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AIR ATOMIZING OIL BURNER

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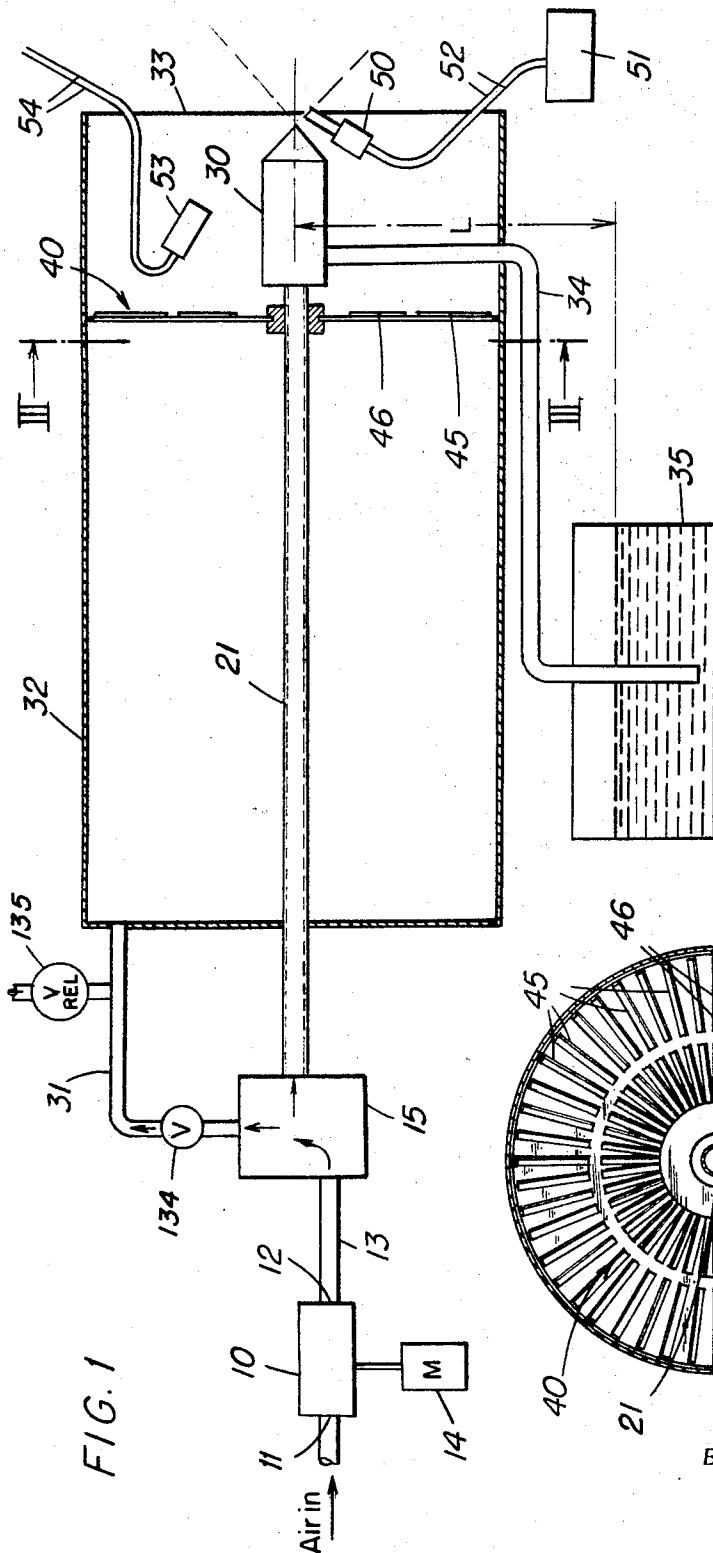


FIG. 1

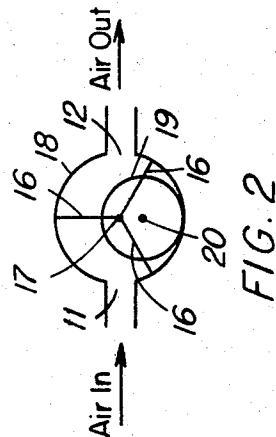


FIG. 2

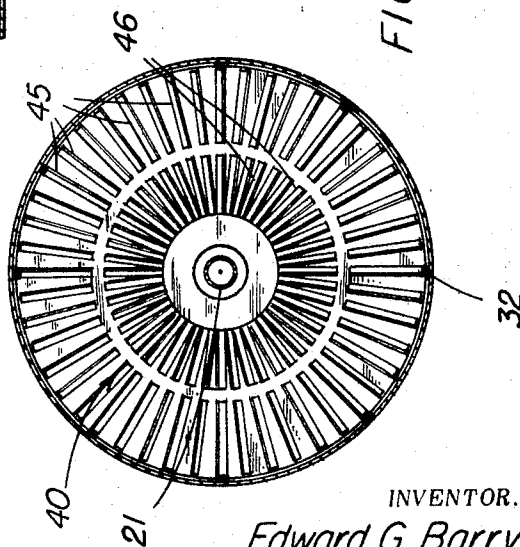


FIG. 3

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AIR ATOMIZING OIL BURNER

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6 Claims

ABSTRACT OF THE DISCLOSURE

An air atomizing low pressure or siphon type nozzle is located in the vicinity of the outlet end of a cylindrical chamber. A compressor supplies pressurized air to a plenum chamber and conduits are connected to the plenum to provide primary air to the nozzle and secondary air to the cylindrical chamber.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to an improved oil burner. More particularly, it relates to an improved air atomizing oil burner.

Description of the prior art

A problem in the oil burner art has been to provide a low cost air atomizing oil burner that is capable of efficient and reliable operation at low capacities on a distillate fuel. Research has been directed to providing such a burner for use in residential heating systems, space heaters, portable heaters, water heaters, incinerators and the like. Since the oil burner may be used in residential equipment, it must maximize combustion to provide clean, odor-free burning.

To aid in the development of low capacity air atomizing oil burners, the American Petroleum Institute published A Survey of Components for Use With Air-Atomizing Oil-Burner Nozzles, API Publication 1720, October 1961, by M. L. Yeager and C. L. Coffin. This survey discusses well known systems which use a low pressure nozzle, and systems which use a siphon type nozzle. In the systems using a low pressure nozzle, oil is pumped to the nozzle under a slight pressure, for example 1 to 15 p.s.i. and low pressure air is supplied to the nozzle to atomize the oil. In the systems comprising a siphon type nozzle, the flow of low pressure air through the nozzle provides both suction to lift the oil from a reservoir and energy to atomize the oil. A siphon type system that was considered by the authors of the survey is described in "Air-Aspirated Oil Burners," Conference Paper CP 61-11 by B. R. Walsh, Proceedings: API Research Conference on Distillate Fuel Combustion, API Publication No. 1541, Mar. 14-15, 1961.

The foregoing publications are concerned with providing primary air to a low capacity air atomizing nozzle to atomize the fuel supplied to the nozzle, and, in a siphon type system, to also provide suction to lift the fuel oil. The publications do not contemplate the need for supplying secondary air for combustion of the atomized fuel. It is known to use a fan to supply secondary air. However, a fan adds to the expense, is subject to breakdowns, and raises control difficulties when the operating conditions of the burner are varied.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an air atomizing burner which comprises a chamber having an end thereof opened to a combustion environment such as a furnace. An air atomizing nozzle is mounted interiorly of the chamber in the vicinity of the opened end. Means are provided for supplying fuel oil

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to the nozzle. A pressurized air reservoir means is operatively connected to the nozzle and the chamber by conduit means to provide a source of pressurized primary air to the nozzle and a source of pressurized secondary air to the chamber. The primary air source is used to atomize the fuel supplied to the nozzle, and the secondary air is used to aid in combustion of the atomized fuel. Means are also provided to supply pressurized air to the reservoir means. Thus, the present invention advances the art by utilizing as secondary air the air not necessary for primary air. By controlling the means for providing the pressurized air to the reservoir means, sufficient primary and secondary air may be provided to operate the system.

In accordance with another aspect of the invention there is provided an air compressor for supplying compressed air to the reservoir means. The air compressor has a round bore housing and a rotor eccentrically mounted in relation to the longitudinal axis of the bore housing. A plurality of vanes are rotatable about the axis of the housing. As the rotor rotates the vanes are driven by the rotor to provide relative motion between the vanes and the rotor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic diagram of an air atomizing burner with a sectional view of its blast tube,

FIGURE 2 is a schematic sectional view of an air compressor, and

FIGURE 3 is a cross-sectional view of the burner along line III—III of FIGURE 1 therefor.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Referring to FIGURE 1, the air compressor 10 is shown having an intake port 11 opened to the atmosphere and an exhaust port 12 connected to a conduit 13. The air compressor 10 may be of the type shown in FIGURE 2 wherein three vanes 16 pivot in the center 17 of a round bore housing 18. The vanes 16 are driven by an eccentrically mounted rotor 19 which rotates on its own center 20. The vanes 16 are radial to the housing 18 to provide a sealing effect. However, a few thousandths of an inch clearance is provided at the vane tips to minimize frictional loss. The displacement of the pump is a function of its vane-to-rotor center distance and the rotor diameter and length. The rotor 19 is generally cylindrical in shape and has three slots formed in its outer surface to permit relative movement between the vanes 16 and the rotor 19.

The compressor shown in FIGURE 2 is described in greater detail in the papers by W. B. Thompson that were published in the General Motors Engineering Journal, Third Quarter 1966, pp. 30-35, and in The General Motors Air Injection Reactor Air Pump, Automotive Engineering Congress, Detroit, Mich., Jan. 10-14, 1966, SAE 660108. A compressor of the type shown in FIGURE 2 may be Chevrolet part No. 5696211 CFB3.

The rotor of the air compressor 10 is driven by an electric motor 14 so that a flow of compressed air is supplied to a plenum chamber 15 via the conduit 13. A primary air conduit 21 connects the plenum chamber 15 to a siphon type air atomizing nozzle 30, and a secondary air conduit 31 connects the plenum chamber 15 to a cylindrically shaped secondary air handling tube or blast tube 32 that has one end 33 thereof opened to a combustion environment, such as a furnace. The secondary air handling tube 32 provides the air necessary for combustion of the atomized fuel exhausting from the nozzle 30. The primary air conduit 21 extends centrally of the secondary air handling tube 32 and the nozzle 30 is located in the vicinity of the opened end 33 of the secondary air handling tube 32.

A pressure control valve 134 is positioned in the secondary air conduit 31 to control the pressure within the plenum chamber 15. Thus, the plenum chamber acts as a primary air reservoir and all air not necessary for the nozzle passes through the secondary air conduit 31 to the secondary air handling tube 32. A relief valve 135 vented to the atmosphere may be provided in the secondary air conduit 31 downstream from the pressure control valve 134 to prevent the secondary air pressure from exceeding a predetermined maximum.

As discussed above under the "Description of the Prior Art," siphon type air atomizing nozzles are known in the art. Siphon type nozzles suitable for the practice of this invention are manufactured by Delavan Manufacturing Company, West Des Moines, Iowa and are listed in Delavan's Catalog 600 under Catalog Nos. SNA .20, SNA .30, SNA .40, SNA .50, SNA .65, SNA .75, SNA .85 and SNA 1.00. Capacities of representative Delavan nozzles are shown in the following table.

Catalog Number	3 p.s.i. Air		4 p.s.i. Air		5 p.s.i. Air		Lift Height (inches)
	Fuel, g.p.h.	Air, c.f.m.	Fuel, g.p.h.	Air, c.f.m.	Fuel, g.p.h.	Air, c.f.m.	
SNA .20-----	.19	.36	.23	.45	.25	.49	1
	.16	.36	.20	.45	.22	.49	4
	.14	.36	.17	.45	.20	.49	7
SNA .50-----	.48	.50	.54	.59	.58	.65	1
	.43	.50	.50	.59	.53	.65	4
	.38	.50	.46	.59	.48	.65	7
SNA 1.00-----	.96	.73	1.10	.91	1.15	1.02	1
	.84	.73	1.00	.91	1.06	1.02	4
	.72	.73	.90	.91	.97	1.02	7

The capacities shown in the above table are based on the minimum air pressures and air volumes possible for good atomization and lift characteristics.

The primary air flow from the primary air conduit 21 through the siphon type nozzle 30 provides suction to lift the oil from an oil reservoir or a constant level device 35 through an oil conduit 34 to the nozzle 30, and energy for atomizing the oil. The oil conduit 34 bends within the nozzle 30 to carry the oil along the longitudinal axis of the nozzle 30 to the vicinity of the nozzle orifice. In the nozzle 30, the compressed primary air passes exteriorly of the portion of the oil conduit 34 within the nozzle 30 and is directed inwardly and in the direction of flow through grooves formed in a swirl stem that is mounted axially of the outlet end of the oil conduit 34. The primary air flow causes the oil to be aspirated from the outlet end of the oil conduit 34 and through an axial inlet in the swirl stem, and to be atomized by the primary air in a nozzle swirl chamber prior to discharging through the nozzle orifice.

Referring to the above table, the lift height noted in the table is the distance L between the longitudinal axis of the nozzle 30 and the level of the oil in the reservoir 35. As shown in the table, a SNA .20 nozzle receiving primary air at 3 P.S.I. is capable of lifting .19 g.p.h. of fuel a lift height of 1 inch and of supplying .36 c.f.m. of primary air for atomization. In comparison, a SNA 1.00 nozzle receiving primary air at 5 p.s.i. is capable of lifting .97 g.p.h. of fuel a lift height of 7 inches and of supplying 1.02 c.f.m. of primary air for atomization. If the combustion application does not permit a constant level device 35, a fuel metering pump may be used to provide the necessary flow rate of fuel oil.

Therefore, the pressure control valve 134 is set to maintain the pressure of the primary air in the plenum 15 at a value sufficient to meet the desired characteristics of the nozzle 30. For example, when any one of the Delavan nozzles listed in Catalog 600 is used, the pressure control valve 134 preferably should be capable of controlling the pressure within the plenum 15 between about 2 p.s.i. and 5 p.s.i.

An air diffuser 40 may be mounted transversely of the longitudinal axis of the secondary air handling tube 32 to evenly distribute and impart a rotary motion to the

secondary air passing through the handling tube 32. The diffuser 40 shown in cross section in FIGURE 1 and in FIGURE 3 has two series 45, 46 of slots which impart a rotary motion to the secondary air. Any well known diffusers may also be used, for example a radially mounted fin arrangement.

When the compressor described hereinabove with reference to FIGURE 2 is used, the electric motor 14 is preferably operated at 1725 r.p.m. If an increased air compressor output is required, a gear arrangement may be used to increase the speed of the rotor.

Another means of increasing the amount of secondary air for combustion may be provided by mounting a fan (not shown) to the left of FIGURE 1 and within a structure containing the combinations of elements discussed hereinabove. The structure would require sufficient air ports and permit the passage of air from the fan to the combustion environment via means exterior to the secondary air handling tube 32.

An electrode assembly 50-52 is provided to ignite the combustible mixture of oil and air in the vicinity of the nozzle orifice. Any number of well known electrode assemblies may be used, and they usually comprise a high voltage transformer 51 for supplying a high voltage to an electrode 50 via a pair of leads 52.

Suitable safety devices are contemplated. For example, a cadmium sulfide photoelectric cell 53 may be mounted to sense the flame. If the photoelectric cell fails to sense the flame, it actuates a switching device (not shown) connected to the cell leads 54 to remove electrical power from the transformer 51, from the motor 14 and other electrically operated devices that may be used.

A stack switch may also be used to remove electrical power from electrically operated elements in a burner when the heat change indicates that combustion has ceased.

The invention also contemplates the use of well known low pressure nozzles wherein the fuel oil is pumped to the nozzle under low pressure, for example 1 to 15 p.s.i.

Since various changes and adaptations may be made to the disclosed specific embodiments without departing from the intent of the invention, it is intended that the foregoing description be considered as illustrative of the present invention and that the only limitations are those recited in the appended claims.

What is claimed is:

1. An air atomizing burner comprising a blast tube having an opened end thereof adapted to be positioned in a combustion environment, an air atomizing nozzle mounted interiorly of said blast tube for directing atomized fuel oil through said opened end, means for supplying fuel oil to said nozzle, means for providing a reservoir of pressurized air, first conduit means operatively interconnecting said reservoir means and said nozzle for providing a source of pressurized primary air to said nozzle to atomize the fuel supplied to said nozzle, second conduit means operatively interconnecting said reservoir means and said blast tube for providing a source of pressurized secondary air to said blast tube, means in said second conduit means for maintaining the air in said reservoir means at a predetermined pressure, and means for supplying compressed air to said reservoir means.

2. An air atomizing burner comprising a chamber having an end thereof opened to a combustion environment, an air atomizing nozzle mounted interiorly of said chamber in the vicinity of said opened end, means for supplying fuel oil to said nozzle, means for providing a reservoir of pressurized air, first conduit means operatively interconnecting said reservoir means and said nozzle for providing a source of pressurized primary air to said nozzle to atomize the fuel supplied to said nozzle, second conduit means operatively interconnecting said reservoir means and said chamber for providing a source of pressurized secondary air to said chamber, means in said sec-

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ond conduit means for maintaining the air in said reservoir means at a predetermined pressure, means in said second conduit means and downstream of said pressure maintaining means for preventing the secondary air provided to said chamber from exceeding a predetermined pressure, and means for supplying compressed air to said reservoir means.

3. The burner of claim 1 including means for distributing the secondary air throughout said blast tube and for imparting rotary motion to the secondary air.

4. The burner of claim 1 wherein said nozzle is a siphon type nozzle.

5. The burner of claim 4 wherein said means for supplying compressed air to said reservoir means comprises an air compressor having a round bore housing, a rotor eccentrically mounted in relation to the longitudinal axis of the housing, a plurality of vanes rotatable about the axis of the housing, and extending through said rotor,

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and means for driving said rotor, whereby the vanes are driven by the rotor to provide relative movement between the vanes and the rotor.

6. The burner of claim 1 further including means in said second conduit means and downstream of said pressure maintaining means for preventing the secondary air provided to said blast tube from exceeding a predetermined pressure.

References Cited

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EDWARD G. FAVORS, Primary Examiner

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239—434, 127; 431—182, 188