May 22, 1962 L. PÉRAS 3,035,780

FUEL INJECTION NOZZLES FOR INTERNAL COMBUSTION ENGINES

Filed May 8, 1961

Fig. 1

PRIOR ART

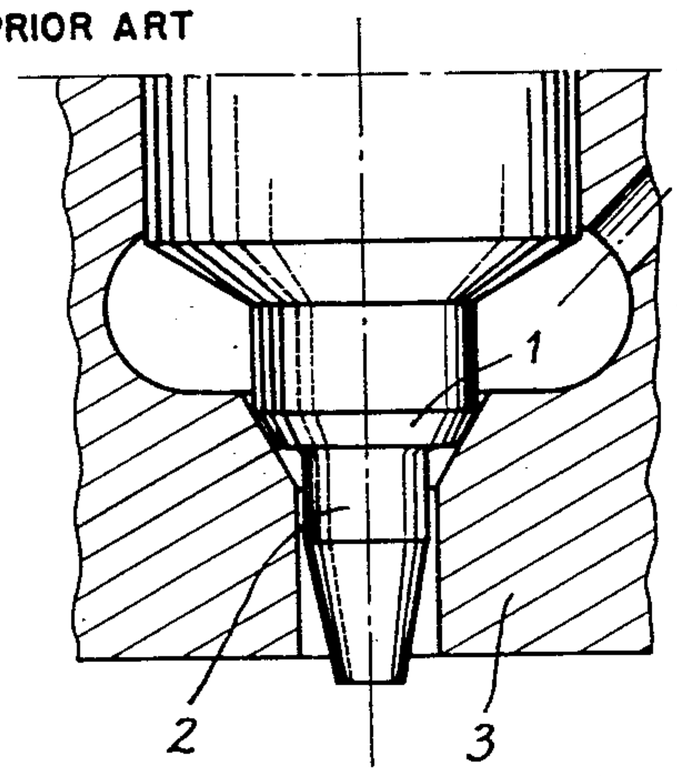


Fig. 2

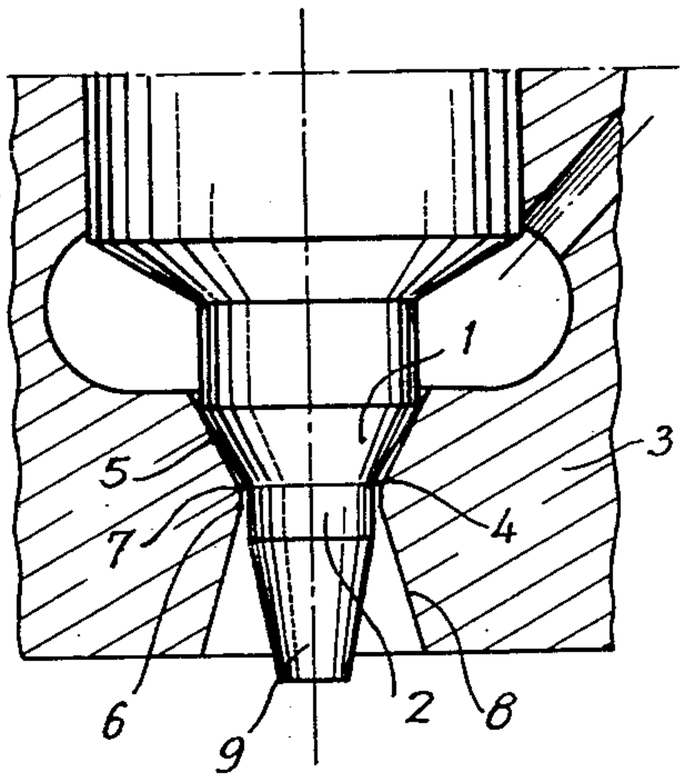


Fig. 3

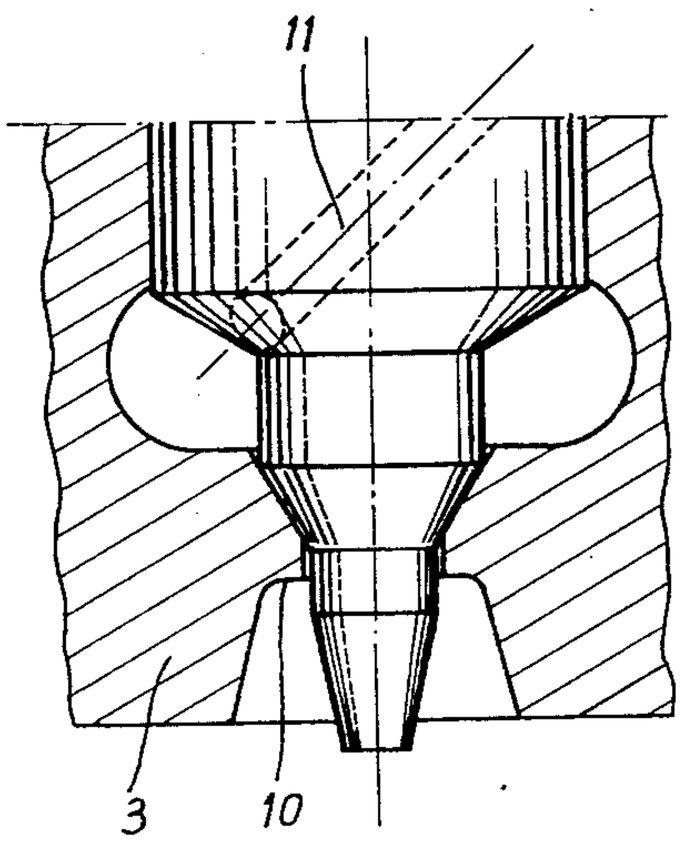
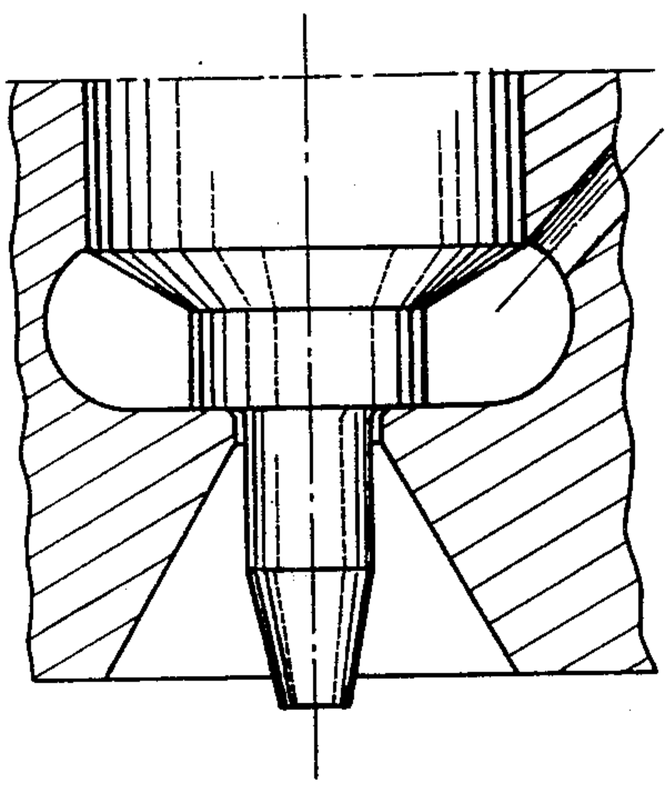


Fig. 4



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3,035,780

Patented May 22, 1962

3,035,780

FUEL INJECTION NOZZLES FOR INTERNAL COMBUSTION ENGINES

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Filed May 8, 1961, Ser. No. 108,487
Claims priority, application France May 20, 1960
7 Claims. (Cl. 239—453)

The present invention relates to automatic fuel injection nozzles designed for internal combustion engines and notably nozzles of the teat type wherein the valve opens in a direction opposite to the direction of the fuel flow.

In conventional injection nozzles of this type the valve seal and the valve seat are provided by surfaces separate from those where the fuel is actually atomized.

In these conventional nozzles, of which FIG. 1 of the attached drawing illustrates a typical embodiment, the valve seat engagement as well as the fluid-tightness are ensured at the nozzle end by a tapered portion **1** separate from the nozzle teat **2** co-acting with the nozzle body **3** to atomize the fuel.

The arrangement of this nozzle is such that when the needle-valve forming body is lifted, the fuel flows past its seat at the expense of a pressure drop subtracted from that producing the fuel atomization through the clearance between the teat **2** and the nozzle body **3**.

As a result, only one fraction of the total overpressure created by the pump actually produces the atomization and it is well known that the latter increases with the pressure by which it is caused.

Thus, the aforesaid separation of division of the sealing and atomizing functions in the injection nozzle is detrimental to the quality of the fuel jet produced.

Moreover, it may be pointed out that this weakness characterizing the beginning of the fuel-injection process is responsible notably for the increase in the ignition time of which it is admitted that the value decreases as the atomization improves.

In order to avoid the drawback set forth hereinabove, it is the object of this invention to provide an arrangement of the injection valve wherein the same component elements perform simultaneously the functions of distribution, fluid-tightness and atomization.

The invention will now be described with reference to the attached drawing illustrating diagrammatically by way of example a few typical forms of embodiment of the invention. In the drawing:

FIGURE 1 is an axial section showing the operative end portion of an injection nozzle according to a known arrangement;

FIGURE 2 is an axial section showing an injection nozzle constructed according to the teachings of the invention;

FIGURE 3 is an axial section showing another possible embodiment of a nozzle designed according to this invention, which incorporates oblique feed passages, and

FIGURE 4 is an axial section showing a teat injection nozzle with a flat sealing surface according to this invention.

Referring to the drawing, FIGURE 2 illustrates a typical embodiment of the needle-valve and nozzle end portions of an injection nozzle constructed according to the teachings of this invention.

The needle-valve section of the nozzle differs from the conventional needle valve illustrated in FIG. 1 in that its tapered seat **1** is connected directly to the teat-forming portion **2** by means of a small fillet **4**.

The nozzle body **3** is formed with a tapered female seat **5** also connected through a fillet **7** of greater radius than fillet **4** to a short cylindrical portion **6**.

The needle valve section shown in its closed portion in

FIG. 2 bears with its tapered portion **1** on the tapered seat **5** of the nozzle body and the teat **2** through its clearance with the cylindrical portion **6** determines the fuel outlet passage available at the beginning of the injection.

As in a conventional teat injection nozzle, the cross-sectional area available for the fuel flow begins to increase as the needle valve is lifted when the tip of the cylindrical teat registers with the upper end of the cylindrical portion **6**.

The usually rather small diameter of the teat might lead to a nozzle end particularly fragile across the cylindrical portion **6**. In order to impart a sufficient rigidity to this member, it may be useful to form after this cylindrical portion **6** a tapered cavity **8** externally of the nozzle, the angle of this cavity being opposite to that of the seat portion **5** and greater than that of the cone-shaped fuel jet issuing from the nozzle.

However, the same tapered cavity may be connected to the cylindrical portion **6** by means of a small annulus **10** (FIG. 3) extending for example in a plane at right angles to the axis of the injection nozzle in order to improve its conditions of operation.

The tip **9** of the teat may have different configurations as in conventional injection nozzles.

The fuel injection nozzle operates as follows: when the needle-valve is lifted according to the conventional operation of automatic injection nozzles, the slit created by the lifting movement beneath the tapered portion **1** and then the clearance provided between the teat **2** and the cylindrical portion **6** will form a cylindro-conical nozzle passage of a cross-sectional area varying without discontinuity, through which the fuel is atomized.

Of course, the proportions of this nozzle, as in any other injector type, must be determined through methodical tests in order to provide the optimum atomization consistent with the other injection requirements such as calibration, output, etc.

When the lift has overstepped the "overlap" point, that is, when the cross-sectional flow area is adjusted through the clearance between the tip **9** of teat **2** and the upper end or meridian of the cylindrical portion **6**, the operation becomes comparable with that of a conventional teat injection nozzle, except that the hydraulic resistances interposed on the fluid path are reduced as the successive sections through which the fuel flows are more regularly evolutive.

On the other hand, as cylindro-conical nozzles are particularly sensitive to the centrifugal action exerted on the fuel, the latter may be fed to the chamber provided upstream of the needle-valve sealing face through oblique ducts of passages **11** (see FIG. 3).

Finally, in order to reduce the considerable throttling time across the tapered seat of the needle valve, the latter may be lightened in weight as well as the movable assembly of the complete injection nozzle (by drilling, reducing certain diameters, etc.).

Of course, a similar principle is also applicable to teat injection nozzles having a flat seat-forming face (FIG. 4) and to atomizer in general operating like teat injection nozzles.

I claim:

1. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion.

2. Automatic teat injection nozzle comprising a needle

valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion, the clearance between said teat portion and said cylindrical portion determining said cross-sectional area available for the flow of fuel during the initial part of the injection and forming with the slit left by the upward movement of the needle valve a variable cylindro-conical nozzle.

3. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion, said cylindrical portion of the nozzle body having an outward extension in the form of a tapered cavity of greater angular value than that of the fuel jet delivered therethrough.

4. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion, said cylindrical portion of the nozzle body having an outward extension in the form of a tapered cavity of greater angular value than that of the fuel jet delivered therethrough, said tapered cavity being preceded by a small shoulder.

5. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a

nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of a greater radius than said small fillet to a relatively very short cylindrical portion, said cylindrical portion of the nozzle body having an outward extension in the form of a tapered cavity of greater angular value than that of the fuel jet delivered therethrough, said tapered cavity being preceded by a small shoulder, formed by a cone of considerably greater angular value.

6. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a tapered bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a tapered seat coacting with the tapered bearing portion of the valve, said tapered seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion, said cylindrical portion of the nozzle body having an outward extension in the form of a tapered cavity of greater angular value than that of the fuel jet delivered therethrough, said tapered cavity being preceded by a small shoulder formed by a flat transverse portion.

7. Automatic teat injection nozzle comprising a needle valve adapted to be unseated in a direction opposite to that of the fuel output, said needle valve having a flat bearing portion and a teat portion, a small fillet directly connecting the bearing portion to the teat portion, a nozzle body for the valve formed with a flat seat coacting with the flat bearing portion of the valve, said flat seat of the nozzle body being connected through a fillet of greater radius than said small fillet to a relatively very short cylindrical portion.

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