United States Patent

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[54] **MULTIORIFICE-TYPE AIRLESS INJECTION NOZZLE**
3 Claims, 3 Drawing Figs.

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[50] **Field of Search** 239/533

[56] **References Cited**

UNITED STATES PATENTS

2,126,623	8/1938	Dow	239/533 X
2,148,192	2/1939	Dow	239/533 X

FOREIGN PATENTS

580,033	6/1933	Germany	239/533

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ABSTRACT: This specification discloses an improved airless fuel injection nozzle which injects a controlled amount of finely particularized fuel into predetermined zones of a combustion chamber prior to ignition and thereafter provides a steadily increasing flow of fuel for controlled combustion during the remainder of a combustion cycle. Means are provided for particularizing the fuel prior to ignition by dividing a fuel supply flow into two separate flows and then recombining these flows by a collision process to effect particularization. Means are also provided for cyclically terminating this particularization process and for providing a relatively greater fuel flow during the remainder of a combustion cycle.

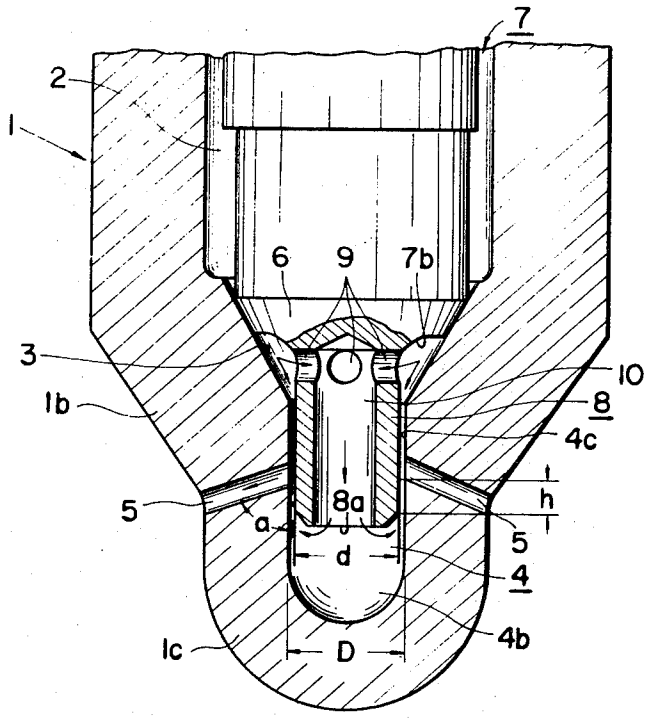


Fig. 1
Prior Art

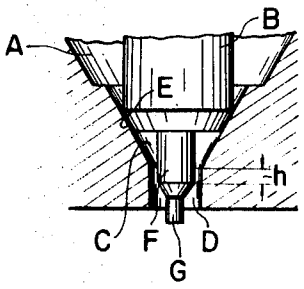


Fig. 3

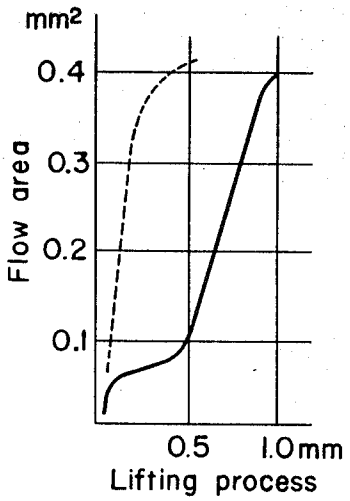
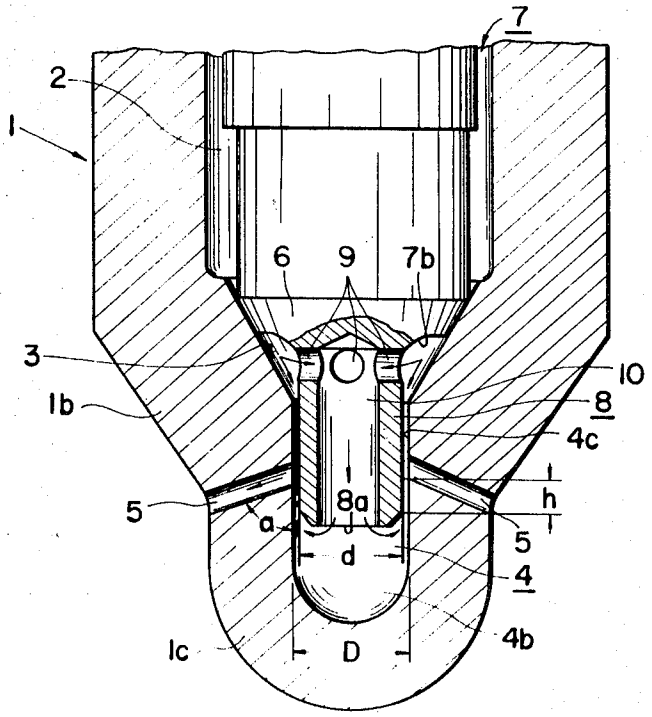


Fig. 2



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MULTIORIFICE-TYPE AIRLESS INJECTION NOZZLE

The present invention relates to an improvement in an airless injection nozzle for a diesel engine, and in particular to an airless injection nozzle of such a type as to have a plurality of radial injection holes.

In a conventional diesel engine, when fuel is injected, a predetermined ratio of fuel is uniformly injected for the whole injection time, the ignition delay time is long, and once a part of the fuel is once ignited, all the fuel is combusted momentarily, and the combustion chamber experiences an abrupt pressure increase, and a so-called "detonation" is brought about.

Therefore, in a diesel engine, a little amount of fuel having been made into fine particles at the primary stage of injection is jetted out, and then, subsequently a large amount of fuel is continuously jetted out, and it is preferable that the preinjected fuel whose amount is adjusted is ignited, and at the same time that the later larger amounts of injected fuel are slowly combusted to increase the pressure progressively in the combustion chamber.

FIG. 1 is a cross-sectional view of a conventional throttle pin nozzle;

FIG. 2 is the enlarged cross-sectional view of a multiorifice airless injection nozzle in accordance with the present invention, and

FIG. 3 is a diagram showing the flow-area-lifting process.

Thus, for the conventional injection nozzle, the throttle pin nozzle is as shown in FIG. 1.

Namely, the peripheral surface of the end portion of the hole A' is cut in the form of a saucer, and the seat surface C of the needle B is formed by the saucer-formed portion, and at the end of said saucer-formed portion, the hole D of a small diameter is formed.

At the end of the needle having the staged surface E capable of connecting to the seat surface of the adjusting pin F whose outer diameter is made smaller than the diameter of said hole D is provided, and the end of the adjusting pin F is provided with the guide pin G whose diameter is smaller than the adjusting pin F.

Thus, the injected fuel is throttled in the annular space between the adjusting pin F and the hole D at the beginning of the lifting process, and the flow rate is restricted, and at the same time the flow speed is increased to have the fuel made into fine particles.

Therefore, the fuel injected during the lifting process has a large flow speed, and at the same time the oil particles thereof are very fine. Therefore the fuel can be directly ignited immediately after the injection of fuel.

However, the nozzle of the above-mentioned structure is of single-hole type, and therefore it is difficult to inject the fuel towards a predetermined region of the combustion chamber.

Thus, it is preferable to apply the nozzle structure of such type to the multiorifice-type injection nozzle having a plurality of holes in the radial direction, but when such a structure is employed, the particularization in the fuel once throttled is not accomplished since the flow speed is lowered during the time required by the fuel to arrive at each hole.

As a result, in multiorifice injection nozzles, no effective structure for adjusting the amount of fuel has been attained.

The object of the present invention is to obtain a multiorifice airless injection nozzle capable of injecting adjusted minimum fuel without impairing the fine particularization of fuel at the primary stage of fuel injection.

In accordance with the present invention, the above mentioned object can be attained by the multiorifice injection nozzle prepared in such a manner that the guide hole, one end of which is closed, is provided on the head portion of the nozzle, and a plurality of injection holes in the radial direction are connected to the guide hole, wherein the fuel-amount-adjusting pin whose outer diameter is smaller than the diameter of the guide hole, capable of being present in said guide hole is provided on the downstream of the nozzle surface of the needle having the nozzle surface capable of being connected to the seat surface formed in the upper stream of said guide hole, and punched holes in the radial direction are provided on the base of said fuel-amount-adjusting pin, and the hole connecting said punched holes and the end surface of said fuel-amount-adjusting pin is provided in said fuel-amount-adjusting pin to connect the upper stream of the guide hole and the bottom portion.

The following are the explanations about an embodiment of the present invention in accordance with the attached diagrams.

FIG. 2 is the cross-sectional view of the multiorifice airless fuel injection nozzle, and the lower portion of the nozzle **1** is tapered by means of the aslant portion **1***b*, and the lower portion of the aslant portion **1***b* is sealed with the half-spherical head **1***c*.

The seat surface **3** is formed by the aslant portion **1***b* at the lower portion of the guide hole **2** within the nozzle **1** to be connected to the fuel injection pump (not shown), and the guide hole **4** in the axial direction whose bottom **4***b* is sealed, is provided in the head portion **1***c* in the downstream of said seat surface **3**, and a plurality of holes **5** in the radial direction are provided on the peripheral surface **4***c* of the guide hole **4** in the middle thereof in the axial direction through the head portion **1***c*.

The angle *a* of the holes **5** is determined appropriately in accordance with the form of the combustion chamber or other conditions, and it cannot be restricted to the angle shown in the diagram.

On the other hand, the needle **7** having the nozzle surface **6** at the end portion to be connected to the seat surface **3**, is inserted into the nozzle **1** and the needle **7** can be raised by an appropriate timing cam (not shown), and the fuel-amount-adjusting pin **8** whose outer diameter *d* is smaller than the diameter D of the guide hole **4**, is provided on the downstream end surface **7***b* of the nozzle surface **6** of the needle **7**.

The fuel-amount-adjusting pin **8** adjusts the amount of the fuel to be injected at the distance of lifting process *h*, and at the base portion thereof the punched hole **9** passing in the radial direction is provided.

The fuel-amount-adjusting pin **8** is provided with the connecting hole **10** from the end surface **8***a* faced against the bottom portion **4***b* of said guide hole **4**, and the connecting hole **10** is connected to the punched hole **9**.

The fuel-injecting nozzle of the present invention has such a structure as mentioned above, and therefore when the needle **7** is raised by an appropriate timing mechanism at the termination of the pressing process of an engine, a fuel flow connection is formed between the nozzle surface **6** and the seat surface **3**, and the fuel in the inlet passes between these surfaces and arrives around the base portion of the fuel-amount-adjusting pin.

Thus, the high pressurized fuel is partly mixed into the ring-formed interval formed between the guide hole **4** and the fuel-amount-adjusting pin **8** directly, and partly branched into the punched hole **9**.

Therefore, the fuel flowing into said interval increases the flow speed in said interval, and arrives at the inlet of the nozzle holes **5**.

On the other hand, the fuel passing through the punched hole **9** is reversed at the bottom **4***b* of the guide hole **4** through the connecting hole **10**, and it is flown into the interval formed at the lower portion of the inlet portion of said holes **5** to increase the flow speed.

Thus, at the inlet of said holes **5**, the fuel streams of high speeds hit each other from respectively opposite directions, and the fuel can be effectively particularized finely through said hitting phenomenon and the fuel is injected through the holes **5** in the form of fog.

The above-given phenomena last for the lifting process *h*, and when the needle **7** is elevated over the lifting process *h* the fuel from the inlet **2** is jetted into the holes **5** which opens at the guide hole **4**, and is jetted from said holes **5**.

FIG. 3 is a diagram showing the comparison of the characteristics of the injection nozzle of the present invention and

the characteristics of the conventional multiporous-type injection nozzle having no fuel-amount-adjusting efficiency.

As is apparent from the above given explanation, in accordance with the present invention, injected fuel can be effectively throttled in the primary stage of injection, and at the same time it can be effectively particularized finely by the hitting phenomenon at the inlet of the holes.

Therefore, the fuel whose amount is adjusted at the primary stage of the injection is little and finely particularized, and ignition can be attained right after the injection of fuel.

Therefore, "detonation" can be avoided, and the following injected fuel can be continuously and slowly subjected to combustion, and therefore the specific output of the engine and specific fuel cost can be improved, and it is possible to obtain smooth and flexible engine drive.

What is claimed is:

1. A fuel injection nozzle including:

means to divide a fuel flow into first and second streams of fuel, said means comprising an inner fuel-adjusting pin structure and an outer concentric guide structure with an included annular space between said structures for containing said first and second fuel streams wherein said inner structure is hollow and at least partially open at both ends to allow fuel passage at both ends to said included annular space thus providing said first and second fuel streams and where said outer structure is closed at one end and adapted to receive said undivided fuel flow at the opposite end;

means recombine said first and second streams of fuel from substantially opposed directions of flow, whereby said first and second streams will recombine by collision one with the other, and

means for routing the recombined stream in predetermined directions of flow to a combustion zone.

2. A device as in claim 1 wherein said means for routing the recombined streams consists of injection holes formed in said outer guide structure.

3. A device as in claim 2 including means for axially moving said inner fuel-adjusting pin structure away from the closed end of said outer guide structure and means for simultaneously increasing the available fuel flow.