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FUEL INJECTION DEVICE

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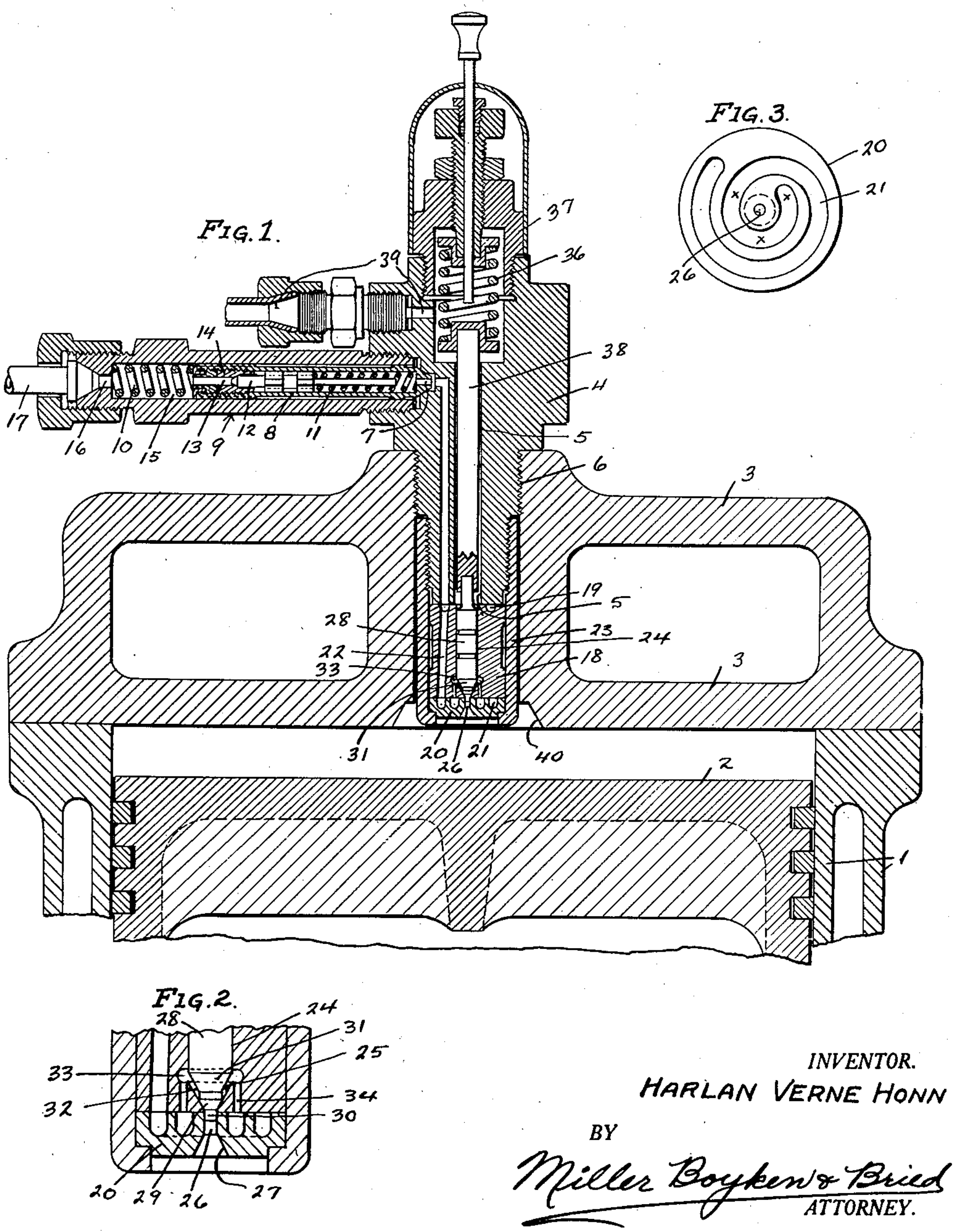

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FUEL INJECTION DEVICE

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9 Claims. (Cl. 299—107.1)

This invention relates to fuel injectors for internal combustion engines, particularly of the Diesel type, and has for its objects the provision of improved means for efficiently preheating fuel charges to substantially the fuel ignition temperature immediately prior to injection of the charges into the power cylinder whereby each charge will ignite as it enters the cylinder, the ignition being progressive at the point of injection. Other objects and advantages will appear in the drawing and description annexed hereto.

In the drawing, Fig. 1 represents a vertical sectional view of my device mounted in the head of a power cylinder, certain portions of the device being in elevation.

Fig. 2 is an enlarged sectional view of my improved fuel injector nozzle.

Fig. 3 is a plan view of one form of a portion of my injector nozzle showing the shape of the passageway formed therein.

In detail, 1 is the upper portion of a power cylinder, 2 is a piston therein and 3 is the cylinder head secured to the cylinder in the conventional manner, the cylinder and head being jacketed for water, as is usual.

Removably secured within an opening formed in head 3 is a vertically extending body 4 formed with a vertical passageway 5 therein. The body 4 is threadedly secured at 6 within the opening in the cylinder head and extends downwardly into the head below the threads at its lower end and projects above the head at its upper end.

The passageway 5 communicates at its upper end with a laterally directed opening 7 formed in a horizontal tubular valve member 8, which member is tapered around its outer side at the end of the opening 7 to seat against a taper seat formed in the body 4 adjacent the upper end of passageway 5.

The valve member 8 is slidably mounted within a tubular casing 9 and is urged to seat at its tapered end against the taper seat in the body by a relatively heavy, stiff coil spring 10 adapted to react between the end of the valve member opposite the tapered end and a shoulder formed in the outer end of the casing.

Valve member 8 is interiorly provided with a coil spring 11 of less power than spring 10, which spring engages a valve 12 for forcing the valve in a direction opposite to that in which valve member 8 is forced to close an aperture 13 formed in a head 14 in member 8 that communicates between the bore of tubular valve member 8 and the portion of bore 15 of casing 9 in which the spring 10 is mounted. The outer end of casing 15 is provided with an inlet 16 from which extends a pressure line 17 that leads to a conventional fuel pressure pump as used in Diesel type engines for pumping the fuel, which pump has a conventional unloading valve.

No claims to specific structure are made as to the unloading valve assembly, the present showing being merely illustrative of the type in which fuel is intermittently passed toward the fuel injection upon predetermined pressure increases in the fuel line and which valve is adapted to automatically relieve excess pressure in the line leading therefrom to the fuel injector.

The lower end of body 4 is finished with a flat ground seat for sealing with the similarly finished upper end of a tubular block 18 extending downwardly in axial alignment with the body. The upper surface of said block is formed with an annular channel 19 adapted to register with the lower open end of passageway 5.

The lower end of tubular block 18 is finished with a flat ground seat for sealing against a similarly flat upper surface of a horizontal disk 20, the upper side of which disk is formed with a volute or plane spiraliform channel 21 substantially U-shape in cross section (see Fig. 3). The outer end of said channel commences adjacent, but inwardly, of the outer edge of the disk 20 and terminates at its inner end adjacent the axis of the disk at one side thereof and its length is proportional to its width, consisting of one or several turns around the axis, much the same as the spiral ornaments which form the principal distinction of the Ionic capital.

A vertical passageway 22 is formed in the wall of block 18 and communicates at its opposite ends between the annular channel 19 and the outer end of channel 21 in the disk.

The body 1, block 18 and disk 20 are all firmly secured together with the ground surfaces of each of the parts in sealing engagement by a tubular sleeve 23 enclosing the lateral sides of block and disk, and threadedly engaging the lower end of the body 1 at the upper end of the sleeve. The lower end of sleeve 23 is slightly turned axially inwardly to engage in the rabbetted lower peripheral edge of disk 20, thus leaving substantially the entire lower surface of disk 20 exposed, particularly that area of the disk below the channel 21.

The vertically extending bore 24 of the tubular block 18 is tapered inwardly adjacent its lower end at 25 to provide a valve seat, and the restricted open end of the tapered portion of the bore communicates with a central restricted discharge orifice 26 in the disk 20 that flares outwardly at 27 at the lower end.

Within the bore 24 of the block 18 is fitted a vertically elongated cylindrical valve member 28 of the pintle type, formed with a tapered lower end 29 adapted to seat against the lower end of the tapered seat 25 of the bore, in which position a short axially extending projection or pintle 30 on the valve member will fit in the orifice 26 and will clean the orifice upon each reciprocation of the valve.

Spaced above the tapered end 29 the valve member is formed with a tapered shoulder 31 that is spaced from the seat 25 when the end 29 engages the lower end of said seat, thus providing an annular space 32 between the upper portion of seat 25 and the shoulder 31.

An annular axially inwardly opening U-shaped channel 33 is formed in the wall of bore 24 adjacent the juncture of seat 25 therewith, and one or more vertical ducts 34, preferably three substantially equally spaced ducts, communicate at opposite ends respectively with the channel 21 and the channel 33, the ends opening into the channel 33, at the inner end of said channel in close proximity to the orifice 26, as at the points marked X in Figure 3.

The valve member 28 is held seated against the seat 25 by a relatively stiff coil spring 36 in a housing 37 at the upper end of the body 4, which spring is calibrated to open under a predetermined fluid pressure reacting against the shoulder 31 of the valve member 28, a rod 38 connecting between said valve member and spring, and a relief line 39 connects with the body 1 in which spring 36 is positioned to permit the release of any fluid passing the valve member 38 to the upper end of the body.

In actual installation, with the body 4 secured in position, the disk 20 is at the under side of the cylinder head, which head is preferably recessed at 40 in order to space the disk away from the water cooled walls of the head, or the disk may project into the cylinder and the head of the piston may be recessed to avoid interference therewith.

While the disk 20 is shown as an element removable from the body 1, it may, of course, be integrally connected thereto by welding or the cylindrical plug and disk may be of the same material and in a single piece.

In operation, the metering pressure pump, not shown, connected to inlet 17 will intermittently force the fuel into the passageways 5 and 7 and into channel 21. The channel 21 is of a size to contain approximately 1 or several charges of fuel and is approximately $\frac{1}{16}$ inch in depth and $\frac{3}{64}$ inch in width, but may be varied as desired.

Spring 36 will allow the pintle valve intermittently and momentarily lift with each pressure impulse on the fuel and the fuel charge in channel 21 nearest the orifice will be ejected through said ducts 34 and orifice 26 directly into the cylinder. Thereafter the valve 28 will immediately close and valve member 8 will close, trapping the fuel in the passageways 5, 22 and channel 21 under an elevated pressure, slightly less than the maximum pressure for lifting valve 28, since the pressure at the intake 17 rapidly falls between impulses due to unloading valve in pump.

The disk 20 is preferably of material having great tensile strength and high conductivity, such as the alloys used in the manufacture of arc welding electrodes, and since the disk is air insulated from the water cooled walls of the cylinder head, the fuel within the channel 21 will be preheated to substantially ignition temperature of the fuel and even higher than the ignition temperature of the fuel when under atmospheric pressure, since the disk 20 is directly exposed to the heat developed by compression and combustion of fuel charges within the cylinder. However, it is obvious that the fuel, between injection into the cylinder, being under relatively high pressure, is maintained therein below the boiling point of the fuel but upon the valve 28 releasing a highly preheated charge or charges of fuel from the channel or reservoir 21 into the cylinder, the fuel will immediately and progressively burn as it is discharged into the cylinder instead of a sudden ignition of the full charge, which latter condition is highly objectionable and has heretofore rendered the Diesel type engine unsuitable for many purposes.

The term "substantially multi-annular" in the claims refers to a spiral shape or a plurality of connected concentric rings such as is shown in Figure 3.

The foregoing designations are not intended to limit me to the precise structure shown, but are intended to cover all forms of structure that may come within the scope of the invention.

Having described my invention, I claim:

1. In a fuel injection nozzle of the character described, a sleeve member, a disk seated in the substantially open end of said sleeve, an axial orifice through said disk, a volute channel in the inner surface of said disk, a block member in said sleeve member bearing against said disk, said block member having a vertical bore adjacent its circumferential edge in registry with the outer end of said channel in said disk to define an inlet passage thereto and an axial bore in alignment with the orifice in said disk, the lower end of said last-named bore in said block member being tapered to provide a valve seat, a valve in said axial bore in said block member, an annular inwardly opening U-shaped channel formed in said block member at the juncture of the axial bore therein and the tapered valve seat, and a plurality of passageways in said block member establishing communication between said annular channel and the inner end of the channel in said disk.

2. In a fuel injection nozzle of the class described, a sleeve member, a disk retained in one end of said sleeve member, an axial orifice through said disk, a volute channel in the inner face of said disk, a block member in said sleeve member above and bearing against said disk to close the channel therein and thereby define a fuel duct, a fuel inlet passage in said block in communication with the outer end of said duct in said disk, an axial valve bore in said block in alignment with said orifice in said disk, valve means in said valve bore and a plurality of passageways in said block establishing communication between the inner end of the duct in said disk and the orifice therein.

3. In a fuel injection nozzle of the class described, a sleeve member, a disk retained in one end thereof, an axial orifice through said disk, a volute channel in the inner face of said disk, a block member in said sleeve member above and bearing against said disk to close the channel therein and thereby define a fuel duct, a fuel inlet passage in said block in communication with the outer end of said duct in said disk, an axial valve bore in said block in alignment with said orifice in said disk and terminating in a tapered seat, a valve therein, and a plurality of passageways

in said block establishing communication between the inner end of the duct in said disk and the orifice therein through the valve bore in said block upon operation of the valve.

4. In a fuel injection nozzle of the character described, a sleeve member, a disk retained in one end of said sleeve member, an axial orifice through said disk, a volute channel in the inner face of said disk, a tubular block member in said sleeve member above and bearing against said disk to close the channel therein and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of said duct in said disk, means for valving successive fuel charges therethrough, an axial valve bore in said block in alignment with said orifice in said disk, a plurality of passageways in said block establishing communication between the inner end of the duct and the orifice in said disk, and valve means in said valve bore in said block member to pass successive fuel charges received from said duct through tht orifice in said disk.

5. In a fuel injection nozzle of the character described, a disk having an axial orifice therethrough and a volute channel in its inner face, a block member bearing against the inner face of said disk to cover said channel and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of said duct in said disk, means for valving successive charges of fuel therethrough, an axial valve bore in said block in alignment with the orifice in said disk, passageways in said block establishing communication between the inner end of the duct and the orifice in the disk through said valve bore, and valve means in said valve bore in said block member to pass successive fuel charges through the orifice in said disk.

6. In a fuel injection nozzle of the character described, a disk having an axial orifice therethrough and a volute channel in its inner face, a block member bearing against the inner face of said disk to cover said channel and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of said duct in said disk, means for valving successive charges of fuel therethrough, an axial valve bore in said block in alignment with the orifice in said disk, passageways in said block establishing communication between the inner end of the duct and the orifice in the disk through said valve bore, valve means in said valve bore in said block member to pass successive fuel charges through the orifice in said disk, and means for retaining the block and disk member in juxtaposition.

7. In a fuel injection nozzle of the character described, a disk having an axial orifice therethrough and a volute channel in its inner face, a block member bearing against the inner face of said disk to cover said channel and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of the duct in the disk, an axial valve bore in said block in alignment with the orifice in said disk, and passageways in said block establishing communication between the inner end of the duct and the orifice in the disk through said valve bore.

8. In a fuel injection nozzle of the character described, a disk having an axial orifice therethrough and a volute channel in its inner face, a block member bearing against the inner face of said disk to cover said channel and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of the duct in the disk, an axial valve bore in said block in alignment with the orifice in said disk, passageways in said block establishing communication between the inner end of the duct and the orifice in the disk through said valve bore, and retainer means to keep said block and said disk in juxtaposition.

9. In a fuel injection nozzle of the character described, a disk having an axial orifice therethrough and a volute channel in its inner face, a block member bearing against the inner face of said disk to cover said channel and thereby define a fuel duct, a fuel inlet passageway in said block in communication with the outer end of the duct in the disk, an axial valve bore in said block in alignment with the orifice in said disk, passageways in said block establishing communication between the inner end of the duct and the orifice in the disk through said valve bore, retainer means to keep said block and said disk in juxtaposition, valve means in the valve bore in said block, and means for operating said valve means.

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