Topics

Variable Orifice Nozzles for Diesel Engines

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To protect the earth's environment, reduction of NOx and particulates emitted from diesel engines is urgently required. An effective way of doing this is to apply higher injection pressure, adopt smaller orifice nozzles, delay the injection timing, etc. Reducing the orifice diameter of the conventional fuel injection nozzles makes it impossible to retain necessary fuel injection amount under a high load even if it provides favorable combustion and emission characteristics under low load. To improve this, it is imperative to vary the number (area) of orifices according to the load by developing a variable orifice nozzle. Realization of such nozzles is expected.

Fig. 1 shows a structure of the newly developed nozzle with variable orifice and a conceptual diagram of the relationship between the engine load and needle position (number of opened holes). Fuel fed to the nozzles passes through the orifice via a T-shaped fuel channel provided on the inside of the nozzle end and the sac section. A row of orifices is formed by arranging three circular orifice holes of small diameter (0.14mm dia.) in close proximity. The number of opened holes is controlled by the orifice opening control edge located at the tip of the needle. When the engine load is low, fuel is injected from the orifice at the end by reducing the amount of needle lift [Fig. 1(b)].

On the other hand, when under high load, the number of opened holes is increased by increasing the amount of needle lift to maintain the injection rate [Fig. 1(c)]. Also, when the needle is in the sitting posture, the orifice opening control closes all the orifices to prevent fuel deposited in the sac from flowing out of the orifice during no injection [Fig. 1(a)].

Fig. 2 shows a close-up photograph of the vicinity of the orifice. As the number of orifice openings increases, the width of spray roots increases, proving that the number of orifice openings is being switched appropriately. The droplet size of the spray does not depend on the number of orifice openings as shown in **Fig. 3**. From this it is found that this nozzle can maintain maximum injection amount while retaining the favorable atomization characteristics of a small orifice nozzle under high load conditions.

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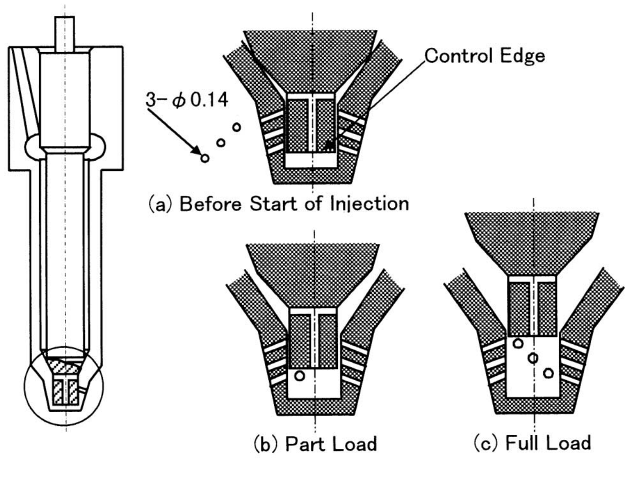

Fig. 1 Relation between position of needle and engine conditions.

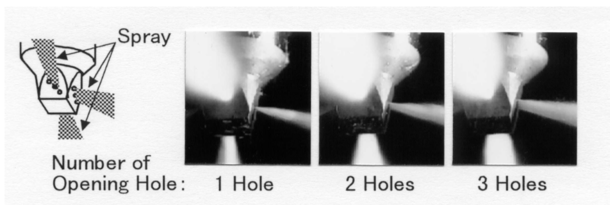

Fig. 2 Change of number of opening hole.

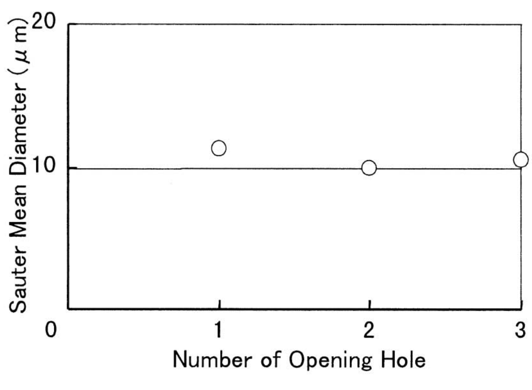

Fig. 3 Effect of number of opening hole on Sauter mean diameter.