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INJECTION NOZZLE FOR INTERNAL COMBUSTION ENGINES

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Fig. 1.

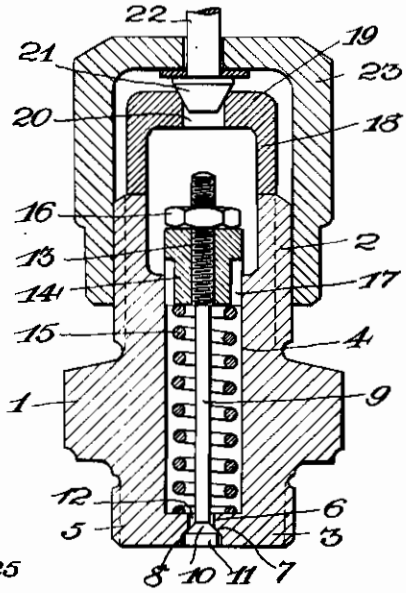


Fig. 2.

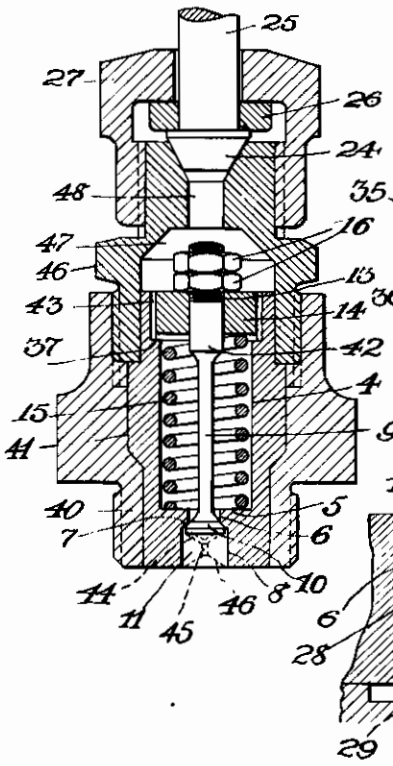


Fig. 4.

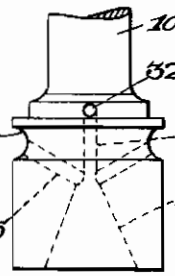


Fig. 5.

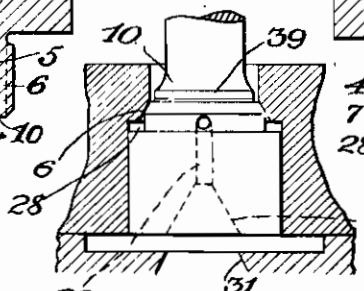
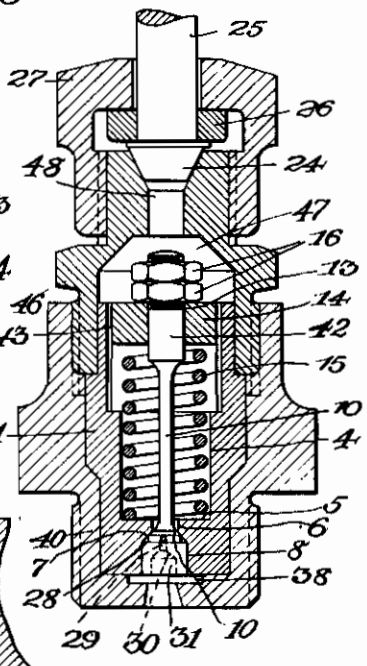


Fig. 3.



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INJECTION NOZZLE FOR INTERNAL COMBUSTION ENGINES

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The invention relates to closed fuel-injection nozzles.

An important object of the invention resides essentially in that a cylindrical body serving as a guide is connected to the lower end of the nozzle valve or needle directly at the valve seating, this body being separated from the nozzle wall by a fine cylindrical gap only, and that a second guide is provided at the opposite, upper, end of the valve or needle. By the design of the nozzle valve or needle mounting in accordance with the invention, fluttering of the nozzle valve or needle is reliably avoided in all engines especially fast-running engines.

According to a further object of the invention the upper guiding body of the valve or needle serves at the same time as an abutment for the valve spring. Preferably the guiding body for the valve stem or the spring abutment is adjustable.

According to a still further object of the invention, a short annular gap is provided in front of the valve seating. In this fashion, the danger, which exists with a long bore above the valve seating, of jamming or burning up or caking of the nozzle needle or valve is avoided.

A still further object of the invention is to provide for the guidance or conducting of the fuel by the arrangement in the cylindrical guide member behind the valve seating, of bores disposed radially or upon a conical surface these bores opening into a collecting passage located, for example, along the axis of the valve or needle. Preferably the number of bores amounts to not less than two and not more than four. An annular gap between the cylindrical guide member and the nozzle bore is not necessary, since the fuel is supplied through the passages only. The injection nozzles in accordance with the invention belong to the class which do not require a special discharge of leakage oil.

Several embodiments of the inventive idea are illustrated by way of example in the accompanying drawings in which:

Figure 1 shows in longitudinal section a nozzle through which the fuel passes between the cylindrical guide part of the valve or needle and the nozzle bore,

Figures 2 and 3 are similar views, and Figure 4 is a detached view of a valve, illustrative of nozzles with passages for the fuel in the cylindrical part of the valve or needle, and

Figure 5 illustrates a modification comprising a throttling collar above the valve seating.

In the constructional example according to Figure 1, the body of the injection nozzle consists of an intermediate nut member 1 with upper and lower spigots 2, 3 provided externally with threads. The nozzle body has a wide bore 4 and is furnished at the bottom with a base 5 surrounding the valve passage. This valve passage consists of a short bore part 6 which widens downwardly to form a conical valve seating 7 which finally runs into a cylindrical bore part 8. Resting against the valve seating 7 is a valve body 10 which is arranged at the lower end of the stem 9 of the valve or needle and which, in the region of the bore 8, likewise runs into a cylindrical form 11, there being a fine cylindrical gap at this point. Between the stem 9 and the wall of the valve passage 6 is a large annular gap 12 of such nature that, firstly, the fuel can flow in large quantities to the valve seating 7 and, secondly, settlement of resinified oil at this point or jamming of the stem or needle 9 when the nozzle is screwed in is prevented. The upper end of the valve stem is provided with a threaded part 13. Screwed upon the latter, are an abutment member 14 for a valve spring 15 and a lock nut 16. The valve spring 15 is located in the bore 4, likewise with such clearance that its coils nowhere touch the cylindrical wall of the bore 4. Its upper end bears against the abutment 14 on the valve stem and its lower end bears against the base 5. The spring abutment 14 slides in the bore 4 and serves at the same time as a guide for the valve stem 9. Furthermore, the abutment member 14 at the same time assists or relieves the guiding action of the valve body 11 and provides for a uniform width of gap at this point. Furthermore, the guide member 14 has longitudinal bores or recesses 17 which connect the spring chamber 4 with the space above such guide member. A cap or bushing 18, which extends the bore 4 and whose top or cover part 19 has a coned central hole 20, is mounted upon the threaded spigot 2 of the injection-nozzle body. The central hole 20 receives the terminal cone 21 of the fuel supply duct or passage 22, this cone being pressed tightly against the cover 19 by a cap 23 screwed upon the threaded spigot 2. In this manner, the intermediate bushing 18, 19, which by itself is loosely mounted, is at the same time held firmly upon the threaded spigot 2.

In the form of construction according to Figure 2, there is mounted in an outer nozzle body 40 an inner nozzle body 41 with the bore 4 which is closed at the bottom by the base 5 in which the valve passage is located. This passage con-

sists of a short cylindrical bore part 6, the valve seating 7 and a cylindrical bore part 8.

Guided in the said bore part 8 is the cylindrical guide member 11 of the valve or needle which is followed by the conical valve seating surface 10 and the stem 9 of the valve. The upper part of the valve or needle stem forms the guide 42 which is mounted in the guide member 14. The valve spring 15 which bears at the bottom against the base 5 and above at the top bears against the guide member 14 is stressed by means of the nuts 18 screwed upon the threaded part 13 of the valve or needle stem. Recesses 43 or longitudinal bores for the passage of the fuel are cut in the guideway for the member 14. The longitudinal recesses or bores may also be cut in the guide member 14, in which case the bore 4 may then be made smooth with a constant diameter. By the form of construction illustrated in Figure 2, the lower closure edge 37 of the guideway serves in simple fashion as abutment for the guide member 14 and consequently as a means for limiting the stroke of the nozzle needle. The stroke of the nozzle needle is indicated at 50.

In accordance with the same form of construction, passages 44 located upon an imaginary conical surface are bored in the cylindrical guide 11 of the nozzle valve or needle from the end nearer the valve seating. These passages run, for example at the axis of the nozzle, into a passage 45 which opens into a conical recess 46.

The inner nozzle body 41 is forced into the outer body 40 by the screw device 48 which encloses a hollow space 47 for the fuel and has a central bore 48 lying in the axis of the nozzle. Connected to the central bore 48 is the terminal cone 24 of the fuel-supply duct or passage 25 which is secured by the cap nut 27 with the intermediary of the washer 26.

Figures 3 and 4 illustrate slight modifications in the arrangement of the bores in the cylindrical guide member. In accordance with the form of construction shown in Figure 3, radial passages 28 which run into a passage 29, preferably located along the axis of the valve or needle, are provided directly below the valve seating surface. Preferably four bores are provided offset by 90° from each other. The passage 29 is followed below by a conical recess 30 which then runs into a cylindrical recess 31. The latter is extended by the conical recess 49 in the outer nozzle body 40. A disc-shaped recess 38 in the outer nozzle body permits of the opening of the nozzle valve or needle whose stroke is determined by the depth of the recess 39. The stroke of the nozzle valve or needle is indicated at 51.

In the form of construction according to Figure 4, radial passages 32 which run into a conical recess 34, advantageously through a central passage 33, are likewise provided below the valve surface. The annular gap or groove 35, provided in the vicinity of the upper edge of the cylindrical guide, serves with the obliquely downwardly directed passages 38 for relief. The space 35 and the passages 36 also have for object to enable the part of the fuel which squeezes through at the upper edge of the cylindrical end of the needle under the action of the injection pressure to be conducted to the main jet.

In the form of construction according to Figure 5, a throttling collar or flange 38, which allows only a slight fraction of the fuel to pass in the first part of the stroke of the nozzle valve or needle, is provided above the conical seating. Due to this measure, only a small fraction of the fuel is ejected into the combustion space during the period of the ignition delay (say 10° of crank angle), so that smooth running of the engines is attained.

The manner of operation of the nozzle in accordance with Figure 1 is as follows:

The liquid fuel flows through the duct or passage 22 and through the recesses 17 into the space 4 in front of the valve 10, 11, and the latter opens under the liquid pressure in accordance with the impulses of the injection pump. The fuel is thus firstly spread conically by the valve seating surface 10, is immediately thereafter brought together again, in the annular gap at 8, to form a hollow cylindrical jet and is atomised in extremely fine fashion during passage through this gap. The upper guide ensures a uniform width of gap and provides for the valve stem remaining precisely located even in the case of one-sided pressure action of the liquid flowing through the valve passage at 8, 8, and thus for the radial width of the passage gap at 8, 8 remaining precisely the same. In this fashion, a uniform injection formation or picture of the fuel jet issuing from the nozzle is also ensured. At the same time, due to the wide outflow opening 12 directly in front of the valve 10, the fuel liquid can arrive unobstructed, in large quantities, free from bubbles and uniformly distributed. Furthermore, the comparatively wide outlet opening prevents the valve stem from sticking or jamming at this point, and avoids caking of resinified oil particles or jamming of the stem due to stresses arising upon the screwing of the nozzle into the thread. The invention is naturally also applicable to mechanically controlled valves.

In the forms of construction in accordance with Figures 2 to 5, the fuel flowing in from above is finely divided in passing through the valve seating and the radially or conically disposed passages, is brought together shortly in the central collection passage and is then atomised into the combustion space as a conical or cylindrical veil.

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