardly, fuel is displaced to one of the outlet ports thereby causing the piston **21** therein to be moved against the action of the spring **24**. During this movement, fuel is displaced from the end of the cylinder containing the spring to the associated nozzle by way of the pipeline **18**. During the initial movement of the piston, the port **22** will be closed but after further movement of the piston, this port will be reopened. At the end of the inward movement of the plungers and upon continued relative angular movement of the distributor and cam ring, the plungers **12** will be allowed to move outwardly a predetermined extent as determined by the shape of the cam lobes. During this outward movement, fuel flows from the pipeline **18** and back through the outlet port **17** into the passages within the distributor and by this means the high pressure within the pipeline at the end of the injection period is relieved. During this time, the piston moves under the action of its spring and assists in the movement of the fuel as described thus ensuring that the limited outward movement of the pumping plungers takes place. It should be noted that the degree of relief afforded to the pipeline is solely dependent upon the profile of the cam lobes and

is in no way connected with the piston **21**, with the piston merely ensuring that the plungers, through the rollers, follow the cam. If the piston **21** does not come into contact with the retainer **33** by the time the outlet port has closed then it will continue to move while the outlet port is closed owing to the fact that it is a loose fit within the cylinder and fuel can leak around it.

In the alternative arrangement seen in FIGURE 3, the bolt is replaced by an adaptor **30** in which the cylinder **20** is formed. Moreover, within the inner end of the cylinder **20** is located an annular seat **31** with which the piston **21** can cooperate to provide the equivalent of a one-way valve. Furthermore, the pipeline **18** communicates with the cylinder **20** by way of a single port **32** formed in the wall of the cylinder, with this portion of the wall being of enlarged diameter. The mode of operation of this example is similar to the first example. Additionally, in this case, the piston **21** at the end of its travel under the influence of its spring, seats against the annular seat before the delivery port reopens. The seating of the piston does not occur however until the retraction or predetermined amount of outward movement of the plungers **12** has been completed. The seating of the piston **21** upon the seat **31** serves to maintain the residual pressure within the pipeline **18**. If such a valve is not provided, then such residual pressure, as frequently occurs in the high pressure pipes **18** between pump and nozzle, can flow rapidly back into the pump when the outlet port **17** reopens, causing disturbed flow conditions at the start of pumping to the detriment of the delivery characteristic.

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

1. A liquid fuel pumping apparatus for supplying fuel to multicylinder internal combustion engines and comprising in combination, a fuel injection pump having a pumping plunger and a cam, relative movement between the plunger and the cam being arranged to occur in timed relationship with an engine with which the apparatus is associated, so that the pump partakes of alternate delivery and filling strokes, a plurality of outlets ports which in use, are connected to delivery nozzles associated with the combustion spaces of the engine respectively, a distributor which is actuated in timed relationship with the engine and which is arranged to distribute the successive deliveries of the pump, to the outlet ports in turn, a plurality of resiliently loaded pistons disposed within cylinders respectively the latter forming part of the flow path through the outlets respectively, the pistons being loaded in a direction towards the injection pump and being arranged during a delivery stroke of the latter to move against the action of their resilient loading to allow fuel flow to the nozzle, the cam being so shaped that after the end of a delivery stroke and while communication between the injection pump and an outlet port is still established, a limited movement of the plunger in the didection in which it moves during a filling stroke can occur, which movement is followed by a period during which the plunger is at rest and during which period the communication between the injection pump and the outlet is broken, whereby during said limited movement of the plunger fuel can flow towards the injection pump to relieve the pressure at the outlet port, the quantity of fuel returning being determined solely by the cam.

2. The apparatus as claimed in claim **1** including seatings with which the pistons cooperate at the end of their travel under the influence of their springs.

3. The apparatus as claimed in claim **1** in which the pistons are loosely mounted within their cylinders.

4. The apparatus as claimed in claim **3** in which the cylinders are defined in parts respectively adapted to be secured to the body of the apparatus.

5. The apparatus as claimed in claim **1** including seatings with which the pistons cooperate at the end of their travel under the influence of their springs and said pistons being loosely mounted within their cylinders.

6. The apparatus as claimed in claim **5** in which said cylinders are defined in parts respectively adapted to be secured to the body of the apparatus.

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U.S. Cl. X.R.

103—161; 123—32, 139