

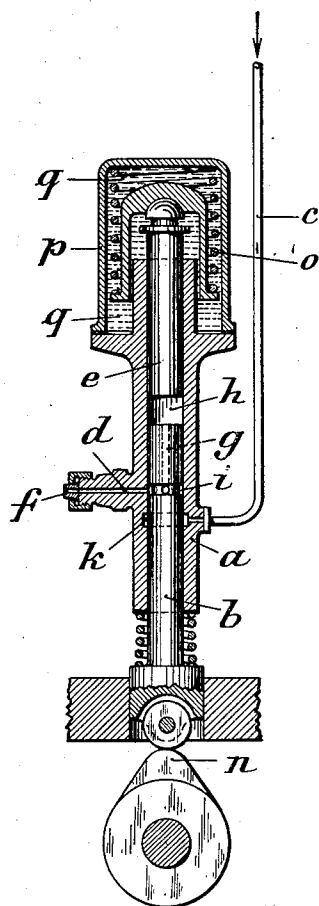
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FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

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FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

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5 Claims. (Cl. 103—154)

This invention relates to fuel injection pumps for solid or airless injection of fuel in internal combustion engines and of the kind in which the fuel is injected by a fuel accumulator or storage piston forming part of the pump.

This application is a companion of applications Serial Nos. 628,471 and 628,472 by the same applicant.

In a pump of this type when the accumulator or storage piston is loaded solely by a metallic spring and the admission to and delivery of fuel from the pump is controlled by a pump plunger cooperating with the accumulator piston, the accumulator piston tends to oscillate to and from the pump plunger when the fuel injection port is uncovered, so that during each movement of the accumulator piston away from the pump piston the pressure within the pump between the accumulator piston and the fuel injection port is momentarily reduced. This tends to result in a jerky back-flow of air or combustion gases from the combustion chamber of the engine into the pump and the present invention has for its object to overcome this disadvantage.

According to the present invention the accumulator piston is loaded not only by a metallic spring but also by a hydraulic spring. In this way the dimensions and therefore the mass of the metallic spring can be reduced whereby the oscillations of the spring and therefore of the accumulator piston during the injection stroke are reduced to a minimum.

Preferably the metallic spring is immersed in the loading liquid, whereby this liquid tends to damp oscillations of the metallic spring.

One construction of fuel injection pump according to the invention is illustrated by way of example in the accompanying drawing and comprises a cylinder *a*, and a pump plunger *b* whereby fuel is drawn from a supply pipe *c* and is delivered during the injection stroke through an injection conduit *d*, as hereinafter described. The pump plunger *b* is moved on its compression stroke by a driving cam *n* and is returned on its suction stroke by means of a spring as shown. An accumulator piston *e* which cooperates with the plunger *b* is loaded by a metallic spring *o* and in addition by a compressible liquid *q* under pressure within a chamber *p*, the spring *o* being immersed in the liquid *q*.

When the plunger *b* arrives at the end of its suction stroke a recess *i* in the plunger registers with a recess *k* within the cylinder *a* so that fuel flows from the supply pipe *c* through an axial bore *g* in the plunger *b* and into the working

chamber of the pump. As the plunger *b* moves forward on its compression stroke communication between the recess *i* and the recess *k* is first cut off, whereupon the plunger *b* commences to apply pressure to the fuel within the working chamber *h* so that the accumulator piston *e* is moved upwards to compress the metallic spring *o* and also the loading liquid *q*. Towards the end of the compression stroke of the plunger *b* the recess *i* registers with the fuel injection conduit *d* whereupon the accumulator piston *e* moves towards the plunger *b* under the action of the loading spring *o* and liquid *q*. In this way the fuel within the working chamber *h* is injected through the injection nozzle *f*.

In known constructions the accumulator piston is loaded solely by a metallic spring so that the spring has necessarily to be of large dimensions in order to produce the requisite fuel pressure. When therefore the fuel injection port is opened the loading spring, being of large mass, tends to oscillate and to transmit such oscillation to the accumulator piston. In a pump embodying the present invention, however, the dimensions of the metallic spring can be reduced since the force of this spring is supplemented by the loading liquid. Oscillations of the spring and therefore of the accumulator piston are in this way reduced. In addition the metallic spring *o* being immersed in the loading liquid *q* results in the oscillations of the metallic spring being damped.

I claim:

1. In a fuel injection pump for internal combustion engines, a cylinder having a working chamber, a plunger reciprocable in said cylinder, a fuel inlet to the working chamber, a fuel outlet from the working chamber, the opening and closing of said inlet and outlet being controlled by said plunger, an accumulator piston also reciprocable in said cylinder, a closed fluid chamber having a volume many times as great as the volumetric displacement of the accumulator piston, said chamber being substantially completely filled with a liquid, means for causing a displacement of liquid in said chamber on outward movement of the accumulator piston, whereby said liquid forms an hydraulic spring for loading the accumulator piston, and a metallic spring also loading said accumulator piston, both the metallic spring and the hydraulic spring acting upon said accumulator piston during expulsion of fuel from the working chamber to impart a motivating force to said piston.

2. In a fuel injection pump for internal combustion engines, a cylinder having a working

chamber, a plunger reciprocable in said cylinder, a fuel inlet to the working chamber, a fuel outlet from the working chamber, the opening and closing of said inlet and outlet being controlled by
5 said plunger, an accumulator piston also reciprocable in said cylinder, a closed fluid chamber having a volume many times as great as the volumetric displacement of the accumulator piston, said chamber being substantially completely
10 filled with a liquid, means for causing a displacement of liquid in said chamber on outward movement of the accumulator piston, whereby said liquid forms an hydraulic spring for loading the accumulator piston, and a metallic spring located
15 in said fluid chamber also loading said accumulator piston, both the metallic spring and the hydraulic spring acting upon said accumulator piston during expulsion of fuel from the working chamber to impart a motivating force to said piston.
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3. In a fuel injection pump for internal combustion engines, a cylinder having a working chamber, a plunger reciprocable in said cylinder, a fuel inlet, a fuel outlet, said plunger having a
25 passage therethrough through which fuel may pass from the fuel inlet to the working chamber when the plunger is in one position, and from the working chamber to the fuel outlet when the plunger is in another position, an accumulator
30 piston also reciprocable in said cylinder, a metallic spring for partially loading said accumulator piston, a closed fluid chamber having a volume many times as great as the volumetric displacement of the accumulator piston, said chamber
35 being substantially completely filled with a liquid, and means for causing a displacement of liquid in said chamber on an outward movement of the accumulator piston, whereby said liquid forms an hydraulic spring for loading the accumulator piston, said metallic spring and said hydraulic spring
40 both exerting a motivating force on the accumulator piston during expulsion of the fuel from the working chamber through the fuel outlet.

4. In a fuel injection pump, a cylinder having a working chamber, a plunger reciprocable in said cylinder, a fuel inlet to the working chamber, an accumulator piston responsive to pressure in
5 said working chamber, a closed fluid chamber having a volume many times as great as the volumetric displacement of the accumulator piston, said chamber being substantially completely filled with a liquid, said accumulator piston causing
10 a displacement of liquid in said chamber on movement of the accumulator piston under influence of pressure in the working chamber, whereby said liquid forms an hydraulic spring for loading the accumulator piston, and a metallic
15 spring also loading said accumulator piston, both the metallic spring and the hydraulic spring exerting their force upon said accumulator piston during expulsion of fuel from the working chamber.

5. In a fuel injection pump, a cylinder having a
20 working chamber, a plunger reciprocable in said cylinder, a fuel inlet to the working chamber, a fuel outlet from the working chamber, the passage of fuel through the fuel inlet and fuel outlet being controlled by said plunger, an accumulator piston
25 responsive to pressure in said working chamber, a closed fluid chamber having a volume many times as great as the volumetric displacement of the accumulator piston, said chamber being substantially completely filled with a liquid, said accumulator
30 piston causing a displacement of liquid in said chamber on movement of the accumulator piston under influence of pressure in the working chamber, whereby said liquid forms an hydraulic spring for loading the accumulator piston, and a
35 metallic spring also loading said accumulator piston, both the metallic spring and the hydraulic spring exerting their force upon said accumulator piston during expulsion of fuel from the working chamber.
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