Feb. 5, 1952 J. E. WITZKY 2,584,408

INJECTION PUMP FOR INTERNAL-COMBUSTION ENGINES

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FIG. 1.

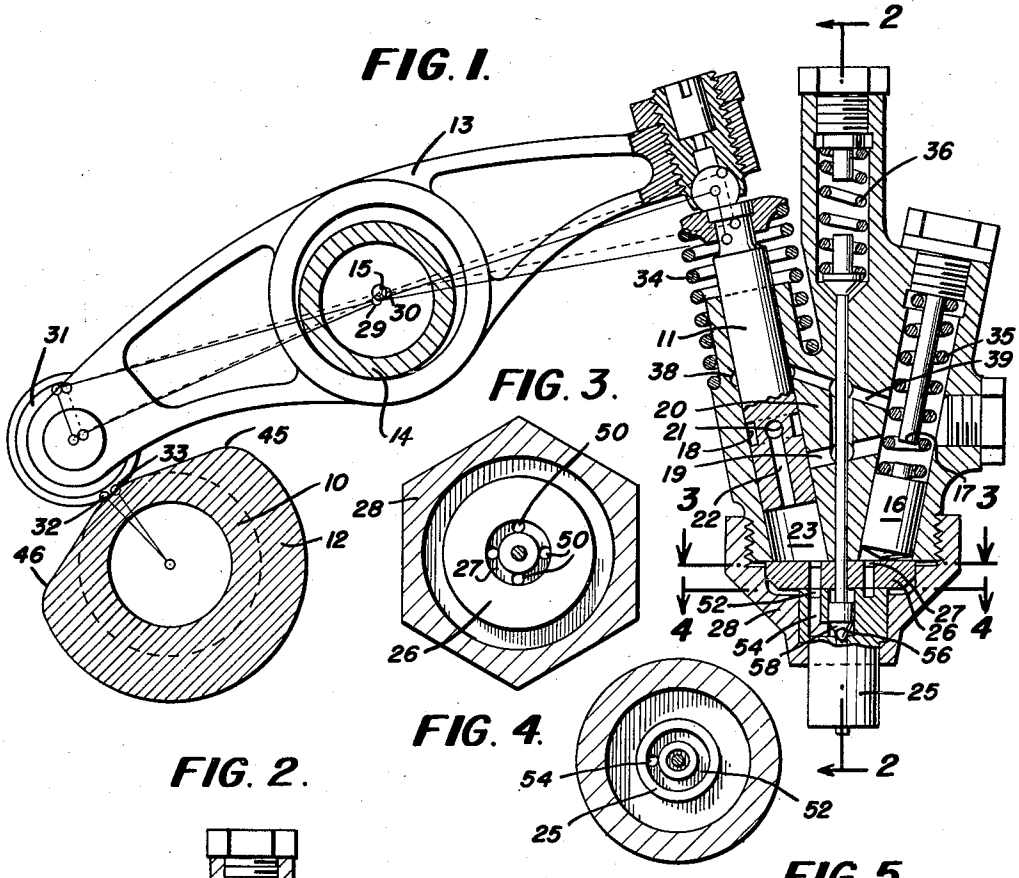


FIG. 3.

FIG. 4.

FIG. 2.

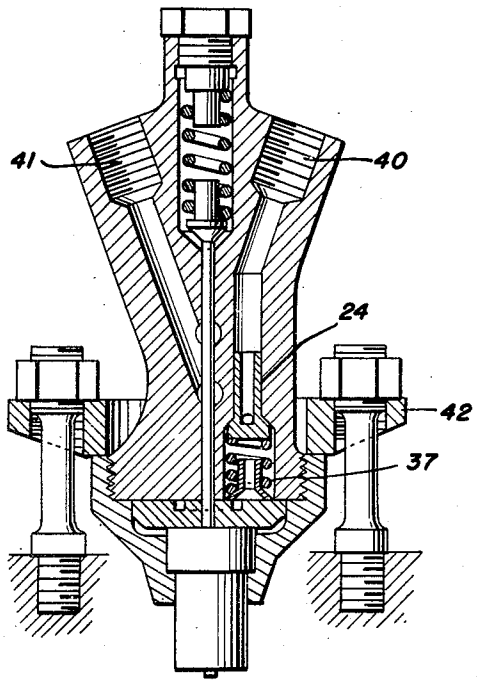
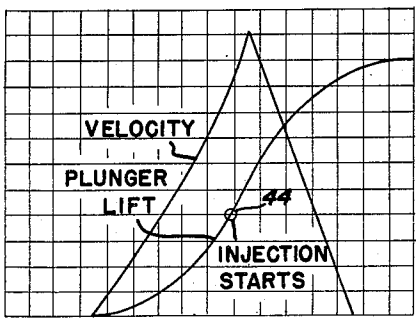


FIG. 5.



CAM TRAVEL
PLUNGER LIFT & VELOCITY

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INJECTION PUMP FOR INTERNAL-COMBUSTION ENGINES

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This invention relates to new and useful improvements in fuel injector pumps for internal combustion engines.

An object of the invention is to provide an injector wherein only that part of the cam curve which has the highest velocity will be utilized for the injection of the fuel.

A further object of the invention is to provide a combined injection pump and injection nozzle.

Another object of the invention is to locate the combined injection pump and nozzle in the cylinder head.

A further object of the invention resides in the provision of an injection pump actuated by the camshaft which operates the intake and exhaust valves. An additional cam on said camshaft has therefore been provided.

Still another object of the invention is to provide an injector wherein the rocker arm which actuates the plunger operates on the same shaft with the rocker arm which operates the valves.

Another object of the invention is to provide an injector wherein the beginning of the injection can be varied by changing the position of the eccentric.

A further object of the invention is to cool the injector system by splashing fuel through the injection unit.

The invention will be more readily understood from the following specification in connection with the accompanying drawings in which an example of the invention is shown. In these drawings,

Figure 1 is a vertical sectional view of the fuel pump unit and associated parts.

Figure 2 is a vertical sectional view of the fuel pump unit and associated parts taken on the line 2—2 of Figure 1 looking in the direction of the arrows.

Figure 3 is a transverse horizontal section taken on line 3—3 of Figure 1 as viewed in the direction indicated by the arrows.

Figure 4 is a transverse horizontal section taken on line 4—4 of Figure 1 as viewed in the direction indicated by the arrows.

Figure 5 is a curve illustrating the relation of plunger lift and velocity.

In the drawings the numeral 10 designates the camshaft which actuates the plunger 11 of the injection pump. The same camshaft operates the intake and exhaust valves, not shown in the drawing. An additional cam 12 therefore has to be provided. A rocker arm 13 actuating the plunger 11 is mounted on the common rocker arm shaft 14.

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This rocker arm shaft has an eccentric 15 to control the amount of fuel injection. Only that part of the cam lift curve, which has the highest velocity, will be utilized for the injection of the fuel as is illustrated in Figure 5. A compensating piston 16 is provided for this purpose. As the plunger 11 of the injection pump travels downward, the compensating piston travels upward until it reaches its stop 17. At this moment the actual injection will start and it will be terminated when the ring groove 18 of the plunger 11 reaches the port 19 of the barrel 20. The ring groove 18 is connected by bores 21 and 22 with the space 23 beneath the plunger 11. The rest of the fuel delivered by the upward stroke of the plunger will be spilled through the bores 21 and 22, the groove 18 and port 19, thus ending the actual injection.

Fuel is supplied through the suction valve 24 when the plunger 11 travels upward, as is best shown in Figure 2, which (valve) receives fuel from a suitable source of storage. Between barrel 20 and the nozzle 25 an adapter plate 26 is provided. The adapter plate 26 has a ring groove 27 which connects the suction valve 24, the space 23 and the space beneath the compensating piston 16. The barrel 20, adapter plate 26 and nozzle 25 are fastened together by an assembly nut 28.

The rocker arm 13 actuating the plunger 11 is mounted on an eccentric 15 of the common rocker arm shaft 14 in order to control the injection amount of fuel. When this shaft 14 is turned, the position of the ring groove 18 is varied with respect to the port 19 in the barrel 20. Figure 1 shows the injection pump with plunger 11 in a position approximately at the upper limit of its stroke. The dotted line indicates a position for full load. By this means, the amount injected of fuel may be varied and the speed of the engine controlled.

By turning of the eccentric 15 from the position 29 to the position 30, the roller 31 travels from position 32 to the position 33, the beginning of the injection may be varied together with the variation of the amount of injection, depending on the original position of the eccentric 15.

The whole system is cooled by the flow of fuel therethrough under pressure. This flow is caused by the fuel supply pump, not shown in the drawings. If the cam 12 has a shape as shown in Figure 1, the ring groove 18 covers the port 19 when the plunger 11 is at the lower limit of its stroke and an amount of fuel flashes through the pump back to the tank. The plung-

er 11 is returned by a coiled spring 34, the compensating piston 16 is returned by a coiled spring 35. The metering valve 58 in the nozzle 25 is loaded by means of coil spring 36 and the suction valve 24 by a coil spring 37.

Any liquid fuel which may seep between the plunger and the surface of the bore is collected in the groove 38, and goes back through the duct 39 together with the surplus fuel to the storage tank. The numeral 40 is the fuel inlet from storage tank, and 41 surplus fuel outlet to the storage tank. The unit injector is conveniently and securely fastened in place by means of a flange 42 and is readily removable when necessary.

The operation is as follows:

When the engine is operating, the injection pump will be actuated by the camshaft 10. Upon rotation of camshaft 10, the cam 12 lifts the roller 31 and the rocker arm 13 pushes the plunger 11 of the injection pump downward. The compensating piston 16 travels upward until it reaches its stop 17. At this moment the plunger 11 has traveled to the point 44 of the lift curve, shown in Figure 5. That means the plunger 11 has a high velocity which is important for a fast injection. At this position in the stroke of plunger 11 the fuel oil under relatively high pressure is forced around through groove 27, down through channels 50, around groove 52, down through channel 54 to the underface of metering valve 58 which is thereby lifted from its seat against the biasing action of spring 36 and the fuel oil is injected at relatively high velocity and pressure thence through nozzle 25 into the cylinder of the motor. The actual injection will be terminated when the ring groove 18 of the plunger 11 reaches the port 19. The rest of the fuel taken in by the upward stroke of the plunger 11 will be spilled through this port 19, thus ending the actual injection.

Fuel is supplied through a suction valve 24 when the plunger 11 travels upward. The rocker arm 13 acutating the plunger 11 is mounted on an eccentric 15 of the rocker arm shaft 14. If the rocker arm shaft 14 is turned, the position of the ring groove 18 is varied with respect to the port 19, that means the amount of fuel per injector stroke will be varied and the speed of the engine controlled.

By turning the eccentric 15, the quantity of fuel injected and the beginning of the injection may be varied simultaneously, depending on the original position of the eccentric.

Various changes in the size and shape of the different parts, as well as modification and alteration may be made within the scope of the appended claims.

Having illustrated and described a preferred form of the invention, what I claim is:

1. A fuel injection pump structure for high velocity injection of fuel into an internal combustion engine having a camshaft and a rocker arm shaft, said pump structure mounted on the cylinder head of said engine, comprising a pump body, an injection nozzle depending from said pump body and projecting through said cylinder head, a spring biased valve for control of fuel flow through said nozzle, a fuel inlet conduit in said pump body, a spring biased check valve for the control of fuel flow through said inlet conduit, a fuel outlet conduit in said pump body, spaced chambers in said pump body, an adapter plate provided with an annular groove in its top surface, said plate positioned in said pump body below said inlet conduit and said spaced chambers so that said annular groove provides fuel flow communication therebetween, a spring biased plunger in one of said chambers, a rocker arm rotatably mounted on said rocker arm shaft, one end thereof bearing on the external end of said plunger, a cam mounted on said cam shaft bearing on the other end of said rocker arm, said cam contoured for a relatively rapid thrust, a relatively long period of dwell at the maximum thrust and a relatively rapid return to the low position, a spring biased compensating plunger in the other of said chambers, adjustable stop means in said other chamber to limit the movement of said compensating plunger and a duct in said pump body communicating with said fuel outlet conduit and through ducts in said plunger with the space therebeneath whereby when said plunger is at the position of maximum thrust the injection of fuel through said nozzle is terminated and fuel oil under pressure flows from said inlet conduit through the ducts in said plunger, through the said duct in said pump body to said fuel outlet conduit to thereby effect a cooling of said pump body.

2. The structure as defined in claim 1 which comprises an adapter plate having a body portion, an annular groove in the top surface of said body portion and a plurality of ducts extending normally from said groove through said body portion.

3. The structure as defined in claim 1 which comprises an injection nozzle having a cylindrical body portion and an enlarged head portion in close contact with the under surface of said adapter plate, a valve seat and spring biased valve in said body portion, an axially positioned duct communicating with said valve seat and with a discharge orifice in the lower surface of said body portion, an annular groove in the top surface of said head portion in alignment with the ducts in said adapter plate and a duct in said head portion connecting said annular groove with the upstream side of said valve seat, whereby, as the pressure on said fuel oil is increased by said plunger, said fuel oil flows through said adapter, through the duct in said head portion to said valve seat, lifts said valve and discharges at high velocity through said orifice into space in said cylinder head.

4. The structure as defined in claim 1 which comprises a spring biased plunger having a cylindical body extending into and adapted to be reciprocated in said one chamber, an annular groove positioned in the lateral surface of said plunger to be in alignment with said duct in said pump body when said plunger is at the limit of inward travel, a diametrically transverse duct in said plunger communicating at both ends with said annular groove and an axial duct in said plunger communicating with said transverse duct and with the lower surface of said plunger.

5. The structure as defined in claim 1 which comprises a rocker arm having an arm rotatably mounted at about its midpoint on an eccentric securely attached to said rocker arm shaft, one end of said arm in contact with the external end of said plunger and the other end of said arm provided with a roller held in contact with the cam on said camshaft whereby rotation of said rocker arm shaft moves the roller in contact with said cam forward or backward with respect thereto thereby increasing or decreasing the

amount of fuel oil drawn into said one chamber by said plunger during the return stroke.

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