# United States Patent [19]

Roy

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[54] **APPARATUS FOR ATOMIZING LIQUID FUELS FOR THE COMBUSTION PROCESS**


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[52] **U.S. Cl.** ..... **239/403;** 239/431; 239/493

[51] **Int. Cl.**..... **B05b 7/10;** B05b 7/06

[58] **Field of Search**..... 239/8, 9, 132.5, 402–404, 239/406, 419, 425, 426, 431, 491, 493, 494, 496, 497, 399, 418, 421, 424.5



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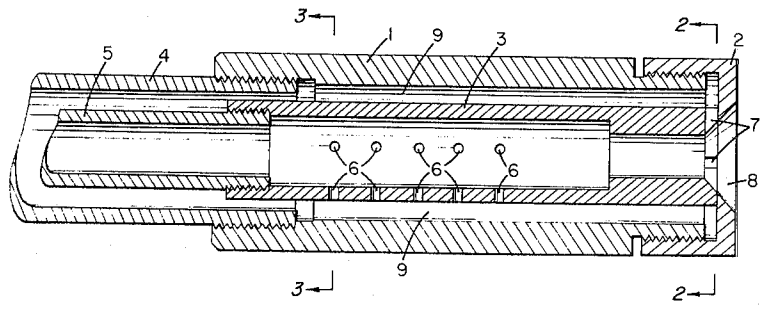
[57] **ABSTRACT**

A nozzle for atomizing large volumes of liquid fuel with steam, air or other conventional fluids. Liquid fuel is introduced into the inner body wherein the atomizing medium is admixed through apertures to lower the density of the fuel and effect a spiraling flow through the inner body. The fuel leaves the inner body through a single exit having a flow area not smaller than one-half the flow area of the main fuel supply conduit where an atomizing medium impinges onto and into the exiting stream to externally atomize the fuel and form a flow pattern that is essentially in the shape of a solid cone. This nozzle provides a solution to fouling problems normally encountered with both commercial grades of liquid fuels and combustible liquid process by-products. The nozzle has performed well with liquid fuels containing suspended solids up to one half inch in diameter and at rates up to 300 gph.


**2 Claims, 3 Drawing Figures**



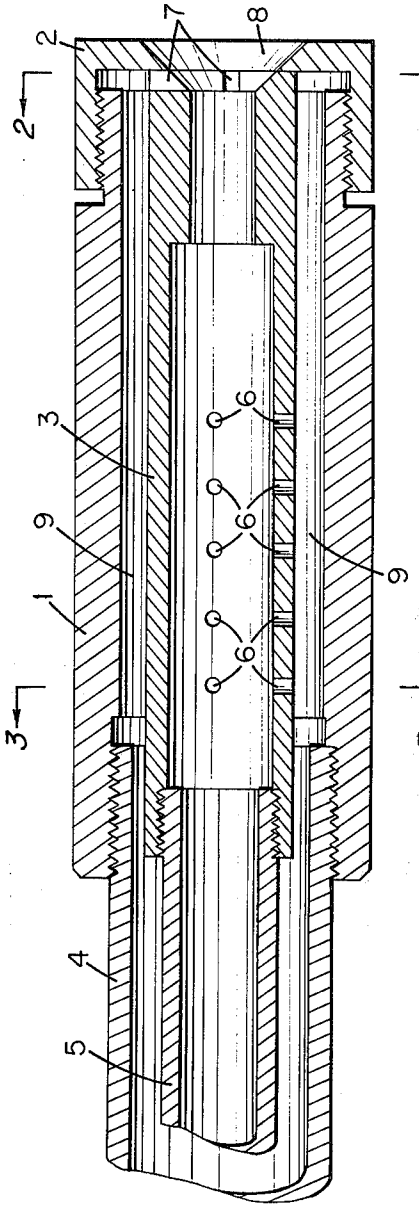



FIG. 1

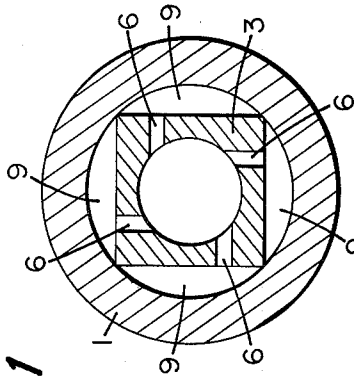



FIG. 3

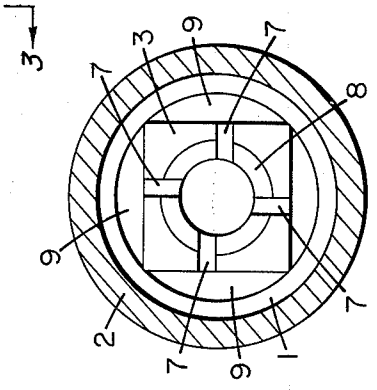



FIG. 2

# APPARATUS FOR ATOMIZING LIQUID FUELS FOR THE COMBUSTION PROCESS

## CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of application Ser. No. 228,491, filed Feb. 23, 1972 and now abandoned by the same inventor.

## BACKGROUND OF THE INVENTION

There is an increasing use of lower grades of liquid fuels by industry accompained by a downward trend in the number of assigned equipment operators. In addition to the combustion of conventional fuels, many processes yield undesirable liquid by-products where incineration is considered as the most suitable means of disposal.

The affects of the current energy crisis coupled with the ecological realizations that particulate emissions from the combustion process are detrimental to the environment have resulted in numerous conversions to liquid fuels from gaseous and solid fossil fuels.

All of these factors, reduced operating manpower, increased liquid fuel demand, process residue disposal and environmental protection have served to emphasize the need for more efficient and dependable liquid fuel burners.

There are two basic methods developed by the prior art employed to atomize liquid fuels for the combustion process. One method utilizes the conversion of fluid pressure to velocity energy whereby the liquid fuel exits the atomizing nozzle as a fine mist. Because of the restrictive passages in the nozzle, this means of atomization is generally limited to clean fuels having a low viscosity. The second method employs an atomizing medium (generally steam or compressed air) introduced prior to the final mechanical sub-division of the liquid fuel.

The mechanical sub-division in both of the basic methods of atomization contribute to rapid fouling from suspended solids in the fuel and the formation of carbonaceous deposits where the numerous exit orifices are exposed to high ambient temperatures. Such fouling restricts flow which in turn decreases the cooling afforded by the fuel. If the restrictions are not periodically removed, the nozzle is subjected to rapid heat deterioration.

## SUMMARY OF THE INVENTION

To overcome the aforementioned problems encountered in the prior art, this invention provides a nozzle that will pass large volumes of liquid fuel through a single exit port which minimizes the amount of surface area on which carbonaceous deposit formation can adhere. But more particularly the invention is characterized by having an exit port with a cross-sectional area which is never less than half of the flow area of the fuel supply conduit. The present nozzle employs a fuel supply having a 0.622 inch internal diameter and has an exit port which is one-half inch in diameter thus allowing virtually all solid impurities reaching the nozzle to pass without impediment.

Another object of the invention is to admix atomizing medium as the liquid fuel enters the inner body and to impinge atomizing medium onto and into the exiting mixture. This method of operation whereby the atomizing medium is applied before either the atomizing medium or the fuel stream is allowed to freely expand maximizes the affects of the atomizing medium to produce an atomized fuel pattern that is essentially in the shape of a solid cone.



## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal vertical section of the subject nozzle.

FIG. 2 is a sectional view on the line 2 — 2 of FIG. 1.

FIG. 3 is a sectional view on the line 3 — 3 of FIG. 1.

## DESCRIPTION OF THE INVENTION

Referring to the drawings, FIG. 1 shows supply line 5 which is positioned within a larger supply line 4, through which liquid fuel is supplied to the nozzle hereinafter described. Surrounding this said supply line 5 is a larger cylindrical supply line 4 through which flows an atomizing medium in the annulus formed by said fuel supply line 5 and said atomizing medium supply line 4. The fuel supply line 5 is fastened by conventional means, not shown, to the inlet of inner body 3 which is rectangular in cross-section with a cylindrical conduit centered along its longitudinal axis. The conduit inlet to said inner body 3 has a cross-sectional flow area that is about 0.5 $in^2$ and ranges from 1.3 to 2 times the cross-sectional area of said fuel supply line 5.

Said atomizing medium supply line 4 is coupled by conventional means, not shown, to an outer body 1 which is circular in cross-section with a cylindrical conduit along its longitudinal axis. Said inner body 3 with the corners of its rectangular cross-section serving as guide means to keep it centered, is positioned within said outer body 1 to form four atomizing medium flow paths 9, each having a cross-sectional area bounded by a flat of said inner body 3 and one-fourth of the circumference of said cylindrical conduit in the outer body 1.

A plurality of apertures 6 through the walls of the inner body 3 and offset from the longitudinal axis of the inner body 3 as shown in FIG. 3 provide communication between said atomizing medium flow paths 9 and the internal volume of said inner body 3.

The outer body is terminated in a retainer cap 2 attached by conventional means, not shown. The inner body 3 protrudes slightly beyond the outer body 1 and abuts against the inner face of said retainer cap 2. A plurality of slots 7 offset from the longitudinal axis of the inner body 3 as shown in FIG. 2 provide communication between said atomizing medium flow paths and the inner body 3 conduit exit 3 utilizing said inner face of the retainer cap 2 to cover the open side of the slots. Said retainer cap 2 terminates with an aperture 8 that in cross-section varies from the exit diameter of the inner body 3 conduit to a diameter that is larger.

In the preferred embodiment of the invention, the diameter of the conduit through the inner body 3 is reduced from twenty-three thirty-seconds to one-half inch about 1 inch from the point of exit for the purpose of maintaining a slight nozzle control pressure when operating at reduced fuel flow. The preferred imbodiment also provides for the apertures 6 through the inner body 3 walls and the slots 7 in the exit face of the inner body 3 to be offset in such a manner as to provide counter rotary forces to the fuel as it passes through the nozzle.

In order to exemplify the invention and to teach construction thereof, specific dimensions have been provided above. It is obvious that the equipment can be scaled in size to meet any of a wide range of capacities dictated by specific requirements and thus the invention should not be restricted to the above stated dimensions.

I claim:

**1.** In combination with a steam, air or other conventional atomizing medium/liquid fuel burner nozzle capable of passing large volumes of liquid fuel, having a liquid supply conduit to an inner body at its forward end, having means to supply and introduce atomizing medium into the inner body for the purpose of decreasing the fuel density and producing a rotary action to the fuel and having means to impinge atomizing medium tangentially onto and into the exiting stream to externally atomize the liquid with a resultant pattern in the shape of a solid cone, the improvements comprising:

a. a singular fuel passage through said inner body with a flow area that is larger than that of the fuel supply conduit and having an exit portion that is between about one half and about one times that of the supply conduit.

b. a plurality of ports extending inwardly from said atomizing supply means and in communication tangentially with the internal volume of said inner body in advance of the exit portion,

c. a plurality of ports extending inwardly from said atomizing supply means and in communication tangentially with the exit of said singular fuel passage.

**2.** A liquid fuel burner nozzle as defined in claim **1** wherein the atomizing medium is admixed within the inner body and at the nozzle exit prior to free expansion of the liquid stream.

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