April 10, 1945. M. J. SMITH 2,373,353

NOZZLE

Filed Sept. 16, 1941

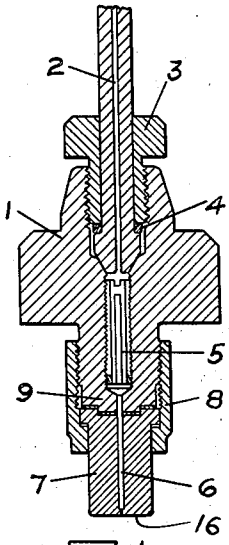


Fig. 1

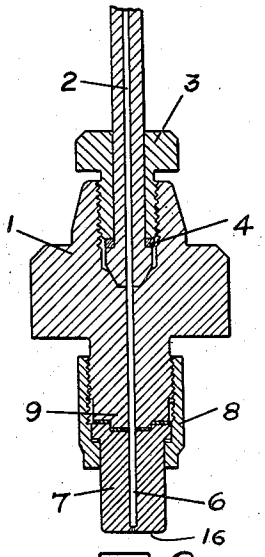


Fig. 2

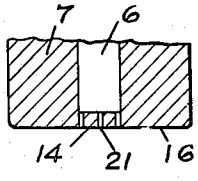


Fig. 3

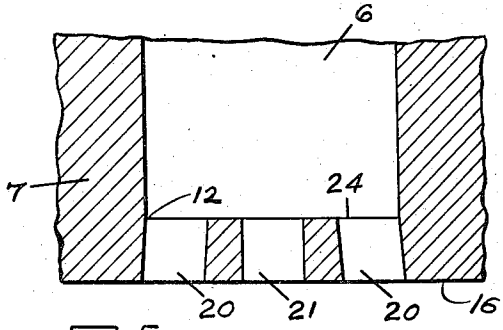


Fig. 5

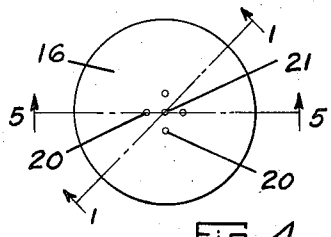


Fig. 4

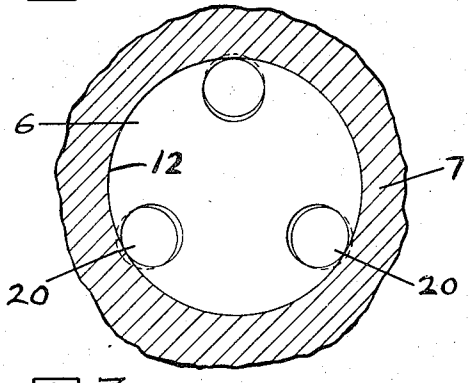


Fig. 7

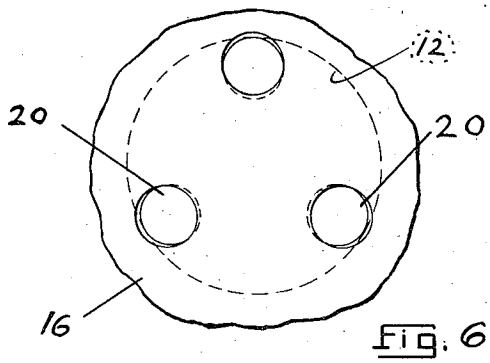


Fig. 6

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2,373,353

NOZZLE

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Application September 16, 1941, Serial No. 411,059

3 Claims. (Cl. 299—107.1)

This invention relates to nozzles for injecting charges of liquid fuel into internal combustion engines. It has been successfully used on Diesel engines but is also capable of use with gasoline. Reference in the specification to Diesel practice are intended to be illustrative, not limiting.

The purposes of the invention include the provision of an injection nozzle which will atomize or finely divide the fuel in the most advantageous manner for the purpose intended, by its construction will not accumulate heat, and will be cooled by the incoming fuel charge. By keeping the face of the nozzle relatively cool the accumulation of carbon thereon is prevented. While described and illustrated in certain specific embodiments it will be understood that these embodiments are of a preferred form but are not limitations upon the invention.

This nozzle is particularly adapted for use with the injection system of my Patent 2,183,875, issued Dec. 19, 1939, although that system can be used with other nozzles and this nozzle can be used with other systems.

In the accompanying drawing which illustrates the preferred form,

Fig. 1 is a longitudinal central section through my injection nozzle on the plane 1—1 of Fig. 4 showing the supply tubing and other features;

Fig. 2 a longitudinal central section through a modified nozzle;

Fig. 3 is a longitudinal central section on an enlarged scale, showing the end portion only of a modified nozzle tip;

Fig. 4 is a face view of the nozzle tip shown in Fig. 3;

Fig. 5 is a greatly enlarged longitudinal central sectional detail on the plane 5—5 of Fig. 4;

Fig. 6 is a greatly enlarged partial face view corresponding to the central portion of Fig. 4 but showing a modified form and including details not included in Fig. 4;

Fig. 7 is a view looking downward in Fig. 5, but showing the same modification as in Fig. 5.

In Figs. 1 and 2 my fuel injection nozzle is shown, comprising a body 1, to which a fuel supply tube 2 is connected by suitable means such as a compression gland 3 bearing down upon a washer 4. My nozzle preferably may include a fuel filter 5, which, like the passages into and out of the nozzle, holds only a very small quantity of liquid. After leaving the filter 5, (if a filter is used) the fuel travels by a passage 6 through the nozzle tip 7, and leaves the passage 6 by some such atomizing arrangement as is shown in the enlarged views. Preferably the nozzle tip 7 is a separable piece held to the main body of the nozzle by any suitable means such as the thimble 8 and appropriately gasketed as at 9. The passage 6 is of small size, for example capillary size as in the apparatus of my Patent 2,183,875. The passage through the tube 2 may also be of capillary size, as in that patent. The inner or discharge face 16 of the nozzle tip is flat or substantially so, free from dome formations, points, edges, high or rough spots, or the like which concentrate heat and form hot spots.

A perforated wall 14 obstructs the outlet of passage 6. The diameter of the individual perforations through the wall 14 is substantially equal to the thickness of that wall, and distinctly less than the diameter of the passage 6 all as somewhat diagrammatically illustrated in Fig. 5. For example, if the central passage 6 of the nozzle is on the order of .03'' diameter, the orifice or orifices through wall 14 will be on the order of .01'' both in diameter and length. Practicable ranges for the orifices are on the order of from six thousandths to twelve thousandths (.006 to .012) inch. Preferred arrangements of orifices include a plurality of such orifices 20 arranged about the internal circumference 12 of the bottom of the passage 6, connecting therewith preferably without any break so that the inner ends such as 24 will be internally tangent to the circumferential wall of the passage 6, as shown in dotted lines in Fig. 6 solid lines in Fig. 7, and in longitudinal section in Fig. 5. The number of such orifices 20 will vary according to cylinder size and intended piston speed, nature of the liquid fuel used, such as Diesel engine oil or gasoline, and other circumstances. Other orifices, particularly a central orifice as indicated at 21, may also be used, which central orifice will preferably be aligned with the axis of the passage 6, as is apparent from Figs. 3 and 5.

Ordinarily the outside orifices 20 will be inclined at an angle of preferably from 4° to 10° outward from the geometrical axial line of the passage 6, to spread the spray. However, as shown in Fig. 3, they may be parallel to the axis of the central passage.

Some satisfactory orifice dispositions and dimensions are here tabulated:

No. of orifices	Diameter	Disposition	Inclination of circumferential orifices
	Inches		
3	.012	Circumferential	Straight.
4	.012	3 circumferential, 1 central	5°.
5	.012	4 circumferential, 1 central	8°.
5	.008	4 circumferential, 1 central	8°.
5	.006	4 circumferential, 1 central	8°.
7	.010	6 circumferential, 1 central	10°.

Obviously when the tip 7 is made removable tips with different orifice arrangements may be substituted one for another.

In operation the small passages of my improved nozzle prevent preheating of the liquid fuel charge to be injected (which is a cause of

carbon deposit on nozzle tips and in cylinders), and the discharge orifice features cause advantageous injection and complete vaporization of the charge.

Reference has been made to the small quantity of liquid which the nozzle will hold. This amount is less than the quantity of liquid fuel used in the cylinder at each charge when the engine is working under load. It may occur that when the engine is idling less fuel is required for a charge than the capacity of the nozzle, but in such a situation the heat is much less than when the engine carries a load. The nozzle and supply tube parts are so proportioned that a single charge of oil for a Diesel engine running at normal load empties about 6 inches of the supply tube, while the amount of oil necessary to fill the passage 6 and filter 5 is equal to only about 3 or 4 inches of the tube 2. Accordingly when enough work is being done to make heat a problem the liquid in the nozzle is always a fresh supply, coming in cool, there is no liquid retained in the nozzle which has been subjected to the heat of the previous power stroke, and each charge passing through the nozzle into the cylinder with an engine running at normal load includes more than the entire liquid content necessary to fill the nozzle after the previous power stroke.

It will be appreciated that while I have shown and described in detail certain forms of the invention, with specific modifications, other changes may be made in the embodiments here shown, all within the scope and principles of my invention.

I claim:

1. An injection nozzle comprising in combination a capillary passage, a wall at the discharge end thereof, said wall having a plurality of orifices therethrough symmetrically disposed and outwardly inclined with respect to the axis of said passage, the outer face of said outer wall being substantially flat, the circumferences of the entrances of said orifices being respectively internally tangent to the circumference of said main passage.

2. An injection nozzle comprising in combination a passage on the order of .03 inch diameter, a wall in the discharge end thereof, and a plurality of discharge orifices through said wall on the order of from .006 to .012 inch diameter, the thickness of said wall being not substantially greater than the diameter of said orifices, the discharge face of said nozzle being substantially flat.

3. An injection nozzle comprising in combination a passage on the order of .03 inch diameter, a wall in the discharge end thereof, and at least one discharge orifice through said wall on the order of not more than half the diameter of said passage, the thickness of said wall being not substantially greater than the diameter of said orifices, the discharge face of said nozzle being substantially flat.

MERTON J. SMITH.