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O. BAUR

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INJECTION PUMP

Filed May 12, 1928

Fig. 1.

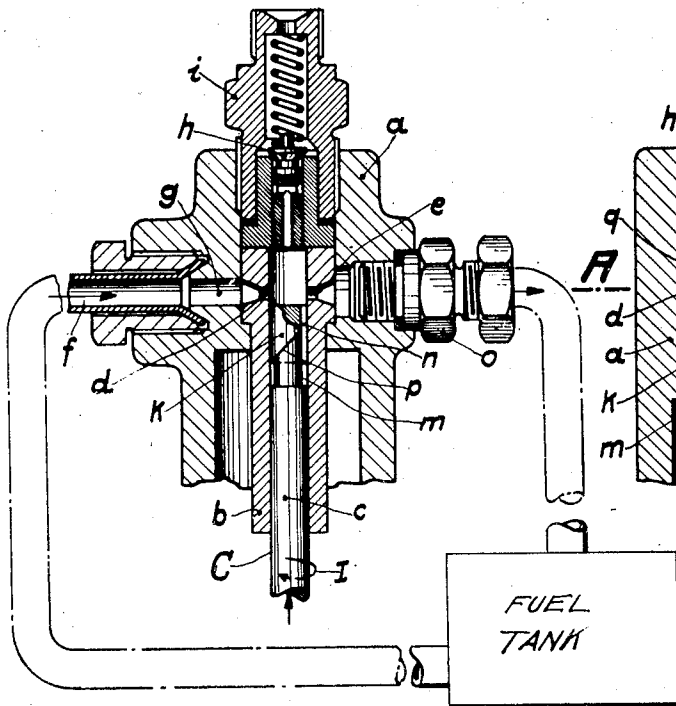


Fig. 2.

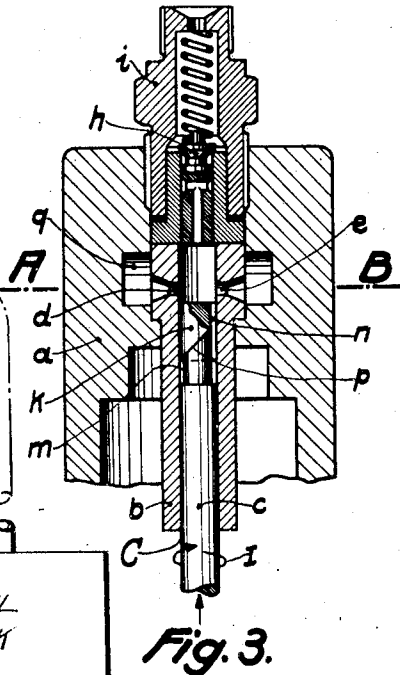


Fig. 3.

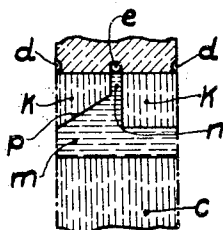
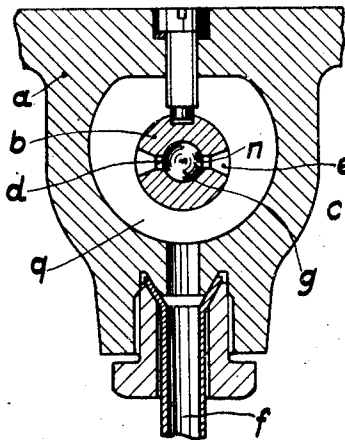


Fig. 4.



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UNITED STATES PATENT OFFICE

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INJECTION PUMP

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The present invention relates to an injection pump for internal combustion engines and more particularly to that type in which the pump piston has a controlling face which is cut away at an inclined angle, which covers a return aperture for the fuel over a portion of the stroke of the piston and which is adjustable by rotating the piston, whilst the pump element is connected by a supply pipe with the fuel tank.

In pumps of this type which are already known the return duct usually opens directly into the supply pipe. It has now been found that pumps of this type do not give a regular supply at all velocities of revolution. Thorough experiments have shown that irregular feed of the fuel is caused by oscillations of the column of fuel in the supply pipe, these oscillations disturbing the regular filling of the pump cylinder on suction. They are set up by the fuel vigorously ejected into the supply pipe immediately after opening of the return pipe, whilst with an increase in the feed pressure, velocity of feed, or the quantity of fuel supplied the oscillations become more powerful.

A uniform feed for the whole range of velocities of revolution can be obtained, however, with a pump of the type described, if the oscillations of the column of liquid in the supply pipe are damped by absorption and reduction of the energy of flow of the fuel ejected from the return aperture to such an extent so that it cannot affect the next charging of the cylinder.

The present invention includes the provision of means for accomplishing this result.

The invention is more particularly described with reference to the accompanying drawings in which two forms of construction are shown and in which:—

Figure 1 is a longitudinal section of the first form of construction.

Figure 2 is a longitudinal section of the second form of construction.

Figure 3 is a cross section along the line A. B. in Figure 2.

Figure 4 is a development of the upper portion of the piston which is the same in both examples assuming that the surface of

the piston has been cut along a generating line C and placed flat.

In the first form of construction a cylindrical bushing *b* in which a piston *c* reciprocates is inserted in a pump housing *a*. In the position shown, the piston is in its outer dead centre position. Only two borings are provided in the wall of the bushing, namely the two transverse borings *d* and *e*, the axes of which lie in a plane at right angles to the axis of the piston. The boring *d* is connected with the fuel supply pipe by means of a duct *g* in the pump housing and a pipe *f* connected to the pump chamber. The transverse bore *e* is an overflow duct which is connected to a return pipe by a nipple *o*. A pressure valve *h* with a nipple *i*, connected by the compression pipe (not shown) with the injection nozzle, is mounted on the cylinder head co-axially with the piston.

The opening of the bore *e* in the running face of the piston is so positioned as to remain covered, during a variable portion of the delivery stroke, by a regulating plate *k* coupled with the piston. This plate is cut away at an angle along the line *p* at its outer side and is connected with the piston by a bar, leaving an annular space *m* between the bar and the cylinder or wall.

A longitudinal groove *n* by means of which the chamber in front of the piston is permanently connected with the annular chamber *m* is cut on the shortest generating line of the plate, from its end, up to the edge *p*.

In the position shown, the piston will feed no fuel through the pressure valve on its compression stroke. The free path to the return duct *e* is therefore open to the fuel forced up over the whole compression stroke as the groove *n* and annular chamber *m* are opposite the duct *e* and no portion of the periphery of the plate covers the opening of the duct *e*. Fuel can only be supplied through the pressure valve when the piston is turned to such an extent in the direction of the arrow I that the groove *n* no longer coincides with the duct *e*, i. e., fuel can only be supplied so long as the duct *e* is covered by the running face of the plate. This covered period lasts longer the more the piston is ro-

tated, since the portion of the plate located between the end of the plate and the inclined edge *p*, is correspondingly longer. As soon, however, as the edge *p* uncovers the duct *e* on the inward stroke of the piston plate, the compression chamber of the cylinder is connected with the annular chamber *m* and duct *e* by the groove *n* and no more fuel is forced to the jet, but is ejected into the return pipe leading from the nipple *o* to the fuel tank. The energy of flow of the ejected fuel cannot accordingly adversely affect the following suction operation.

The only manner in which the second form of construction differs from the first is in the guidance of the return fuel. Whilst in the construction just described a special return pipe is provided, the second example shows a form of construction in which this special pipe is omitted. The overflow boring *e* opens into a widened chamber *q* in the pump housing, filled with fuel. The fuel supply pipe *f* and the suction boring *d* also open into this chamber *q*. In the arrangement of the overflow duct, care must of course be taken that the fuel emerging from the over-flow bore with high kinetic energy at high velocities of revolution causes no disturbing return flow in the supply pipe, as otherwise the regular filling of the pump would be disturbed. In the example shown the disturbing effect of the return fuel is prevented by displacing the over flow bore relative to the suction pipe and by the buffer action of the chamber *q*. The buffer action of the chamber *q* increases of course with the volume and it is therefore preferable to make the chamber *q* as large as possible.

I claim:

1. An injection pump for internal combustion engines consisting of a pump cylinder, a piston reciprocating within said cylinder, inlet, exhaust and overflow ports in said cylinder, an enlarged chamber surrounding said cylinder, a fuel supply tank and a pipe leading from said fuel supply tank to said enlarged chamber whereby fuel is fed from said pipe through said inlet into said cylinder and when said overflow port is open said fuel is ejected into said enlarged chamber before entering the pipe from said fuel tank.

2. An injection pump for internal combustion engines consisting of a pump cylinder, a valve controlled port in said cylinder for delivery of fuel, a piston reciprocating within said cylinder, inlet and overflow ports in said cylinder, a supply tank, an enlarged chamber surrounding said cylinder and said inlet and overflow ports and a pipe leading from said supply tank to said enlarged chamber, the inlet between said supply pipe and said enlarged chamber being transverse to said inlet and overflow ports.

3. An injection pump for internal combustion engines consisting of a pump cylinder,

a valve controlled port in said cylinder for delivery of fuel, a piston reciprocating in said cylinder, a supply tank, inlet and overflow ports diametrically opposed on opposite sides of said cylinder and at the same level in the walls of said cylinder, a controlling face on said pump piston adapted to cover and uncover said overflow port and means to absorb, damp or reduce the energy of flow of the fuel ejected through the overflow port so that it does not affect the next succeeding charge of fuel in the cylinder.

4. A fuel injection pump comprising a housing, a bushing forming the pump cylinder mounted in said housing, said cylinder being provided with openings extending transversely through the walls thereof to provide overflow and suction ducts, a piston adapted to reciprocate in said cylinder and having a control surface with two control edges adapted to control said overflow and suction ducts, at least one of said control edges being inclined relative to the pump axis, and means for revolvably adjusting said pump piston relative to said cylinder.

5. A fuel pump as set out in claim 4 further characterized by the fact that the housing is provided with a chamber into which said overflow and suction duct or ducts open, and that a fuel supply pipe is connected to said chamber.

6. A fuel pump as set out in claim 4 in which the bushing forming the cylinder is held in place in the housing by a fitting in which is mounted the discharge pressure valve.

In testimony whereof I have hereunto affixed my signature.

OTTMAR BAUR.