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Hibbins

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[54] **GAS COOLED DUAL FUEL AIR ATOMIZED FUEL NOZZLE**

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[73] Assignee: **General Electric Company,** Schenectady, N.Y.

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[52] **U.S. Cl.** ..... **239/422,** 239/406, 239/425, 60/39.74 R

[51] **Int. Cl.** **B05b 7/08**

[58] **Field of Search** ..... 60/39.74 R; 239/400, 239/403, 405, 406, 422, 423, 424, 425, 424.5, 428, 430

[56] **References Cited**

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Assistant Examiner—John J. Love
Attorney—William C. Crutcher et al.

[57] **ABSTRACT**

A dual fuel, air-atomized, fuel nozzle of the type prevalent in some gas turbine combustion chambers wherein the hot atomizing air conduit is remotely positioned with respect to a central liquid fuel or oil conduit so that the nozzle will operate cooler during liquid fuel operation. A gaseous fuel conduit is interposed between the liquid fuel conduit and the atomizing air conduit to provide additional nozzle cooling during the gaseous fuel operation while preventing thermal breakdown of any liquid fuel residuum which could cause nozzle clogging.

7 Claims, 2 Drawing Figures

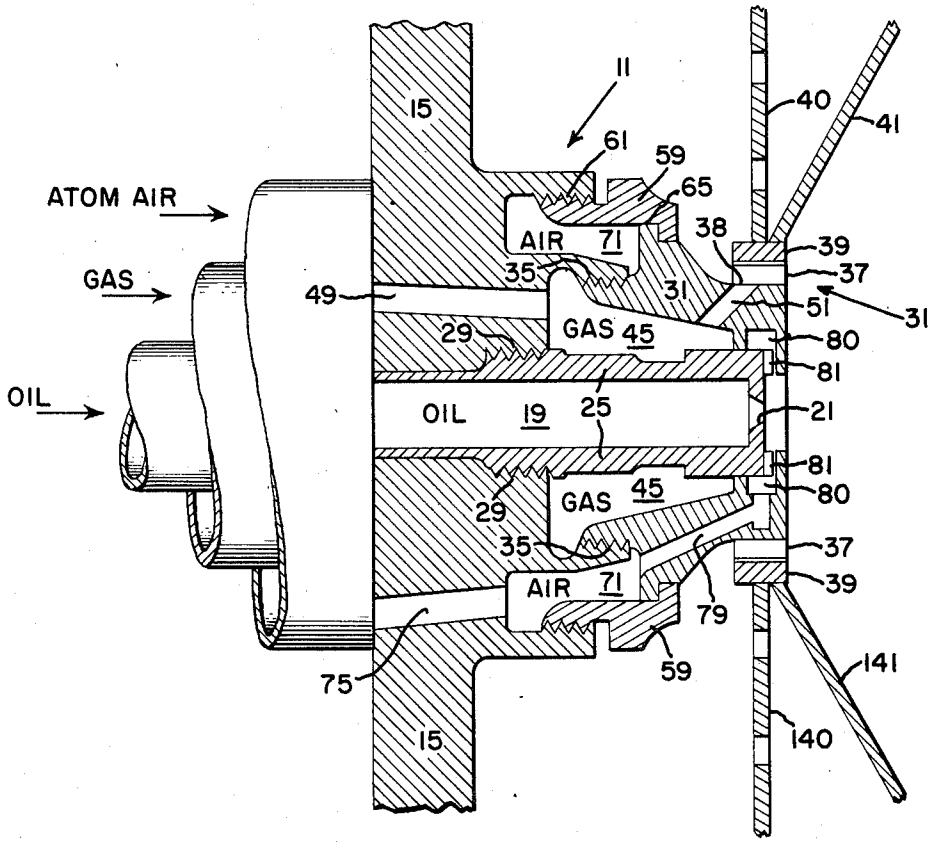
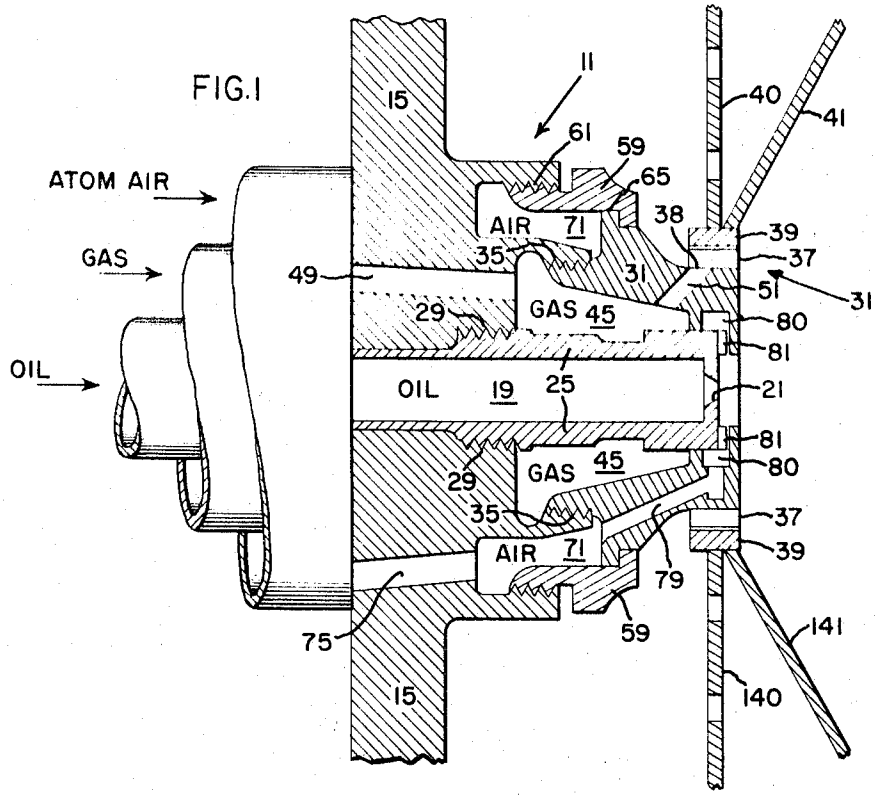


FIG.1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15
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59
65
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AIR 71
38
40
41
GAS
35
49
31
39
37
51
31
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GAS 45
80
81
OIL
OIL 19
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GAS 45
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35
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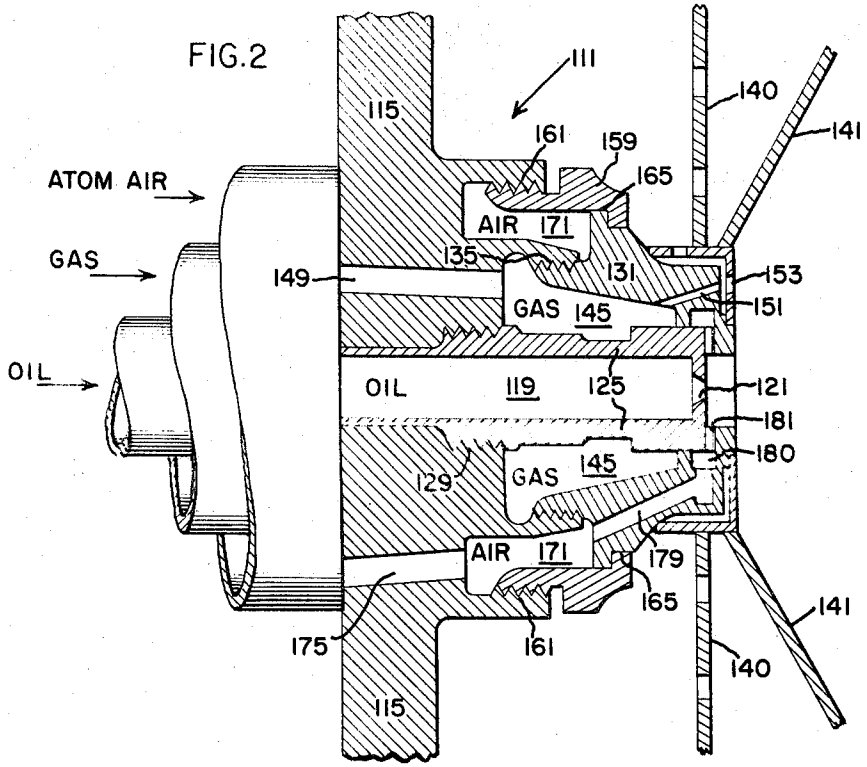
AIR 71
39
79
59
75
141
15
140

FIG.2


111
115
140
161
159
141
165
ATOM AIR
AIR 171
GAS
135
131
149
153
GAS 145
151
OIL
OIL 119
125
121
181
129
GAS 145
180
AIR 171
179
165
141
175
161
140
115

GAS COOLED DUAL FUEL AIR ATOMIZED FUEL NOZZLE

BACKGROUND OF THE INVENTION

This invention pertains in general to fuel nozzles of the type prevalent in gas turbine combustion chambers and in particular relates to dual fuel nozzles utilizing high-temperature atomizing air.

Liquid fuel which is to be utilized in a gas turbine combustion chamber must be atomized at the nozzle portion before proper combustion may take place. Atomizing the fuel consists in breaking down the fuel into fine particles to form a spray at the nozzle portion. There are generally two methods of atomizing fuel, i.e., pressure atomizing and air atomizing. Pressure atomizing comprises the sending of liquid fuel under high pressure through a greatly restricted orifice or nozzle. Air atomizing consists of striking liquid fuel with a high-temperature, high-pressure jet of air as the liquid fuel leaves the nozzle. This causes the liquid fuel to be broken down into particles and form a cone-shaped spray. Air-atomized nozzles have ecological advantages in that they reduce the amount of smoke present in the combustion process.

A dual fuel nozzle is one which may run on either gaseous fuel or liquid fuel. The criteria which determines which fuel is used may be based on economic considerations or supply considerations. In a dual fuel, air-atomized nozzle, high-temperature atomizing air is used in conjunction with the flow of liquid fuel. A problem arises when a transfer is made from liquid fuel to gaseous fuel in that a residuum of liquid fuel remains in the liquid fuel or oil passages of the nozzle and is subject to long periods of heat soaking which breaks down the oil into gums, carbon and varnish. One source of heat is the high-temperature atomizing air which usually runs adjacent and parallel to the liquid fuel passageway. The deposits of gums, carbon and varnish clog the small orifices in the nozzle and upon retransferring from gaseous to liquid fuels, the liquid fuel pressure becomes excessive and the flow restricted.

One method of attempting to reduce residuum bluidup, is by passing a reduced flow of atomizing air through the liquid fuel nozzle while running on gas This method has not been successful because the atomizing air passes over any nozzle clogs, not through them, and hence does not purge the oil from the system; also, the temperature of the atomizing air is such that it may induce thermal breakdown of the residuum of liquid fuel.

In a dual fuel, atomizing air fuel nozzle for a gas turbine combustion chamber, it is one object of this invention to prevent thermal breakdown of residuum liquid fuels and consequent nozzle clogs while the nozzle is running on gaseous fuel.

Another object of this invention is to lower the operating temperatures of the nozzle while the nozzle is running on liquid fuels.

Other objects and advantages will become apparent from the following description of the invention and the novel features will be particularly pointed out hereinafter in the claims.

SUMMARY OF THE INVENTION

A dual fuel, air-atomized fuel nozzle including a nozzle support ring having concentric flange portions and a center opening. A liquid fuel or oil pipe is disposed into the center opening and engages a first flange portion. A nozzle cap is disposed about the oil pipe and engages a second flange portion while defining an annular gas plenum. A retaining ring is partially disposed over the nozzle cap and engages a third flange portion while defining an annular atomizing air plenum. The atomizing air plenum is remotely positioned from the liquid fuel pipe to prevent the atomizing air from heating the liquid fuel or liquid fuel residuum. The gas plenum provides additional nozzle cooling when the nozzle is operating on gaseous fuel and further acts to prevent thermal breakdown of residuum liquid fuel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation view, partially in cross section, of a dual fuel, air-atomized nozzle with a swirler cap having the present invention applied thereto.

FIG. **2** is an elevation, partial cross section of a dual fuel, air-atomized nozzle with a shrouded nozzle cap having the present invention applied thereto.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. **1**, a dual fuel, air-atomized nozzle is shown generally at **11**, including a nozzle support ring **15**, which is secured to an outer casing (not shown).

The dual fuel air-atomizing nozzle has a central oil supply or liquid fuel pipe **19** connected at one end to a supply source (not shown) and terminated by an oil nozzle **21** at the other end. The oil nozzle and oil pipe are formed within a casing **25** having an exterior threaded portion. The threaded portion is secured into a first threaded flange portion **29** on the nozzle support ring **15.**

An air swirler nozzle cap **31** of the type disclosed in U. S. Patent Application Ser. No. 7,947, filed Feb. 2, 1970, for Edward P. Hopkins, now matured into U. S. Pat. No. 3,630,024, and assigned to the assignee of the present invention, is placed around the oil pipe casing **25.** The swirler cap **31** has external threads which are secured into a second threaded flange portion **35** on the nozzle support ring **15.** The swirler cap has a plurality of swirler blades **37** circumferentially arranged at the forward end of the swirler cap and having gas distribution holes **38** positioned between selected blades. A circumferential mounting ring **39** surrounds the swirler blades and positions a combustion chamber casing **40** and liner **41.**

An annular gas plenum **45** is defined by the nozzle support ring **15,** the oil pipe casing **25** and the nozzle cap **31.** The gas plenum is fed through a plurality (only one shown) of circumferentially arranged inlet pipes **49** which are connected to an outside supply pipe. Gas is then distributed from the plenum through selected swirler blades by means of a plurality (only one shown) of gas passages **51** which are circumferentially arrayed within the gas nozzle, each terminating in a gas distribution hole **38.**

A retaining ring **59** having an exterior threaded portion is secured into a third threaded flange portion **61** on the nozzle support ring **15** and is formed with an inwardly directed flange which abuts the swirler cap formed with a mating outwardly directed flange to form a seal **65.**

An annular atomizing air plenum **71** is defined within the retaining ring **59,** the nozzle cap **31** and the nozzle support ring **15.** The plenum **71** is supplied by means of a plurality (only one shown) of circumferentially ar-

ranged inlet pipes **75** which are connected to an outside supply pipe. Atomizing air is delivered to the nozzle face through a plurality of air passages **79** (only one shown) into a distribution ring **80.** The distribution ring **80** is an annulus adjacent the nozzle casing which feeds atomizing air to circumferentially arranged slots or openings **81** in the face of the casing **25** to distribute atomizing air to the fuel emanating from the fuel nozzle.

Referring now to FIG. **2,** a second embodiment of a dual fuel atomized fuel nozzle **111** is shown including a nozzle support ring **115.** A centrally mounted oil supply pipe **119** is connected at one end to an oil supply source and terminates at the other end in an oil nozzle **121.** The oil pipe is formed within a casing **125** having an exterior threaded portion. The threaded portion is secured within a first threaded flange portion **129** on the nozzle support ring.

A shrouded nozzle cap **131** is positioned about the front end of the oil pipe casing **125** and includes an exterior threaded portion which is secured within a second threaded flange portion **135** of the nozzle support ring. The outer portions of the shrouded nozzle cap contact a combustion chamber casing **140** and liner **141.** The nozzle support ring, the oil pipe casing and the shrouded nozzle cap define an annular gas plenum **145.** A plurality (only one shown) of circumferentially arranged inlet pipes **149** feed gaseous fuel from a supply pipe to the plenum which is distributed to the shrouded nozzle cap face through gas passages **151** and outlet holes **153** in the face of the nozzle cap. Both the gas passages and the outlet holes are circumferentially arranged about the nozzle cap.

A retaining ring **159** having an exterior threaded portion is secured into a third threaded flange portion **161** on the nozzle support ring **115** and is formed with an inwardly directed flange which abuts the nozzle cap **131** at an outwardly directed mating flange and holds it in place, as well as forming a seal **165.**

An annular atomized air plenum **171** is defined within the retaining ring **159,** the nozzle cap **131** and the nozzle support ring **115.** The plenum **171** is supplied by means of a plurality (only one shown) of circumferentially arranged inlet pipes **175** which are connected to an outside supply pipe. Atomizing air is delivered to the nozzle face through a plurality of air passages **179** (only one shown) into a distribution ring **180.** The distribution ring includes an annulus adjacent the nozzle casing **125** face which distributes atomizing air thereto through slots or openings **181** adjacent the fuel nozzle **121** opening.

OPERATION

There are two modes of operation inherent in the operation of a dual fuel nozzle. The nozzle may operate on liquid fuels such as oil or it may operate on gaseous fuel. When the nozzle operates on liquid fuel, hot atomizing air is sent through the air passages so that oil flowing through the oil nozzle is atomized. The atomizing air is at a temperature of about 350°F.

The nozzle may be switched to operate on gaseous fuel which is usually at a temperature of 70°–90°F. When the nozzle operates on gaseous fuel, the atomizing air passages carry a reduced amount of air and the oil pipe is shut off.

The problem arises when the nozzle is running on gaseous fuel in that a residuum of liquid fuel remains in the oil pipe and will break down into clogs of gum, carbon and varnish if the hot atomizing air pipe is adjacent the oil pipe. By transposing the gas and atomizing air conduits as taught by the present invention, residuum oil clogs are prevented because the atomizing air conduit is farther away from and separated from the oil pipe by the gas plenum **45, 145** and because the flow of relatively cool gaseous fuel cools the nozzle when the gaseous operation of the nozzle is in use.

A further benefit of the transportation of the gaseous and air atomizing pipes is that the nozzle itself will run cooler about 150°F when operating on liquid fuel.

While there is shown what is considered to be, at present, the preferred embodiment of the invention, it is, of course, understood that various other modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A dual fuel, air-atomized fuel nozzle of the type used in a combustion chamber for a gas turbine, said nozzle including:

a nozzle support ring having concentric flange portions and a center opening;

a liquid fuel conduit partially disposed within said center opening and engaging a first concentric flange;

an annular nozzle cap partially disposed about said liquid fuel conduit and engaging a second concentric flange to define an annular gas plenum with said support ring and said liquid fuel conduit;

at least one gas supply pipe interconnecting said gas plenum with a gas supply through said nozzle support ring; and, gas passageways through said nozzle cap interconnecting the gas plenum with said combusion chamber; and,

an annular retaining ring abutting said nozzle cap and engaging a third concentric flange to define an annular atomizing air plenum with said support ring and said nozzle cap, whereby said liquid fuel conduit is insulated from said atomizing air plenum by said gas plenum, gas supply pipe and said gas passageways.

2. The nozzle as recited in claim **1** wherein the nozzle cap is formed with a plurality of circumferentially arrayed blades disposed within the combustion chamber and having holes between selected blades; the gas passages interconnecting the gas plenum with the holes between circumferentially arrayed blades.

3. The nozzle as recited in claim **1** wherein the nozzle cap is formed with a plurality of concentrically arrayed outlet holes communicating with the combustion chamber and through the face of the nozzle cap; the gas passageways interconnecting the gas plenum with said circumferentially arrayed holes.

4. The nozzle as recited in claim **1** further including a plurality of atomizing air inlet pipes passing through the nozzle support ring and interconnecting the atomizing air plenum with an atomizing air supply.

5. The nozzle as recited in claim **4** further including a plurality of atomizing air passageways interconnecting the atomizing air plenum with a distribution ring in communication with an oil nozzle within the liquid fuel conduit.

6. The nozzle as recited in claim **1** wherein the first, second and third concentric flanges are threaded for easy assembly and disassembly.

7. The nozzle as recited in claim **1** wherein said nozzle cap and retaining ring are formed with inwardly and outwardly directed flanges forming a seal.

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