

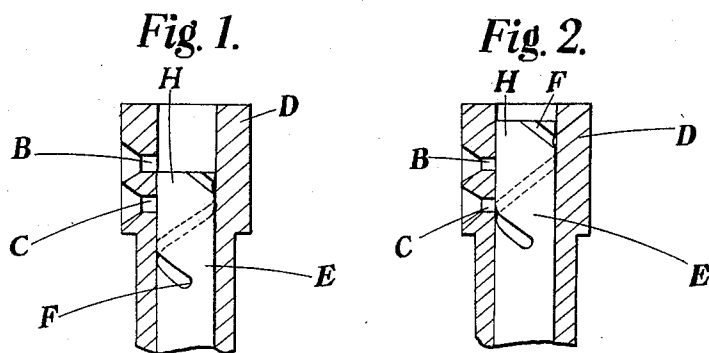
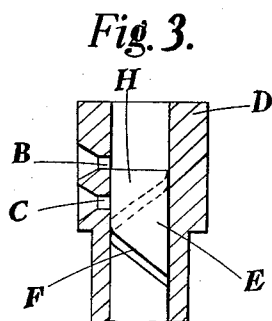
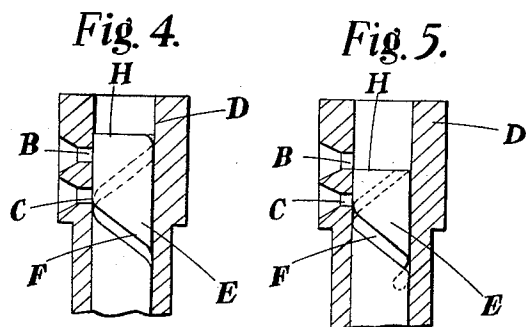
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FUEL INJECTION PUMP

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FUEL INJECTION PUMP

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1 Claim. (Cl. 103—41)

This invention relates to fuel injection pumps for internal combustion engines, of the type having a plunger reciprocable with constant stroke in a cylinder ported to communicate with a fuel supply chamber.

In such pumps it is general to provide means enabling a relative rotation of the plunger and cylinder under manual or governor control, the plunger and the ports in the cylinder being adapted for co-operation in such manner that variations in the relative rotation of the plunger and cylinder effect corresponding variations of the quantity of fuel delivery during each working stroke of the plunger regardless of the constancy of the plunger strokes.

It has also been proposed to provide, in a fuel injection pump, the combination, with a cut-off edge on the piston (i. e., plunger) which lies in a plane normal to the piston axis and uncovers a relief port in the cylinder wall during the initial part of the delivery stroke but covers such relief port during an intermediate part of the delivery stroke, of a helical or inclined controlling edge which constitutes the upper edge of a substantially triangular recess in the piston and uncovers a relief port to terminate the effective part of the delivery stroke.

An object of the present invention is to provide a relief passage constituted by a helical groove of uniform width extending one complete turn round the plunger from the working face thereof, whereby lateral thrust exerted by the fuel under pressure in the cylinder during a working stroke is balanced, minimizing friction and equalizing wear of the plunger and the cylinder bore, while the maximum possible bearing surface is left on the plunger to minimize such wear.

Another object of the invention is to obtain rapid increase and decrease of delivery pressure by providing in the cylinder, for co-operation with the aforesaid groove, a plurality of drillings, namely at least an upper drilling co-operating with the working face of the plunger to determine the beginning of the injection and a lower drilling co-operating with the helical groove to determine the end of injection.

An embodiment of the invention, as referred to in the preceding paragraph, will be described, by way of example, with reference to the accompanying drawing, wherein Figs. 1 to 5 are axial sections of the cylinder with the plunger in various positions.

Figs. 1 and 2 show the plunger angularly disposed in the cylinder to afford maximum delivery. The cylinder D is ported by a group of drillings

B and C, having their centres disposed in a common axial plane of the cylinder. The plunger E has a helical groove F of constant pitch extending around it through one complete turn and communicating at its upper end with the working face H of the plunger. In this figure, the plunger is shown at the bottom of its stroke wherein the drilling B enables fuel to flow from the usual supply chamber surrounding the cylinder D into the bore of the cylinder in readiness for transmission to the injector pipe line by the operation of the plunger E. As the plunger commences to rise in its working stroke the exposed area of the drilling B is gradually reduced, and by the time the working face H passes the upper limits of the drilling B the plunger has attained high speed and the subsequent rise in pressure of the fuel trapped in the bore of the cylinder D for delivery to the engine is rapid. The plunger continues to rise until it nearly reaches the upper limit of its stroke as shown in Fig. 2. In this position the plunger is still travelling rapidly, and the groove F comes into register with the drilling C, thereby permitting the by-passing of fuel from above the working face H, along the groove F, and through the drilling C back to the supply chamber, enabling the pressure in the pipe line to decrease rapidly. The angular position of the plunger is such that, as described, while delivery commences shortly after the beginning of the plunger stroke, by-passing is delayed until immediately before the end of the stroke, whereby maximum delivery of fuel is effected.

Fig. 3 again shows the plunger at the bottom of its stroke, but with its angular relationship to the cylinder D varied by rotation anti-clockwise in plan. As before, at the beginning of the injection stroke the drilling B is completely closed only when the plunger has attained considerable speed to afford subsequent rapid increase of pressure. However, as shown in Fig. 4, the groove F now comes into register with the drilling C when the plunger is at about mid-stroke. There is again a rapid by-passing of fuel through the drilling C, but since this occurs earlier in the stroke the quantity of fuel actually delivered is reduced in proportion, the remainder of the plunger stroke being ineffective.

By further anti-clockwise rotation of the plunger to the position shown in Fig. 5, the pump is set so that there is no delivery, the disposition of the groove F being such that before the upper part of the drilling B is closed by the passing of the working face H, the groove F comes into register with the drilling C, whereby the whole

of the fuel in the bore of the cylinder D is enabled to flow back through the groove and the drilling C to the supply chamber, the whole of the plunger stroke being thereby rendered ineffective.

- 5 Variations may be made in the porting of the cylinder D. For example, other drillings may be disposed in vertical alignment between the drillings B and C, or the vertically aligned plurality of drillings may be substituted by a vertical slot.
- 10 Alternatively, the drillings in a group may be disposed in different axial planes.

- Obviously, the groove F may be duplicated for cooperation with duplicate groups of drillings. Preferably, in such case, the groups of drillings
- 15 would be disposed diametrically opposite one another in the cylinder bore, and the two grooves in the plunger would be of the same pitch and disposed diametrically opposite one another.

- No description has been given of the general pump construction or of the mode of actuating the plunger since these may be widely varied.

- The invention affords advantages in operation and simplification of manufacture which will be evident. As has already been explained, the porting of the cylinder by drilling affords a notable
- 25 simplification, and economy in manufacture. It will be appreciated that with the known milled ports, a special milling operation is necessary for each size of pump cylinder, since with constant
- 30 movement of the milling tool the area at the surface of the cylinder bore will vary with the radius of such surface. Thus, the requisite port area has to be determined by special manipulation of the milling tool. On the contrary, when the port
- 35 is effected by a group of drillings, every drill is

disposed to enter the cylinder radially, and the port area opened up by each drill is practically constant regardless of the radius of the cylinder bore; the total port area thus varies with the number of drillings and the manufacture of different sizes of pump cylinders is greatly simplified; grooving of the plunger is also a simple manufacturing operation.

I claim:—

A fuel injection pump comprising a cylinder, 10 a plunger reciprocable with constant stroke in the cylinder, said cylinder and said plunger being arranged for relative angular adjustment, a discharge duct at the upper end of said cylinder, a fuel supply chamber adjacent the cylinder, an inlet port in the cylinder wall disposed to be masked by the plunger except when the plunger is near its lower limit of stroke, a helical groove of uniform width extending one complete turn round the plunger from the working face thereof, 20 and a circular relief port in said cylinder wall of a diameter substantially equal to the width of said groove, said groove adapted to establish communication between the compression space above the working face of said plunger and said 25 relief port at different points in the stroke of said plunger with respectively different angular adjustments of said plunger with relation to said cylinder, the uniformity of the said helical groove in the one complete turn being effective to preserve the lateral balance of said plunger under fluid pressure continuously communicated from the compression in said cylinder and exerted against the cylinder wall.

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