P. L. SCOTT.

SPRAY VALVE FOR LIQUID FUEL ENGINES.

APPLICATION FILED JUNE 18, 1918.

1,295,612. Patented Feb. 25, 1919.

Fig. 1,

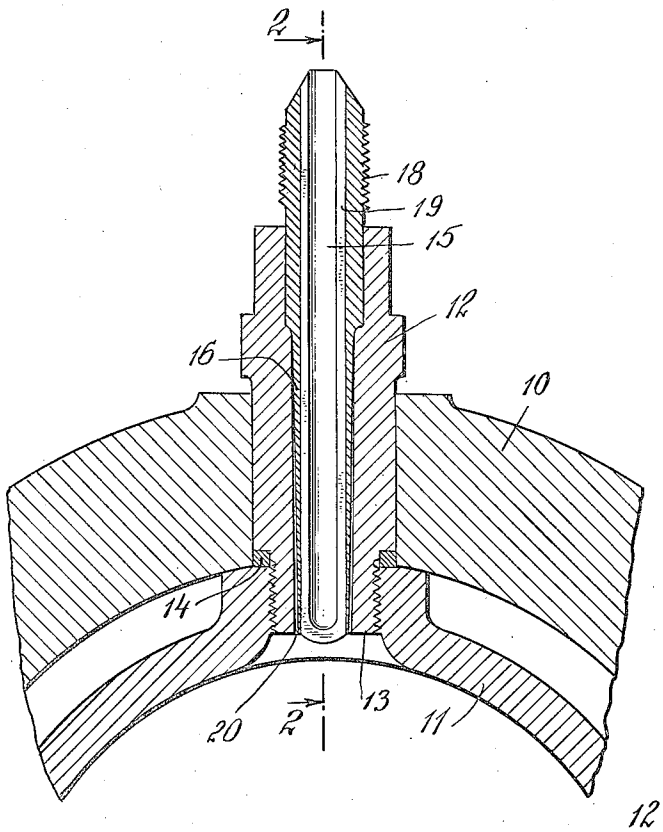


Fig. 2,

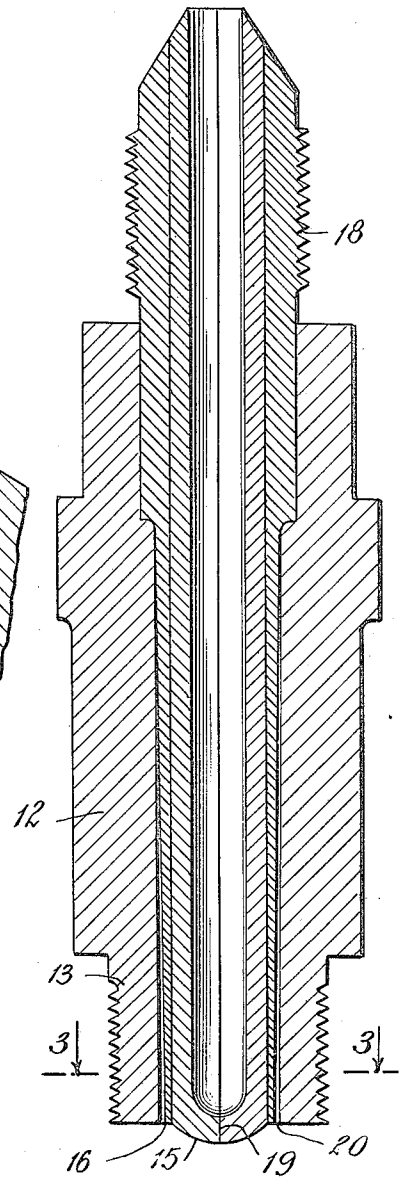


Fig. 3,

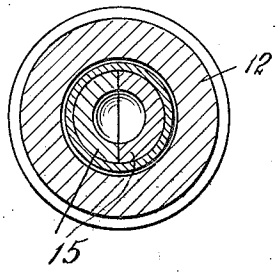
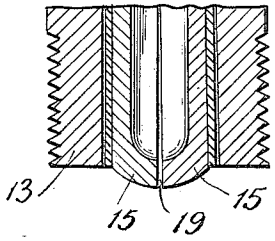


Fig. 4.



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SPRAY-VALVE FOR LIQUID-FUEL ENGINES.

1,295,612. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed June 18, 1918. Serial No. 240,710.

To all whom it may concern:

Be it known that I, PHILIP LANE SCOTT, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Spray-Valves for Liquid-Fuel Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to injection valves particularly adapted for use in a system of direct or solid fuel injection for internal combustion engines; *i. e.*, a system in which liquid fuel, such as oil, is pulverized and sprayed into a combustion chamber without the use of compressed air.

To secure a sufficient degree of pulverization in systems of this type, it is necessary that the fuel be supplied through a small aperture at very high pressure and very high velocity; and it has been a defect, generally speaking, of the engines of this type which have heretofore been proposed, that the pressure at which the fuel is supplied has not been carried to or consistently maintained at the point necessary to properly atomize the fuel. As an illustration of the importance of very high pressure of injection in such systems, it may be stated that a certain fuel oil issuing from such a valve under a pressure of from 2,000 to 3,000 pounds per square inch will burn either very sluggishly or not at all when ignited by a match in the open air. At 4,000 pounds per square inch, this oil will burn readily and at 6,000 pounds per square inch it will burn explosively.

If an engine of this type is to operate on the Diesel cycle, as is usually the case, the rate of injection of the fuel must vary. If this varying fuel feed is supplied to the combustion chamber through a valve opening of fixed size, the pressure and velocity may be too low at the beginning of the injection, reach a dangerously high point during the maximum rate of injection, and drop to a point below that necessary to properly atomize the fuel at the end of the injection. It is, consequently, of great importance to provide an injection system in which the size of the opening is constantly proportional to the desired rate of injection, so that the pressure and velocities may remain constant during the entire period of injection, or substantially so.

It is further of importance to so construct the injection valve that the maximum surface of the pulverized fuel shall constantly be presented to a fresh portion of the air compressed within the combustion chamber.

These several objects are achieved, in accordance with the present invention, primarily by forcing the fuel into the combustion chamber under very high pressure through an injection valve or orifice, the opening of which is due to the injection pressure and is opposed by the tensile strength and resistance to linear deformation of a valve-retaining member made of a metal, such as steel, having good tensile strength and such elasticity that the high pressures of injection are well within the limit of elasticity of the metal. In this way, the injection valve or orifice opens, under the very high pressure of the liquid fuel, only to a minute extent which is constantly proportional to the applied pressure, and the liquid fuel is pulverized to a very high degree, while the pressures and velocities of injection remain substantially constant throughout the injection period.

The particular nature of the invention, as well as other objects and advantages thereof will appear more clearly from a description of a preferred embodiment thereof as shown in the accompanying drawing in which Figure 1 is a sectional view taken transversely through the cylinder at the point where the valve is inserted; Fig. 2 is an enlarged longitudinal sectional view taken along the line 2—2 of Fig. 1; Fig. 3 is a transverse section along the line 3—3 near the lower end of the valve, and Fig. 4 is a sectional view of the lower end of the valve showing the quills in separated relation.

Referring to the drawings in which similar reference characters denote similar parts throughout the several views, the outer casing of a cylinder of an internal combustion engine to which liquid fuel is supplied directly is indicated at 10, and 11 indicates the inner wall of the cylinder forming the combustion chamber. Fitted within an aperture in the outer casing is the body 12 of the valve. This body is provided with a portion 13 at its inner end of reduced diameter and which is threaded into the inner wall 11 of the cylinder, a gasket 14 be-

ing provided for forming a tight joint. The body 12 is provided with a central bore within which are tightly inserted the inner members of the valve.

These inner members comprise a pair of metallic quills 15 which are held together throughout their length by a surrounding sleeve or jacket 16, preferably formed of high grade spring steel shrunk on the quills in such a manner that it holds them firmly together, forming an oil tight joint along their entire length. The upper end of the jacket is screw threaded as at 18 for attachment to a fuel pump which may be of any suitable construction adapted to supply liquid fuel to the valve under high pressure.

The transverse portions 19 of the quills, which form the closed end of the valve are normally held tightly in contact with each other by the tensile strength and the resistance to deformation of the surrounding jacket. When, however, the pressure of fuel supplied by the pump rises in the valve to a point where the resistance to the deformation of the spring-steel jacket is overcome, the tips of the two quills will separate slightly. The lower end of the bore 12 should be slightly larger than the normal outside diameter of the surrounding jacket as indicated at 20 to permit such expansion; and the elastic limit of the jacket should be well above the injection pressure. As the two quills separate under the influence of high pressure, a narrow aperture will be formed of a size proportionate to the applied pressure and from which the fuel will issue under high pressure and at high velocity and will assume a flat fan-shaped form which will cause the fuel to be sprayed in a narrow sheet across the combustion chamber.

If the engine is one operating on the Diesel cycle, it is necessary that the rate of injection of fuel should be varied, but the valve of the present invention will automatically maintain the pressure and velocity of the fuel practically constant during injection, regardless of the rate of injection, for the reason that the increase of injection pressure will cause additional expansion of the jacket with a corresponding increase in the width of the slit, which will thus permit more fuel to be supplied to the cylinder without any substantial increase in the velocity or pressure of injection. The conditions are interdependent and work automatically to maintain constant velocity of fuel supply, regardless of the rate of injection, until the pressure drops below that predetermined point at which the valve will close.

I claim:

1. In a system of direct fuel injection for internal combustion engines, an injection valve, a metallic valve retainer firmly holding the valve closed, and means for applying liquid fuel to the valve under a pressure sufficient to effect the opening thereof against the resistance to linear deformation of the retainer but well within the limit of elasticity of the metal thereof, substantially as described.

2. In a system of direct fuel injection for internal combustion engines, an injection valve comprising a feed tube split at the injection end to form an injection orifice, a metallic retaining jacket surrounding the tube and firmly holding the injecting orifice closed, and means for applying liquid fuel to the valve under a pressure sufficient to effect the opening thereof against the resistance to expansion of the retaining jacket but well within the limit of elasticity of the metal thereof.

3. A valve for injecting liquid fuel into the cylinder of an internal combustion engine comprising a pair of symmetrical members forming a tube normally closed at one end and open at the other end for the admission of liquid fuel, an expansible jacket surrounding said members and normally holding them in contact but adapted to expand under the pressure of fuel within said members to permit them to separate at the normally closed end to form a narrow slit through which fuel may be injected into the cylinder.

4. A valve for injecting liquid fuel into the cylinder of an internal combustion engine comprising a pair of symmetrical members forming a tube normally closed at one end and open at the other end for the admission of liquid fuel, an expansible jacket surrounding said members and normally holding them in contact but adapted to expand under the pressure of fuel within said members to permit them to separate at the normally closed end to form a narrow slit through which fuel may be injected into the cylinder, and a body member into which the tube and the jacket are tightly fitted and provided with clearance to permit expansion of the jacket and separation of the members at the normally closed end of the tube.

5. A valve for injecting liquid fuel into the cylinder of an internal combustion engine comprising a tubular member open at one end and normally closed but divided transversely at the other end, an expansible jacket surrounding said tubular member and normally holding the divided end thereof closed, but adapted to expand under pressure of fuel within said member to permit the portions thereof to separate at the normally closed end to form a narrow slit through which fuel may be injected into the cylinder of the engine.

6. A valve for injecting liquid fuel into the cylinder of an internal combustion engine

comprising a tubular member open at one end and normally closed but divided transversely at the other end, an expansible jacket surrounding said tubular member and normally holding the divided end thereof closed, but adapted to expand under pressure of fuel within said member to permit the portions thereof to separate at the normally closed end to form a narrow slit through which fuel may be injected into the cylinder of the engine, and a body portion provided with a central bore within which the tubular member and the surrounding jacket are inserted, said bore being of slightly greater diameter than the jacket at the closed end of the tubular member to allow the jacket to expand and open the normally closed end of the tubular member.

In testimony whereof I affix my signature.

PHILIP LANE SCOTT.