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LIQUID SPRAY NOZZLE

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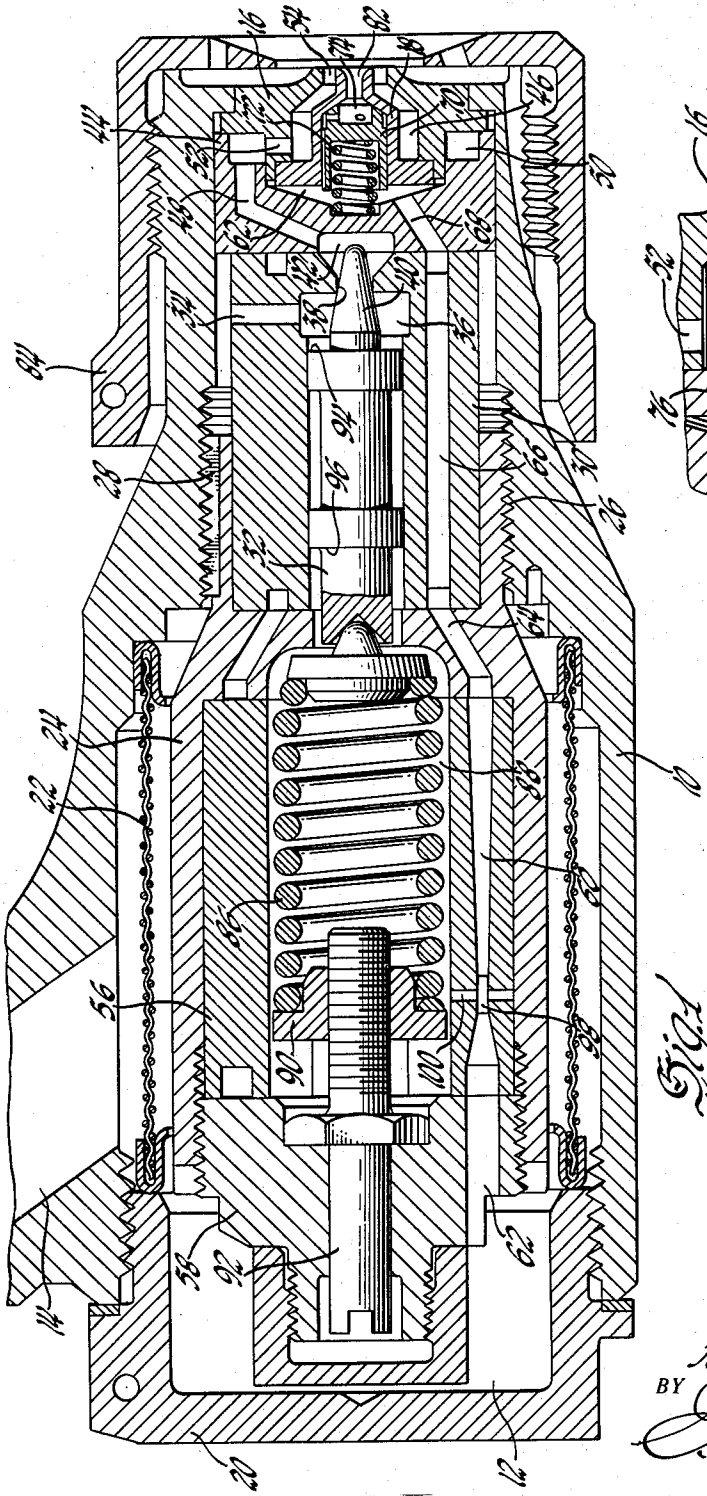


Fig. 1

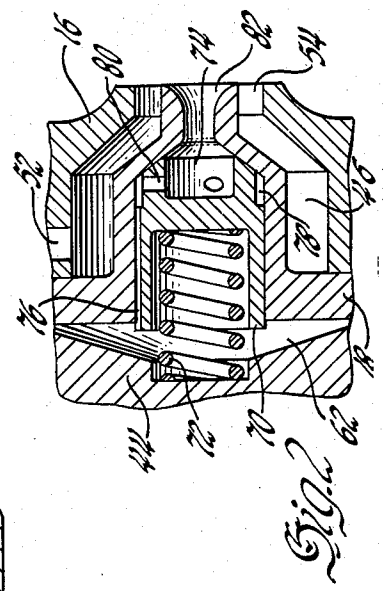


Fig. 2

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LIQUID SPRAY NOZZLE

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This invention relates to liquid spray nozzles and more particularly to nozzles of the type having plural flow paths to accommodate a wide flow range.

A typical nozzle of this type is utilized to spray fuel in a gas turbine combustion chamber. In order to achieve good atomization of the fuel at high and low flow rates, such nozzles are provided with separate low and high capacity flow passages leading to the spray tip, the high capacity flow passage having a spring-biased piston valve to keep it closed in the low flow range. The back side of the piston valve is conventionally vented to atmosphere or to the combustion chamber and considerable pumping effort is required to maintain it full open at the maximum rate of flow.

It is an object of the invention to realize the maximum rate of flow with less pumping effort.

Other objects of the invention will be apparent from the drawings and ensuing description.

In the drawings:

Figure 1 is a sectional view along the axis of a liquid spray nozzle incorporating the invention; and

Figure 2 is an enlargement of the spray tip portion of Figure 1.

Referring to the drawings, the liquid fuel nozzle has an outer housing **10** with an inner chamber **12** that receives fuel at various rates of flow from an inlet **14** which connects to the usual fuel pump. High and low capacity spray tips **16** and **18** are mounted at one end of the chamber **12** to provide a fuel atomizing outlet for the nozzle. A cap **20** closes off the other end of the chamber **12** and secures a filter **22**. An inner housing **24** is mounted in the outer housing **10** by a threaded portion **26** which is longitudinally slotted at **28** to allow fuel to pass to the spray tip **16**.

A valve housing **30** is received in the spray tip end of the inner housing **24** and mounts a reciprocal piston valve **32**. A radial passage **34** in the valve housing **30** transmits fuel from the chamber **12** to a chamber **36** on the inlet side of a valve seat **38**. The piston valve **32** has a tapered pin **40** which is movable in the valve seat **38** to control flow to the high capacity spray tip **16**. From a chamber **42** in a flow distribution plug **44** on the outlet side of the valve seat **38**, fuel is led to a high capacity swirl chamber **46** by way of a passage **48**, an annular chamber **50** and a plurality of tangentially directed passages **52**. A discharge orifice **54** for the high capacity fuel flow is formed by the concentric spray tips **16** and **18** to receive fuel from the swirl chamber **46**.

A bushing **56** is retained in the inner housing **24** by a threaded plug **58** and is provided with a restricted flow area or venturi-shaped passage **60** which communicates with the chamber **12** by way of a passage **62** in the bushing. From the venturi passage **60** fuel is led to a chamber **62** behind the spray tip **18** by a passage **64** in the inner housing **24**, a passage **66** in the valve housing **30** and a passage **68** in the flow distribution plug **44**. A swirl plug **70** is retained in the low capacity spray tip **18** by a coil spring **72** and forms a swirl chamber **74**

which receives fuel from the chamber **62** by way of a slotted passage **76**, an annular chamber **78** and a plurality of tangential passages **80**. The swirl chamber **74** feeds a low capacity discharge orifice **82** in the spray tip **18**. The tip end of the nozzle may be provided with the usual air director cap **84** to aid atomization.

From the foregoing it is seen that fuel is ejected from the spray tip **18** by way of the passages **80, 76, 68, 66, 64, 60** and **62** whenever fuel is supplied to the inlet **14** at any rate of flow. In order to achieve good atomization at low rates of flow the swirl passages **80** are necessarily small and the aforesaid overall flow passage system is accordingly a low flow capacity system. The swirl passages **52** of the spray tip **16** are substantially larger than the swirl passages **80** and a high flow capacity passage system is accordingly formed by the passages **52, 48, 34** and **28** which feed the spray tip **16**. Higher pressures and higher rates of flow are required to obtain good atomization from the larger spray tip **16**, hence its flow passage system is closed at the lower pressures and flow rates by the piston valve **32**.

In order to close the piston valve **32**, a compression spring **86** is received in a valve vent chamber **88** in the bushing **56** to engage one end of the valve and urge it in closing direction. A nut **90** is threaded on a post **92** to provide spring force adjustment. The piston valve **32** has a face area **94** which is exposed to the inlet pressure of the high flow capacity passage system and another face area **96** which is exposed to the static pressure in the chamber **88**. In the usual fuel nozzle the chamber **88** is vented to atmosphere or to the combustion chamber in order that the fuel pressure acting on the face area **94** can overcome the spring **86** and move the piston valve **32** in opening direction. The invention provides a different means of venting the chamber **88** which results in improved nozzle performance at high flow rates.

In accordance with the invention the low flow capacity passage system was provided with a reduced area or venturi portion **60** and the chamber **88** is vented to the static pressure of the venturi throat **98** by a passage **100**. The pressure on the face area **96** of the piston valve **32** thus varies in accordance with the rate of flow through the spray tip **18**. At low rates of flow the pressure on the face area **96** is but slightly less than the pressure on the face area **94** and the spring **86** is especially effective in maintaining the piston valve **32** closed. As the pressures and flow rates increase to a high level, the static pressure drop in the venturi throat **98** is reflected in the chamber **88** and the reduced pressure on the face area **96** thus augments the increased pressure on the face area **94** to move the piston valve **32** against the spring **86**. Less pumping effort at the maximum flow rate is thus required to maintain the valve open than would be the case if the chamber **88** were vented directly to atmosphere or to the combustion chamber.

While the embodiment of the invention here described is preferred, it is understood that modifications may be made by the exercise of skill in the art which will lie within the scope of the invention.

I claim:

1. In a liquid fuel spray nozzle of the duplex flow type having an inlet and an outlet connected by separate high and low flow passages, means for supplying liquid fuel to the inlet at various rates of flow, the low flow passage providing constant communication between the inlet and outlet and having a restricted area portion therein, a piston valve for controlling flow through the high flow passage, one side of the piston valve being exposed to the static pressure of the restricted area of the one passage and the other side of the piston valve being exposed to the pressure in the other flow passage, and a

spring engaging and biasing the piston valve in a direction to reduce flow through the other flow passage.

2. A liquid fuel spray nozzle of the duplex flow type comprising a low capacity flow passage having an inlet and a spray tip outlet and a venturi throat therebetween, a high capacity flow passage having an inlet and a spray tip outlet, means for supplying liquid fuel to both inlets at various flow rates, a piston valve for controlling flow through the high capacity flow passage, one side of the piston valve being exposed to the static pressure of the venturi throat of the low capacity flow passage and the other side of the piston valve being exposed to the pressure in the high uapacity flow passage, and a spring engaging and biasing the piston valve in a direction to reduce flow through the high capacity flow passage.

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