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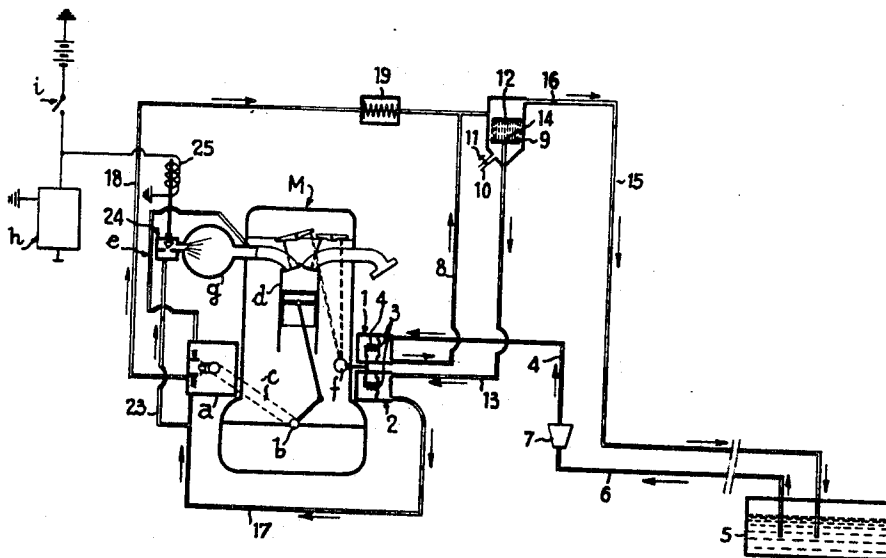
[54] FUEL FEED DEVICE FOR AN INJECTION ENGINE
3 Claims, 2 Drawing Figs.

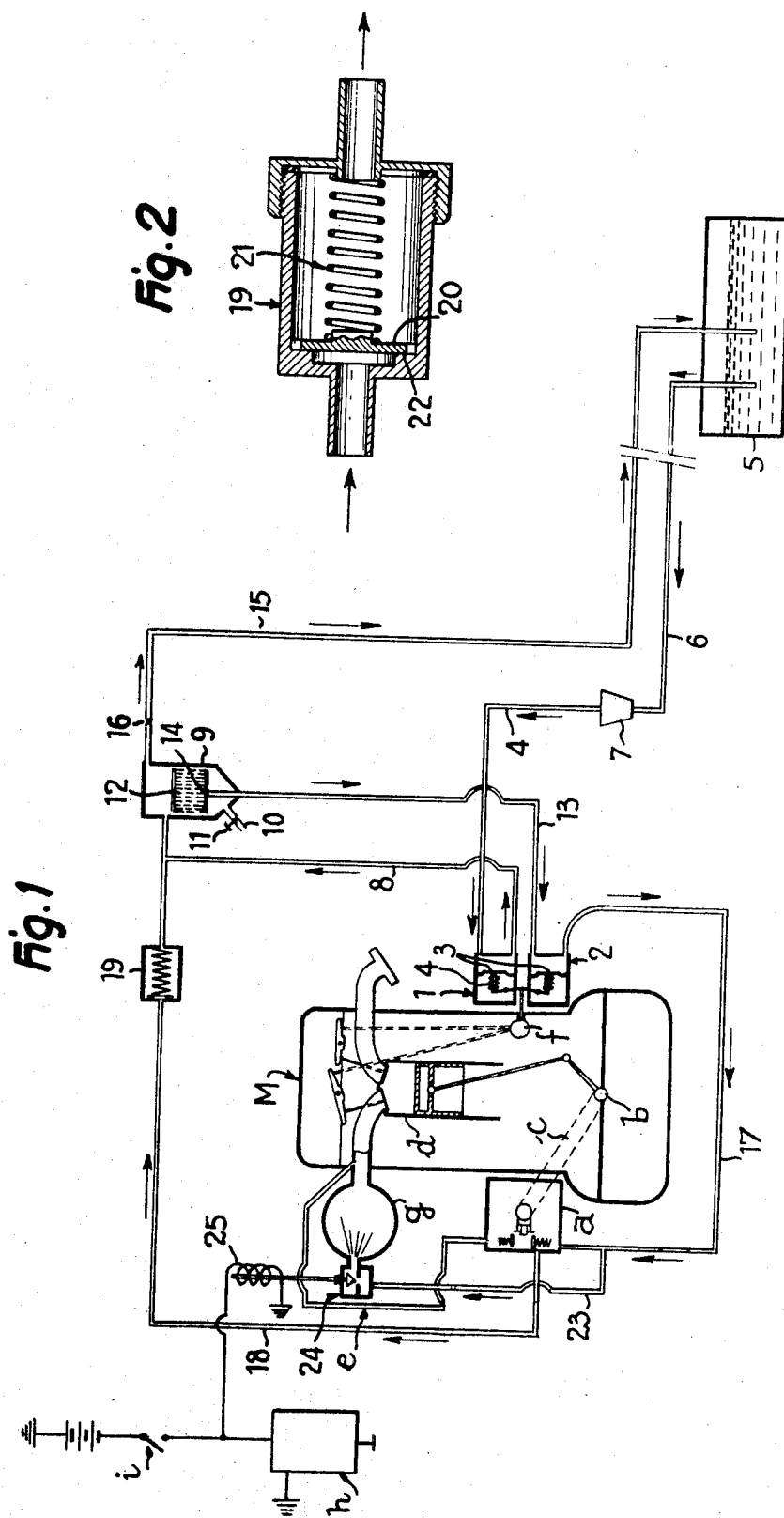
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ABSTRACT: Fuel feed device comprising, located between a fuel feed tank and an injection pump, a low-pressure pump and a high-pressure pump. The low-pressure pump inlet is connected to the tank and the outlet is connected to the top of a chamber affording a pressure head. The high-pressure pump inlet is connected to a fuel takeoff point at the bottom of the chamber and its outlet is connected to the injection pump. The high-pressure pump output exceeds the injection pump output and the chamber volume above the takeoff point at least equals the volume of fuel drawn in by the injection pump when priming the low-pressure pump.





FUEL FEED DEVICE FOR AN INJECTION ENGINE

The present invention relates to fuel feed devices for injection engines.

It is known that the required conditions for ensuring good starting up and good operation of such engines are:

- permanent priming of the feed pumps;
- rapid removal of gas from the circuit and rapid rise in pressure upon the first revolution of the engine;
- fuel fed to the injection pump under constant pressure of the order of 1 kg./cm²; and
- no formation of vapours in the course of operation.

The usual solutions employed are the following:

- a. Feeding of the injection pump by a pump driven by an electric motor, which presents several drawbacks. The electropump is costly and the electric motor, which is highly stressed, creates problems of motor life.
- b. Feeding of the injection pump by a mechanically driven pump, which also presents several drawbacks. Owing to its very drive, the position of the pump is usually rather remote from the tank in a badly cooled region and, in operation, this results in formation of petrol vapours in the feed circuit and, upon stoppage, a depriming of the pump.

As the pump is not started up as soon as the engine is switched on but simultaneously with the starting up of the engine, the rise in pressure is delayed.

The object of the invention is to provide a fuel feed device for an injection engine which is so improved as to overcome these various drawbacks.

The device according to the invention comprises, in series relation between a fuel feed tank and the usual injection pump, two mechanical pumps, one of which is a low-pressure pump and the other a high-pressure pump, driven by the engine, the inlet of the low-pressure pump being connected to said tank whereas the outlet thereof is connected to the top of a chamber affording a pressure head and having a lower fuel takeoff point connected to the inlet of the high-pressure pump which discharges the fuel to the injection pump and whose output exceeds that of said injection pump, the volume of the chamber above the takeoff point being at least equal to the volume of fuel absorbed by the injection pump during the priming of the low-pressure pump.

This arrangement results in appreciable saving in cost relative to electric pumps while it satisfies all the conditions for ensuring both good starting up and good operation namely:

- a permanent priming of the high-pressure feed pump; the vapours in the part of the circuit upstream of the injection pump are reduced to a minimum; and
- a rapid rise in pressure.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawing.

In the drawing:

FIG. 1 shows a diagram of the assembly of a fuel feed device for an injection engine according to the invention; and

FIG. 2 is a sectional view of the valve of this device which results in a rapid rise in pressure.

According to the illustrated embodiment, the invention will be described as being applied to an internal combustion injection engine M whose injection pump *a* is driven, for example by a crankshaft *b*, through a transmission *c*, this pump injecting petrol into each cylinder *d* by way of a pipe *e*.

The engine M mechanically drives, for example through its camshaft *f*, simultaneously a low-pressure pump 1 and a high-pressure pump 2. Both these pumps are of a type currently employed in internal combustion engines and they differ from each other only in respect of the dimensions of the diaphragms 3 and the springs 4.

The low-pressure pump 1 draws petrol from a tank 5 through a conduit 6 in which is interposed a prefilter 7 consisting for example of a fine strainer of plastics material, this prefilter being placed, if desired, at the inlet of the pump 1 in which it can be incorporated

The pump 1 delivers the petrol by way of a conduit 8 to the upper part of a chamber 9.

The lower part of this chamber constitutes a decantation sump from which the impurities can be discharged by way of a drain aperture 10 provided with a cock 11, whereas the upper part of the chamber comprises a filtering cartridge 12, for example of paper, through which the petrol must pass to reach the high-pressure pump 2 by way of a conduit 13, which extends into the chamber up to the base of the filter. The conduit 13 must be as short as possible and of sufficient diameter that pressure drops are negligible. It must not have a part rising in the direction of flow of the fuel.

The chamber 9 must be placed in such manner that it affords a pressure head relative to the high-pressure pump 2 and its volume above the point 14 at which the conduit 13 takes off fuel must be sufficient to contain an amount of fuel exceeding that which the injection pump *a* would absorb during the priming of the low-pressure pump 1 when starting up.

Another conduit 15 comprising a constriction 16 extends from the upper part of the chamber 9 and ensures the return of excess fuel to the tank 5.

The high-pressure pump 2 discharges fuel under pressure by way of a conduit 17 into the injection pump *a*. Its flow exceeds the consumption of the engine and the excess fuel returns to the chamber 9 by way of a conduit 18 in which is interposed a check valve 19 which opens only when the discharge pressure of the high-pressure pump 2 is sufficient, that is, higher than a given value *p*, for example 1 kg./cm².

This valve 19 can be constructed for example as shown in FIG. 2. It mainly comprises a disc 20 biased by a spring 21 with such force that the disc remains applied against its seat 22 so long as the pressure of the fuel on the upstream side is less than the aforementioned value *p*, thereby ensuring the operation of the injection pump *a*.

A bypass conduit 23, connected to the discharge conduit 17 of the high-pressure pump 2, terminates in an electrovalve 24 which communicates with the inlet pipe *g* of the engine M.

The coil 25 of this electrovalve is electrically fed in parallel with the starter *h* of the engine so that it is open only during the period of operation of this starter, when the switch *i* is depressed, and closed in normal operation of the engine.

The device operates in the following manner:

When starting up after a period of inactivity, the conduit 13 is always filled with liquid fuel since if bubbles of fuel vapour have a tendency to be given off in the course of this inactive period they naturally rise to the upper part of the chamber 9 whose higher position relative to the high-pressure pump 2 ensures that the latter is permanently primed. This pump 2 is therefore in a position to discharge fuel to the injection pump *a* at the very moment of starting up the engine.

The opening of the electrovalve 24 during the period of operation of the starter performs a double function:

When starting up in warm conditions, this opening combined with the negative pressure prevailing at this moment in the inlet pipe *g* ensures the rapid discharge of petrol vapours which might have formed inside the high-pressure pump 2.

When starting up in cold conditions, this opening enables fuel to be injected directly in this inlet pump *g* thus producing a richer mixture which facilitates the starting up of the engine.

In any case, the valve 19 maintains the conduit 18 closed so long as the discharge pressure of the high-pressure pump 2 has not reached the value *p*, the rising pressure being possible owing to the fact that the output of the pump 2 exceeds the fuel drawn off by the injection pump *a*.

Operation under conditions of high surrounding temperature is not disturbed by the formation of vapours in the circuit, since the output of the low-pressure pump 1 and high-pressure pump 2 is distinctly higher than the consumption of fuel, so much so that the large flow of petrol results in sufficient cooling. However, if vapours form between the tank 5 and the chamber 9, they would not be drawn in by the conduit 13 whose fuel takeoff point 14 is at the base of the filter 12 but return to the tank 5 by way of the conduit 15 with the unconsumed fuel.

Further, the constriction 16, which retards the return of the fuel to the tank, maintains a slight pressure in the chamber 9 which retards a possible start of percolation at the inlet of the high-pressure pump 2.

Although a specific embodiment of the invention has been described, many modifications and changes may be made therein without departing from the scope of the invention.

I claim:

1. In an internal combustion engine having a fuel feed tank and an engine driven injection pump, a fuel feed device comprising a low-pressure pump and a high-pressure pump adapted to be driven by the engine, the low-pressure pump having an inlet for connecting to said tank and an outlet, a chamber affording a pressure head relative to the high-pressure pump and having a top part and a lower fuel takeoff point, filter means in said chamber, said outlet being connected to said top part of said chamber and said fuel takeoff point in said chamber being located at the base of said filter means, said high-pressure pump having an inlet connected to said fuel takeoff point and an outlet which is connected to discharge the fuel to the injection pump, the fuel output of said high-pressure pump exceeding that of said injection pump, the volume of the chamber above said takeoff point being at least equal to the volume of fuel drawn in by the injection pump during the priming of said low-pressure pump, and two fuel return conduits connecting respectively the inlet of the injection pump to the upper part of said chamber, and the upper part of said chamber to the fuel feed tank, a check valve being provided in said fuel return conduit connecting the inlet of the injection pump to the upper part of said chamber.

2. A device as claimed in claim 1, wherein restrictor means are provided in said fuel return conduit connecting the upper part of said chamber to the fuel feed tank.

3. In an internal combustion engine having a fuel feed tank, an injection pump and an electric starter, a device comprising a low-pressure pump and a high-pressure pump adapted to be driven by the engine, the low-pressure pump having an inlet for connecting to said tank and an outlet, a chamber affording a pressure head relative to the high-pressure pump and having a top part and a lower fuel takeoff point, filter means in said chamber, said outlet being connected to said top part of said chamber and said fuel takeoff point in said chamber being located at the base of said filter means, said high-pressure pump having an inlet connected to said fuel takeoff point and an outlet which is connected to discharge the fuel to the injection pump, the fuel output of said high-pressure pump exceeding that of said injection pump, the volume of the chamber above said takeoff point being at least equal to the volume of fuel drawn in by the injection pump during the priming of said low-pressure pump, and two fuel return conduits connecting respectively the inlet of the injection pump to the upper part of said chamber, and the upper part of said chamber to the fuel feed tank, a check valve being provided in said fuel return conduit connecting the inlet of the injection pump to the upper part of said chamber, and a bypass conduit controlled by an electrovalve which is adapted to be actuated at the same time as the starter of the engine, said conduit connecting said discharge conduit of said high-pressure pump to the induction manifold of the engine.

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