United States Patent [19]

Watkins

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[54] **AIR-FUEL SPRAY NOZZLE**

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[73] Assignee: **Avco Corporation,** Stratford, Conn.

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[52] **U.S. Cl.** ..... **239/405;** 60/39.74 R; 239/431

[51] **Int. Cl.**[2] **B05B 7/10;** B05B 7/06

[58] **Field of Search** ..... 239/399, 403, 405, 406, 239/425, 429–431; 60/39.74 R

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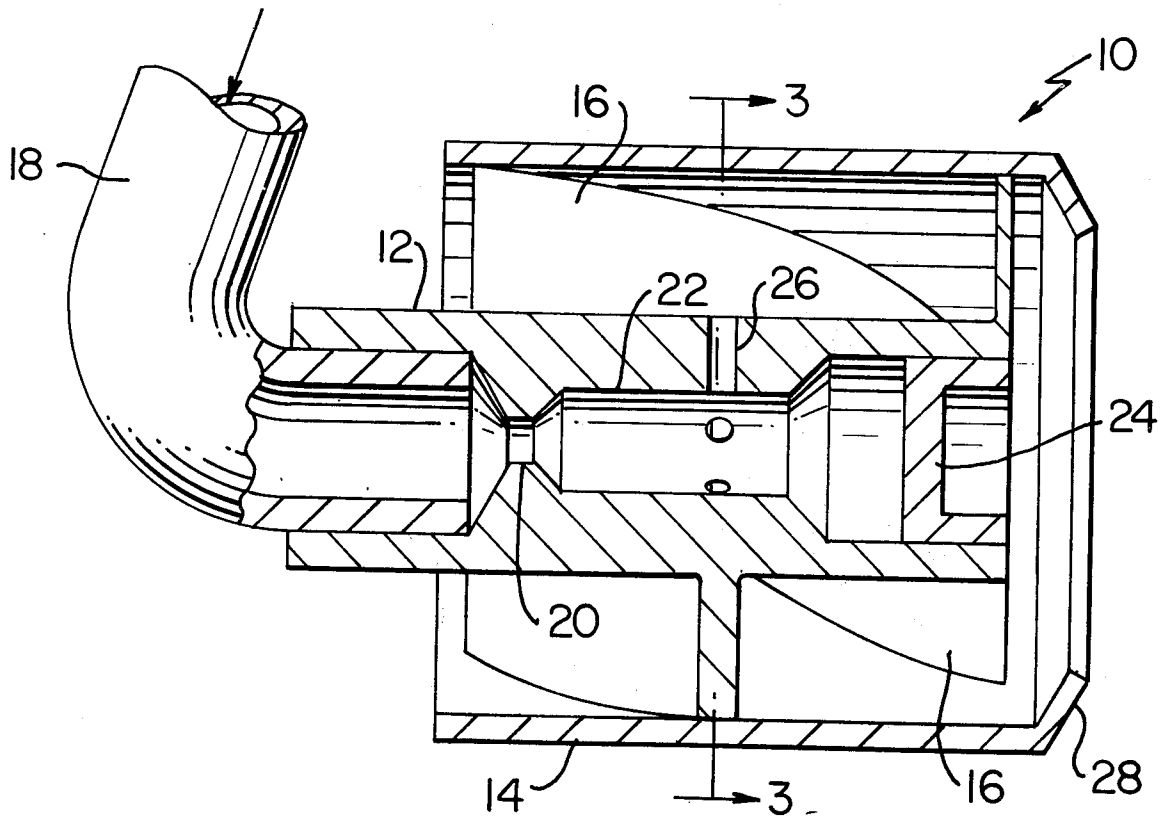
[57] **ABSTRACT**

A spray nozzle is disclosed for obtaining an air-fuel mixture within the confines of the nozzle. Fuel is directed radially outwardly from a central housing into a helical passage about the central housing. Air passing in the helical passage between the central housing and outer wall mixes with the fuel so that a uniform mixture of fuel and air exits from the nozzle into the surrounding area.

2 Claims, 4 Drawing Figures



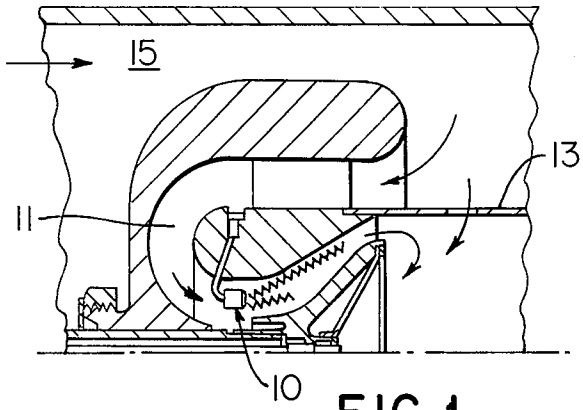


FIG. 1

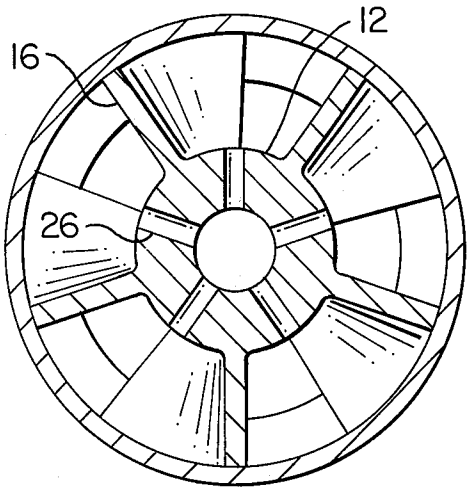


FIG. 3

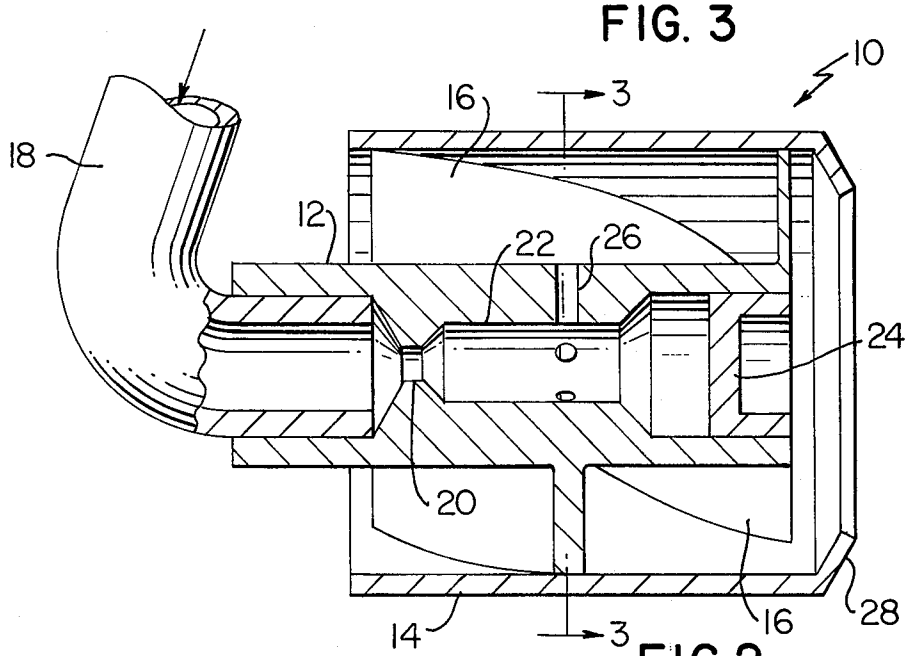


FIG. 2

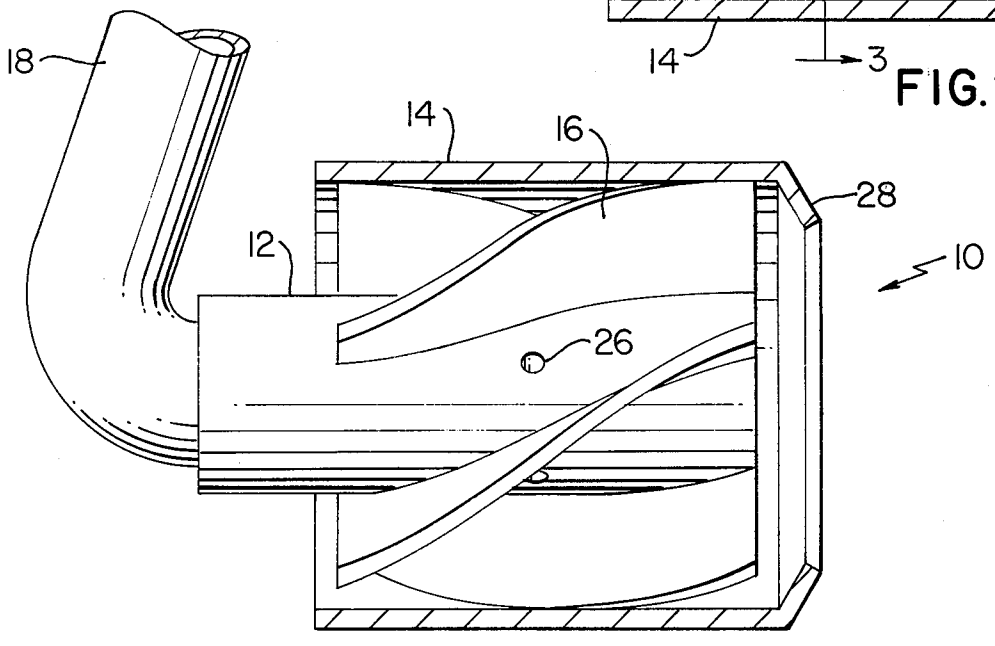


FIG. 4

AIR-FUEL SPRAY NOZZLE

BACKGROUND OF THE INVENTION

This invention relates generally to fuel atomizing nozzles, but more particularly to air-fuel spray nozzles to provide a uniformly atomized air-fuel mixture.

The use of air-spray fuel injection systems is widely known particularly in the internal combustion engine field, where it is important to insure that finely atomized fuel, at the correct air-fuel ratio, is supplied to the engine for ignition. Gas turbine engines, however, have similar requirements for ignition, but somewhat less stringent requirements after ignition is achieved. In one particular type of combustor it is necessary to supply a fuel-air mixture of substantially constant richness ratio having a uniform droplet size into the primary zone through an annular duct. The means of fuel atomization must not allow any of the fuel droplets produced to wet the walls of the duct, since wet walls provide big drops that will sooner or later enter the combustor and pass through it, largely unburnt. All prior type pressure atomizing nozzles can achieve the level of atomization required, but some fuel droplets will possess sufficient momentum to pass through the airstream, and impinge on the duct walls. Streaky sprays, normally acceptable, contain large drops which cannot follow the airstream, and either impinge on the duct walls or enter the primary zone and burn poorly, or not at all.

Accordingly, it is the object of this invention to provide an air-fuel spray nozzle which permits the air and fuel to be mixed within the space of the nozzle.

A further object of this invention is to provide an air-fuel spray nozzle which will atomize the fuel for mixture with the air.

A still further object of this invention is to provide an air-fuel spray nozzle which provides a uniformly distributed air-fuel mixture exiting from the nozzle.

SUMMARY OF THE INVENTION

This invention provides an improved air-fuel spray nozzle having particular utility in gas turbine engines. The nozzle directs fuel radially outwardly from a central housing into helical passages formed between the central housing and outer wall. Air passing through the helical passages mixes with the fuel therein such that a uniformly distributed air-fuel mixture exits from the nozzle into the surrounding area. Means are provided to equalize and insure that an equal mixture occurs.

Other objects, details, uses and advantages of this invention will become apparent as the following description of one exemplary embodiment thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show a present exemplary embodiment of this invention in which:

FIG. 1 is a partial cross-sectional view of a gas turbine combustor incorporating the nozzle of this invention;

FIG. 2 is an enlarged cross-sectional view of the spray nozzle of this invention;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2; and

FIG. 4 is a view of the nozzle with the outer wall removed to show the vanes therein.

DESCRIPTION OF ILLUSTRATED EMBODIMENT

Reference is now made to FIG. 1 of the drawings which illustrates one exemplary embodiment of the improved air-fuel spray nozzle of this invention, which is designated generally by the reference numeral **10.** The nozzle **10** is mounted within an air passage **11** of a typical combustor generally designated as **13,** the combustor **13** being mounted within the primary air flow path **15** of a gas turbine engine upstream of the compressor turbine stage.

As particularly seen in FIGS. **2–4,** the nozzle **10** comprises a central portion or housing **12.** An outer wall or cap **14** is secured coaxially with the central housing **12** and is supported thereabout by a plurality of helically extending vanes **16.** The passageways defined by the respective vanes **16** and outer wall **14** are open at each end thereby providing an air passageway therethrough.

Fuel is supplied to the nozzle **10** through a suitable line **18** which is secured by suitable means such as brazing or the like, to the central housing **12.** The housing **12** includes a restrictor **20** between the fuel line **18** and an open fuel chamber **22.** A cap or plug **24** seals the one end of the chamber **22.** Extending radially outwardly from the fuel chamber **22** and extending through the housing **12** is a plurality of apertures or bores **26.** The bores **26** provide communication between the fuel chamber **22** and the helical air passageways. As particularly seen in FIG. **3,** a bore **26** is in communication with each of the respectively helical air passageways.

When fuel is delivered to the nozzle **10,** the restrictor **20** equalizes such fuel supplied and meters the amount of fuel to the fuel chamber **22.** Fuel is transmitted radially outwardly through the respective bores **26** into each passageway defined by the respective vanes **16.** The vanes form a helical passageway through the nozzle **10** such that air passing therethrough is caused to move in a rotary or screw fashion. The fuel exiting from the bores **26** is atomized and mixed with the air moving through the respectively helical passageways thereby forming a swirling ring of air-fuel mixture in the space defined by the end of the housing **12** and the inwardly projecting lip **28** of the wall **14.** Thus, an air-fuel mixture is discharged from the orifice formed by the lip **28** into the turbulent air in the passage **11** (FIG. **1**) downstream of the nozzle where further fuel break up and mixing occur.

It is thus seen that the nozzle provides for an initial mixing of the air and fuel within the confines of the nozzle itself. The air-fuel mixture that is discharged from the nozzle is less likely to impinge on the walls of the combustor and is more easily mixed with the added air in the airstream.

Accordingly, it is seen that the objectives hereinbefore set forth have been accomplished.

While a present exemplary embodiment of this invention has been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced by those skilled in the art.

What is claimed is:

1. A spray nozzle for mixing fuel and air therein, said nozzle comprising:

a cylindrical housing having an inner chamber on the axis thereof, a plurality of circumferentially spaced helical vanes radially extending outwardly from said housing, said vanes extending over essentially the entire length of said housing, said chamber having a fuel inlet and a plurality of fuel outlets, each

of said fuel outlets extending radially through said housing into the spaces between said vanes;

a cylindrical wall mounted coaxially with said cylindrical housing, said wall being spaced from said housing by said vanes, said vanes contacting said housing throughout the entire length of said vanes to provide a plurality of helical passages, each of said fuel outlets communicating with a respective passage, said housing having an air inlet at one end and an outlet at the other end, the outlet end of said cylindrical wall being formed with a radially inwardly projecting lip;

means supplying fuel to said chamber under pressure,

whereby all of said fuel flows radially into said helical passages; and

means for flowing air through said helical passages whereby all of said fuel supplied to said chamber is mixed with air moving through said passages, and mixed fuel and air exits from said outlet.

2. The nozzle as set forth in claim **1** further comprising restrictor means in the inlet end of said central housing wherein fuel passing therethrough is metered by said restrictor to insure uniform distribution of fuel to the chamber.

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