

Description

The present invention is directed to a fuel injection nozzle particularly suited for compression-ignition engines and to a novel valve used in conjunction therewith to provide an atomized supply of primary and pilot fuels into the compression-ignition chamber of the engine.

Standard practice in the operation of a compression-ignition engine is to introduce the liquid fuel into the combustion chamber at high pressures near the end of the compression stroke of the piston. This promotes rapid mixing and evaporation of the fuel and leads to autoignition and combustion with the air previously inducted into the chamber. Autoignition refers to the condition wherein the fuel spontaneously ignites under the temperature and pressure conditions existing within the chamber.

Fuels which readily ignite under the conditions within the chamber require only a single nozzle for injection of the fuel into the chamber, as in most standard diesel combustion engines.

Some fuels, however, such as methanol and ethanol do not readily autoignite. Such fuels possess desirable properties such as low exhaust emissions which make them desirable fuels for combustion engines. Thus, efforts have been made to promote ignition of these fuels.

It is known that ignition can be promoted with an injection of a small amount of a readily ignitable fuel such as diesel fuel. Typically, these so called "pilot fuels" are injected into the combustion chamber in advance of the primary fuel injection. Under the conditions of the combustion chamber, the pilot fuel ignites which causes ignition and combustion of the primary fuel.

It is also known to inject a single fuel of uniform composition but poor ignition quality into an engine using double injection for each combustion event. Such staged or "staggered" injection systems also employ an injection of pilot fuel in advance of the main injection, allowing the injected pilot fuel to undergo physical and chemical conditioning and to ignite. This aids the ignition and combustion of the main fuel charge having the identical chemical composition. This system is particularly suited for fuels having poor ignition quality.

In order to introduce both the primary and pilot fuels to the combustion chamber, it is known to use two separate and independent fuel injection systems. Each system is provided with its own means of pressurizing the fuel and injecting the fuel into the combustion chamber as an atomized spray. Specifically, one of the fuel injection systems will have a nozzle particularly suited for injecting the primary fuel and the other the pilot fuel.

One of the disadvantages of a two nozzle system is that under typical operating conditions it is prefer-

red to introduce the fuel at or near the physical center of the combustion chamber. The center of the combustion chamber is usually occupied by the primary fuel nozzle so that the pilot fuel nozzle must be placed in a less desirable location at the periphery of the chamber.

It is desirable to be able to convert an engine from one which is powered by an autoignitable fuel such as diesel fuel to one which can use a non-autoignitable fuel such as methanol and ethanol in order to avoid the cost of producing two different types of engines.

However, such conversion is rendered difficult and costly when a one-nozzle system is converted to a two-nozzle system since it is often necessary to modify major parts of the engine including the cylinder head.

Exemplary of the prior art adopting the arrangement with two distinct fluid-collecting chambers is DE-A-35 36 021, in which, however, the flow path for the pilot fuel is neither continuous, nor unobstructed.

It would therefore be desirable to provide a fuel injection system which can meter two different fuels to the combustion chamber through the same nozzle, and which can readily be removed and replaced by a system for injecting only a single fuel to the chamber.

It is an object of the present invention to provide a simple and readily installable and removable fuel injection system for injecting both a primary and a pilot fuel from a single nozzle into a combustion chamber, whereby the flow path of the pilot fuel is a continuous and unobstructed pathway.

In order to offset the drawbacks of the prior art devices, the present invention, therefore, provides a fuel injection nozzle comprising a housing having a primary fuel receiving means including an inlet port and a passageway leading to a centrally located cavity of the housing, said passageway having a cross-sectional dimension less than that of said inlet port, a pilot fuel receiving means including a pilot fuel receiving port connected to a pilot fuel line extending into the housing, a valve body contained in said cavity and provided with a circumferential annular groove, an axial bore extending over a portion of the valve body, and a radial bore communicating with said groove and said axial bore, said groove being in continuous communication with said pilot fuel line, said valve body being moveable within said cavity and spring biased to sealingly engage a wall of the cavity to form an annular collection zone which is connected to said passageway for collecting said primary fuel as well as to isolate said annular collection zone from a further collection zone continuously communicating with injection ports, said axial bore being extended by an axial passageway providing a pathway for the flow of said pilot fuel into said collecting zone, said fuel injection nozzle being characterized in that the pathway for the flow of said pilot fuel from the pilot fuel re-

ceiving port into said collecting zone is a continuous unobstructed pathway.

The following drawings in which like reference characters indicate like parts are illustrative of embodiments of the invention.

FIGURE 1 is a side view of the fuel injection nozzle of the present invention showing respective fuel intake means and means for injecting the fuels into a chamber;

FIGURE 2 is a partial cross-sectional view of the nozzle shown in FIGURE 2, and

FIGURE 3 is a cross-sectional view of another embodiment of the invention in which the fuel flowing through the nozzle is sent directly into a collection zone below the seal formed by the valve means and the cavity wall.

The present invention eliminates the need for a separate nozzle system to inject a pilot fuel. Referring to FIGURES 1, and 2, the fuel injection system 20 of the present invention includes a housing 22 having at least one primary fuel receiving means 24 and at least one pilot fuel receiving means 26. The primary fuel receiving means 34 includes an inlet port 28 and a passageway 30 leading to the center of the housing 22. It is preferred that the passageway 30 has a cross-sectional dimension less than that of the inlet port 28 in order to maintain or increase the pressure on the primary fuel flowing therethrough.

The pilot fuel receiving means 26 includes an inlet port 32 adapted to receive the pilot fuel from a pump (not shown) and to transport the pressurized pilot fuel through a fuel line 34 which exits into the housing 22 as explained hereinafter.

In the embodiment shown in Fig. 3, only the primary fuel is sent to the collection zone 62 while the pilot fuel is sent directly from the axial channel 46 into the zone 54. This embodiment provides better separation between the fuels because the pilot fuel is isolated from the primary fuel collection area 62 by the seal 60 which remains intact during collection and evacuation from the zone 54.

More specifically, the pilot fuel is sent, via the groove 64, the radial bore 66 and the axial hole 46, out of the injection ports 56. During collection and evacuation of the pilot fuel from the zone 54, the seal 60 between the valve 68 and the cavity 36 is maintained. The primary fuel is then sent into the collection zone 62 until sufficient pressure is generated upwardly against the valve 68 to disrupt the seal 60. The primary fuel is then injected into the chamber through the injection ports 56, and subsequently the valve body 38 moves into sealing engagement with the wall of the cavity 36, to prevent the residual pilot fuel from mixing with residual primary fuel possibly present in the collection zone 62.

Claims

1. A fuel injection nozzle comprising

- a housing (22) having a primary fuel receiving means (24) including an inlet port (28) and a passageway (30) leading to a centrally located cavity (36) of the housing, said passageway having a cross-sectional dimension less than that of said inlet port (28)
- a pilot fuel receiving means including a pilot fuel receiving port (32) connected to a pilot fuel line (34) extending into the housing (22),
- a valve body (38) contained in said cavity (36) and provided with a circumferential annular groove (64), an axial bore (46) extending over a portion of the valve body (38), and a radial bore (66) communicating with said groove and said axial bore, said groove (64) being in continuous communication with said pilot fuel line (34),
- said valve body (38) being moveable within said cavity (36) and spring biased (72) to sealingly engage a wall of the cavity (36) to form an annular collection zone (62) which is connected to said passageway (30) for collecting said primary fuel as well as to isolate said annular collection zone (62) from a further collection zone (54) continuously communicating with injection ports (56),
- said axial bore (46) being extended by an axial passageway (80) providing a pathway for the flow of said pilot fuel into said collecting zone (54), characterized in that the pathway (34,64,66,46,80) for the flow of said pilot fuel from the pilot fuel receiving port (28) into said collecting zone (54) is a continuous unobstructed pathway.

Patentansprüche

1. Brennstoffeinspritzdüse mit

- einem Gehäuse (22) mit Hauptbrennstoff-Aufnahmemitteln (24) einschließlich einer Einlaßöffnung (28) und eines Durchganges (30), der zu einem zentral angeordneten Hohlraum (36) des Gehäuses führt, wobei der Durchgang eine Querschnittsabmessung hat, die kleiner als jene der Einlaßöffnung (28) ist,
- Zündbrennstoff-Aufnahmemitteln einschließlich einer Zündbrennstoff-Aufnahmeöffnung (32), die mit einer Zündbrennstoffleitung (34) in Verbindung steht, welche sich in das Gehäuse (22) erstreckt,
- einem Ventilkörper (38), der in dem Hohlraum (36) angeordnet und mit einer ringförmigen



- migen Umfangsnut (64), einer Axialbohrung (46), die sich über einen Abschnitt des Ventilkörpers (38) erstreckt, und einer Radialbohrung (66) versehen ist, die mit der Nut und mit der Axialbohrung in Verbindung steht, wobei die Nut (64) in ständiger Verbindung mit der Zündbrennstoffleitung (34) steht,
- wobei der Ventilkörper (38) innerhalb des Hohlraumes (36) bewegbar und federbelastet (72) ist, um an einer Wand des Hohlraumes (36) abdichtend anzugreifen, um eine ringförmige Sammelzone (62) zu bilden, die mit dem Durchgang (30) zum Sammeln des Hauptbrennstoffes in Verbindung steht, und um die ringförmige Sammelzone (62) von einer weiteren Sammelzone (54) zu isolieren, die in ständiger Verbindung mit Einspritzöffnungen (56) steht,
 - wobei die Axialbohrung (46) durch einen Axialdurchgang (80) verlängert ist, der einen Strömungspfad für den Zündbrennstoff in die Sammelzone (54) bildet, dadurch gekennzeichnet, daß der Pfad (34, 64, 66, 46, 80) für die Strömung des Zündbrennstoffes von der Zündbrennstoff-Aufnahmeöffnung (32) in die Sammelzone (54) ein kontinuierlicher unbehinderter Pfad ist.

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Revendications

1. Buse d'injection de combustible, comprenant :

- un corps (22) qui comporte un moyen (24) d'admission du combustible principal incluant un orifice d'entrée (28) et un passage (30) qui conduit à une cavité (36) située au centre du corps, ledit passage ayant une section inférieure à celle dudit orifice d'entrée (28),
- un moyen d'admission du combustible pilote incluant un orifice (32) d'admission du combustible pilote relié à une canalisation (34) de combustible pilote qui s'étend jusque dans le corps (22),
- une aiguille d'injecteur (38) contenue dans ladite cavité (36) et pourvue d'une rainure annulaire (64) sur sa circonférence, d'un alésage axial (46) s'étendant sur une partie de l'aiguille d'injecteur (38), et d'un alésage radial (66) communiquant avec ladite rainure et avec ledit alésage axial, ladite rainure (64) communiquant en continu avec ladite canalisation (34) de combustible pilote,
- ladite aiguille d'injecteur (38) étant mobile à l'intérieur de ladite cavité (36) et poussée par un ressort (72) pour venir en contact étanche avec une paroi de la cavité (36)

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afin de former une région collectrice annulaire (62) qui est reliée audit passage (30) pour recueillir ledit combustible principal ainsi que pour isoler ladite région collectrice annulaire (62) d'une autre région collectrice (54) qui communique en continu avec des orifices d'injection (56),

- ledit alésage axial (46) étant prolongé par un passage axial (80) qui fournit un trajet pour l'écoulement dudit combustible pilote jusqu'à dans ladite région collectrice (54), caractérisé en ce que le trajet (34, 64, 66, 46, 80) pour l'écoulement dudit combustible pilote depuis l'orifice (32) d'admission du combustible pilote jusqu'à dans ladite région collectrice (54) est un trajet continu et non-obstrué.

