Feb. 6, 1951 R. J. IFIELD ET AL 2,540,395

LIQUID-FUEL INJECTION MEANS FOR PRIME MOVERS

Filed July 10, 1947 2 Sheets-Sheet 1

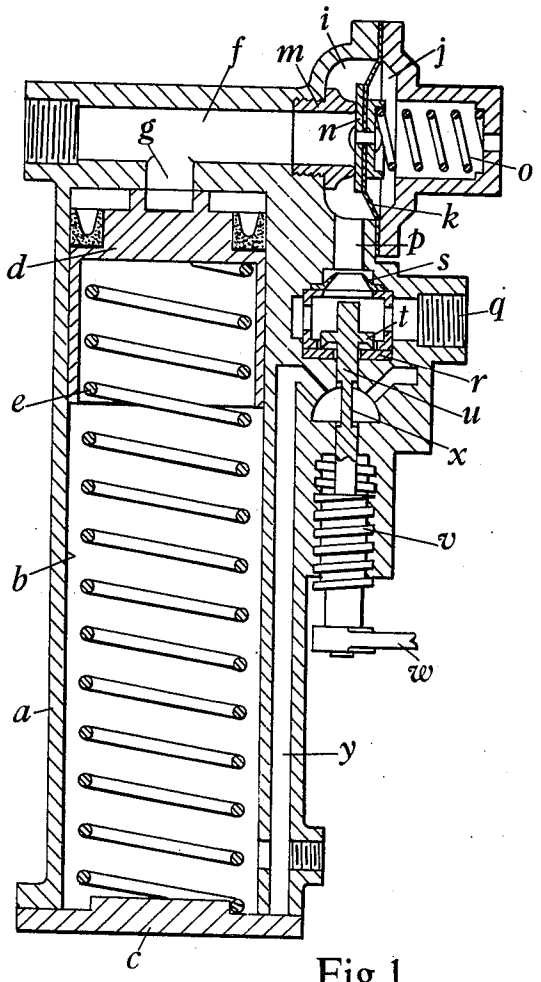

Fig.1

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2 Sheets-Sheet 2

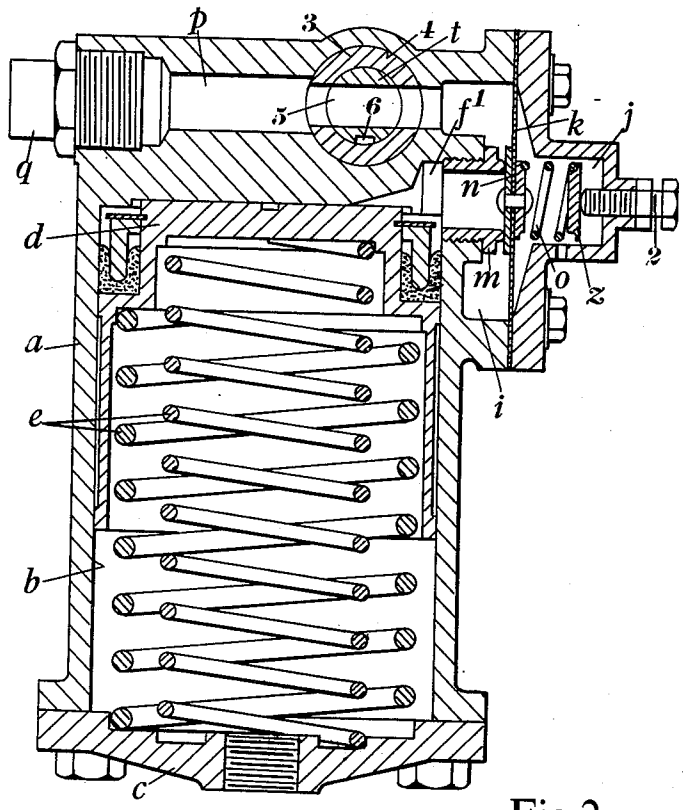

Fig.2

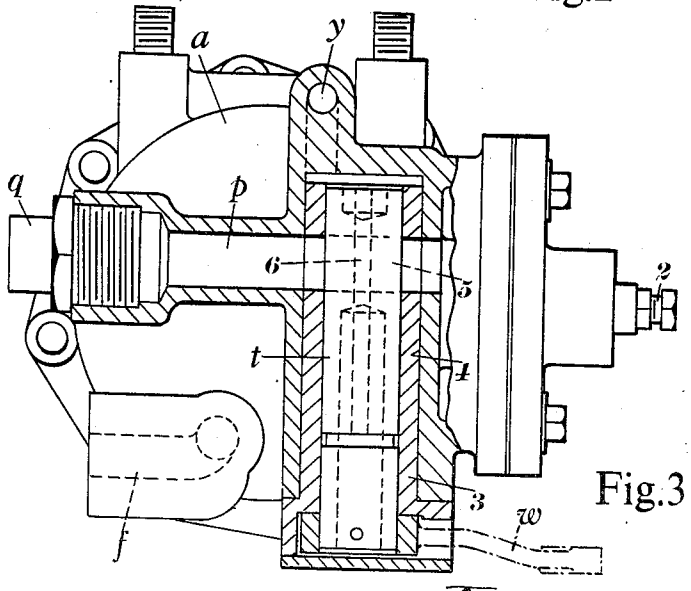

Fig.3

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LIQUID-FUEL INJECTION MEANS FOR PRIME MOVERS

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2 Claims. (Cl. 137—69)

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In the specification of British Patent No. 552,725 there is described and claimed an invention which relates to liquid fuel injection systems for prime movers, and of the kind comprising a pump driven by the prime mover and a delivery nozzle or nozzles to which the fuel is supplied by the pump. The said invention comprises a system having in combination with the pump, an accumulator which is charged by the pump during the starting operation, and a valve adapted to control the supply of liquid fuel from the pump and accumulator to the nozzle or nozzles and also adapted to be opened automatically when a predetermined quantity of liquid fuel has been stored in the accumulator, or when a predetermined pressure is reached in the system. The said invention also comprises, for use in the system aforesaid, an accumulator having in combination a hollow cylindrical body part, a loaded piston slidable in the body part, and a discharge valve adapted to be opened when a predetermined quantity of liquid fuel has been supplied to the accumulator or when a predetermined pressure is reached in the system.

In the development of the said invention we have devised a modification which forms the subject of the present specification.

In the accompanying sheets of explanatory drawings:

Figure 1 is a sectional side elevation of an accumulator embodying the modification aforesaid.

Figures 2 and 3 are respectively a sectional side elevation and a part sectional end elevation of another form of accumulator embodying the said modification.

In the example shown in Figure 1, we employ a hollow body part *a* having a cylindrical bore *b* which extends from one end of the body part to a position near the other end, and which is closed at its outer end by a plate *c*, the body part being herein termed a cylinder. Arranged in the cylinder bore *b* is a slidable piston *d* which is loaded at one side by a helical spring *e* also contained in the cylinder bore, one end of the spring abutting against the piston and the other against the closure plate *c*. At its end remote from the closure plate *c* the cylinder *a* is formed with a transverse passage *f* having one end adapted for connection by a pipe to a liquid-fuel supply pump. This passage *f* communicates with the inner end of the cylinder bore *b* through a lateral hole *g*. At the other end of the passage *f* there is provided on the cylinder *a* a chamber which is divided into two compartments *i*, *j* by a flexible diaphragm *k*, and this end of the said passage

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(which leads to the compartment *i*) is provided with or adapted to serve as a valve seating *m*. A discharge valve *n* adapted to co-operate with the seating *m* is attached to or formed on the diaphragm *k*. In the compartment *j* may be arranged a spring *o* for holding the valve *n* on its seating *m* until sufficient fluid pressure is attained in the passage *f* to lift the valve off the seating. The compartment *j* may be open to atmosphere or it may be adapted for connection to any desired low pressure part of the liquid fuel injection system. The other compartment *i* communicates with a passage *p* leading to a discharge outlet *q* adapted for connection to a pipe leading to the delivery nozzle or nozzles through which liquid fuel is supplied to the prime mover which drives the above-mentioned pump.

Preferably we arrange for the passage *p* to be controlled by a two-way valve which may be operable by hand or automatically. Thus, in the example shown in Figure 1, we provide a pair of coaxial valve seatings *r*, *s* in the passage *p* at opposite sides of the outlet *q*, and on the axis of these seatings we arrange a slidable two-way valve *t* adapted to co-operate with either seating. The valve *t* is movable by a stem *u* which has a screw threaded part *v* in engagement with a complementary part of the cylinder *a*, and which is provided at its outer end with an actuating lever *w*, the latter being operable by hand or automatically. When the valve *t* is in contact with the seating *r* it establishes communication between the outlet *q* and the fluid discharge compartment *i*. When the valve *t* is in contact with the other seating *s* it interrupts communication between the outlet *q* and the fluid discharge compartment *i*, and a reduced portion *x* of the valve stem *u* serves to establish communication between the discharge outlet *q* and a drain pipe or passage (a part of which is shown and indicated by *y*) through which liquid fuel in the pipe leading to the nozzle or nozzles can be drained to a sump or elsewhere. Preferably and as shown the portion *y* of the drain passage is formed in the wall of the cylinder *a* and is in communication with the portion of the cylinder bore *b* containing the spring *e*.

When the liquid fuel injection system containing the accumulator above described is at rest the piston *d* occupies its forward position under the action of its spring *e*. In this position the discharge valve *n* co-operates with its seating *m* to interrupt communication between the passage *f* and the chamber *i*. Assuming now that the control valve *t* is in the position in which

it establishes communication between the chamber *i* and the outlet *q*, and that the pump which supplies liquid fuel to the passage *f* is started, the first effect of the pump is to charge the cylinder bore *b* with liquid fuel against the action of the spring loaded piston *d*. When a sufficient fluid pressure is attained in the passage *f* the valve *n* is moved off its seating *m* and establishes communication between the passage *f* and the outlet *q*. The liquid fuel in the cylinder bore *b* is now discharged into the passage *f* under the action of the spring loaded piston *d*. At the same time the pump continues its discharge, and the combined discharges are such as will ensure an ample supply of liquid fuel to the nozzle or nozzles. The valve *n* having been opened will remain open so long as the pump is in action. To bring the pump to rest the control valve *t* is moved to its other position in which it interrupts communication between the chamber *i* and the outlet *q*, and allows liquid fuel in the pipe leading to the nozzle or nozzles to be drained.

The example shown in Figures 2 and 3 is distinguished from that shown in Figure 1 by various constructional details which will now be described. Thus, the end of the cylinder *a* remote from the closure plate *c* is formed with three passages *f*, f^1 and *p*. At one end the passage *f* communicates with the inner end of the cylinder bore *b*, and the other end of this passage is adapted for connection by a pipe to a liquid fuel pump. The passage f^1 also communicates at one end with the inner end of the cylinder bore *b*, the other end of this passage being provided with or adapted to serve as the seating *m* for the discharge valve *n*. As in the previously described example the discharge valve *n* is attached to or formed on a flexible diaphragm *k* which serves to divide a chamber on the cylinder *a* into two compartments *i*, *j*, and the compartment *j* contains a spring *o* for holding the valve on its seating *m* until sufficient fluid pressure is attained in the passage f^1 to lift the valve off its seating. The spring *o* is situated between the valve *n* and an abutment *z* which is adjustable by a screw **2** to vary the effect of the spring on the valve. The passage *p* communicates at one end with the compartment *i*, and the other end of this passage is provided with a discharge outlet *q*, the latter being adapted for connection by a pipe to the delivery nozzle or nozzles. Extending transversely across the passage *p* is a rotary two-way valve *t* of cylindrical form, this valve being supported by a stationary ported sleeve **3** in a transverse bore **4** formed in the corresponding end of the cylinder *a*. The valve *t* is formed with a transverse hole **5**, and with a longitudinal groove **6** in its outer periphery. In one position of the valve *t* its hole **5** serves to establish communication between the outlet *q* and the compartment *i*, and in another position of this valve its groove **6** serves to establish communication between the outlet and a pipe or passage as *y* through which liquid fuel in the pipe leading to the nozzle or nozzles can be drained to a sump or elsewhere. The valve *t* is operable by hand or automatically through the agency of a lever *w* on one end of the valve. The piston *d* contained in the cylinder bore *b* is loaded by a pair of helical springs *e*.

In other respects and in operation the example shown in Figures 2 and 3 is essentially similar to that shown in Figure 1.

By employing a discharge valve carried by or formed on a flexible diaphragm as above described, we are able to ensure greater reliability of action in some cases than when employing a piston-type valve, and the additional two-way valve (when required) enables the system to be put out of action and the residual liquid fuel in the part of the system between the accumulator and the nozzle or nozzles to be drained away conveniently.

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

1. A liquid fuel injecting device having in combination a liquid fuel inlet, a liquid fuel discharge outlet, an accumulator cylinder having one end in communication with said inlet so that said cylinder can be charged with liquid fuel through said inlet, a spring loaded piston slidable in said cylinder, a valve seating arranged between the inlet end of said cylinder and said discharge outlet, a valve co-operating with said seating and arranged to be opened by liquid pressure created when said cylinder is charged with liquid fuel, and a flexible diaphragm by which said valve is supported and which is arranged so that when said valve is opened the liquid pressure acting on said valve also acts on a part of said diaphragm around said valve and thereby retains the latter in its open position.

2. A liquid fuel injecting device as claimed in claim 1 and having in combination a two-way control valve of cylindrical form situated between said discharge valve and discharge outlet, a drain outlet connectible by said control valve to said discharge outlet, and a stationary support in which said control valve is rotatably mounted, said control valve being provided with a tranverse hole which in one position of said control valve permits liquid fuel flow from said discharge valve to said discharge outlet, and being also provided with a longitudinal peripheral groove which in another position of said control valve establishes communication between said discharge outlet and said drain outlet.

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