Dec. 20, 1966 G. R. SMITH 3,292,682

VAPORIZING OIL BURNER

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FIG. 1

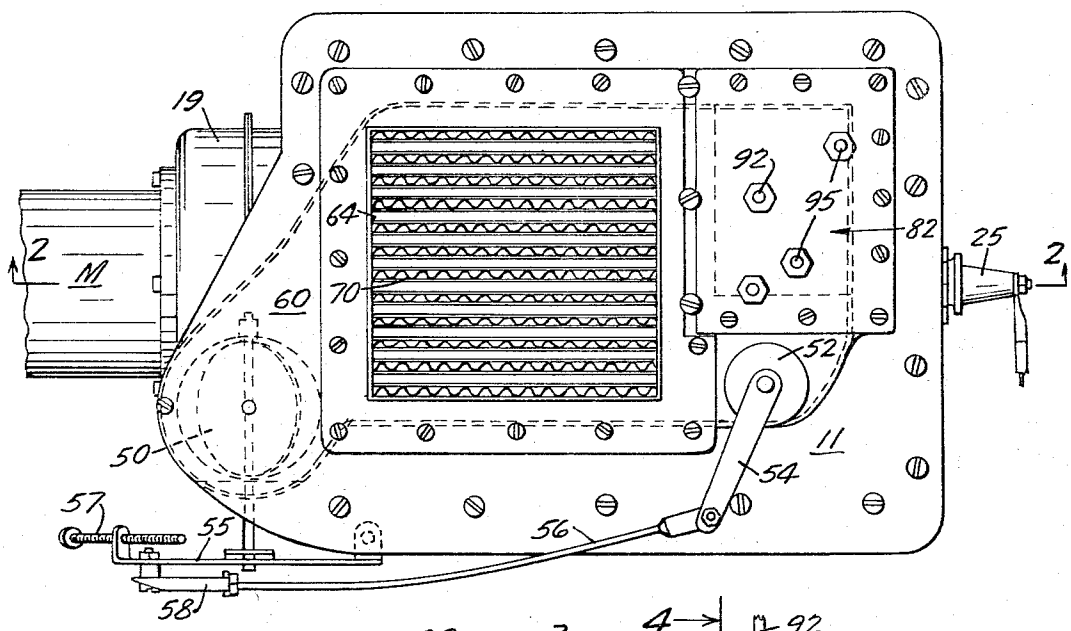
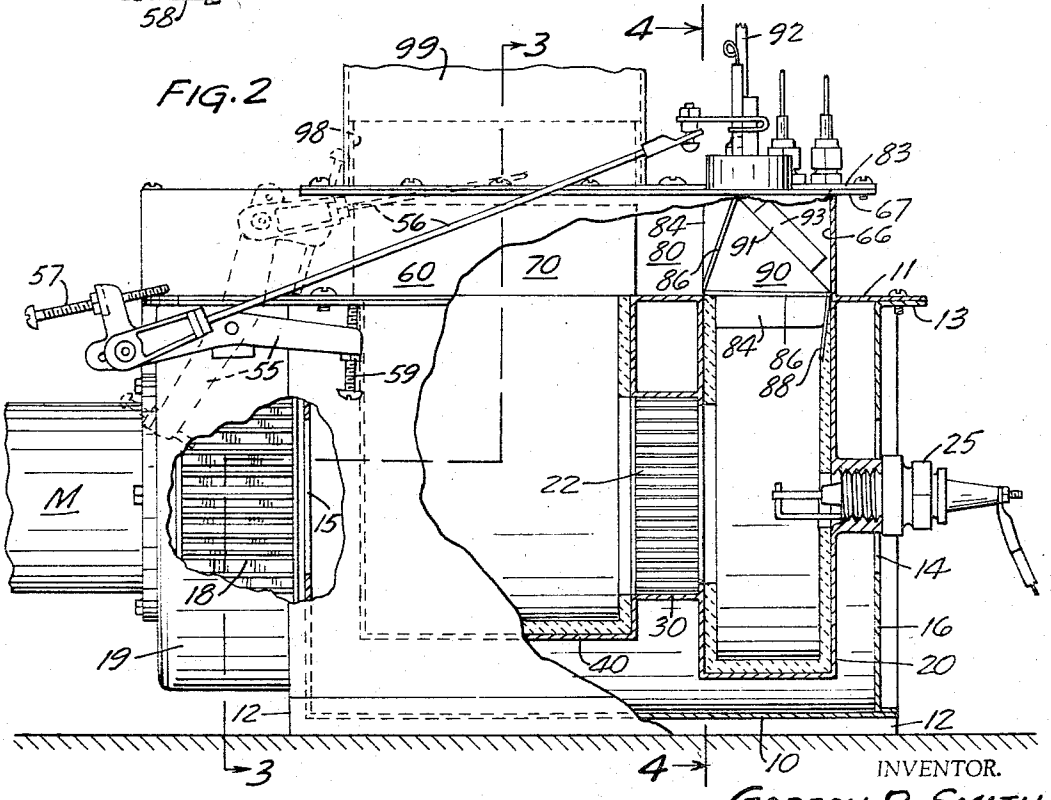


FIG. 2



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FIG. 3

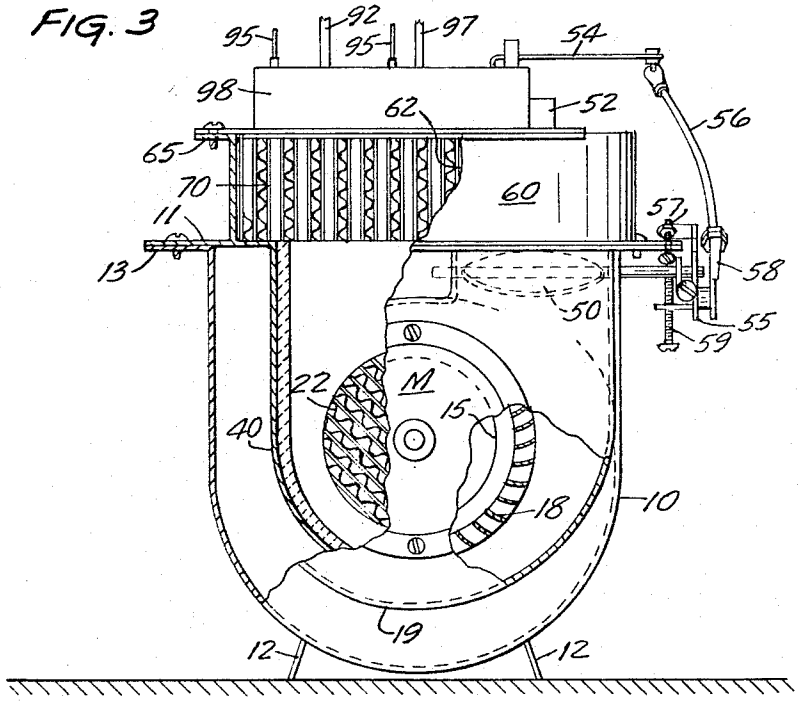


FIG. 4

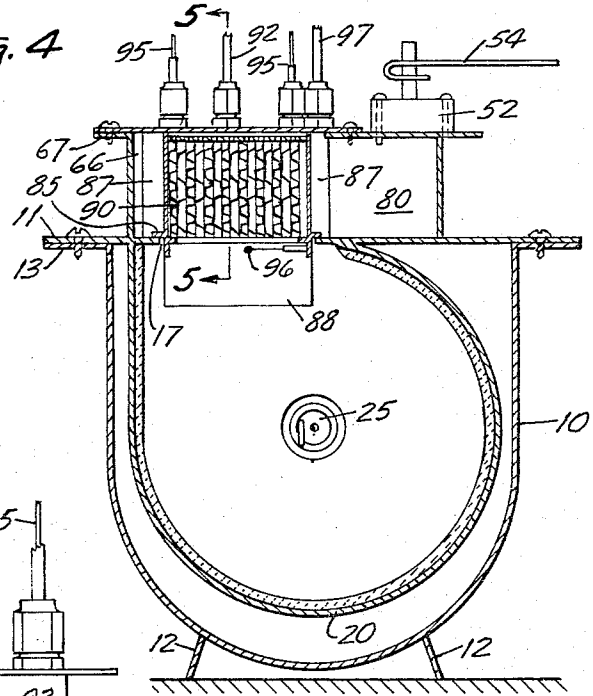
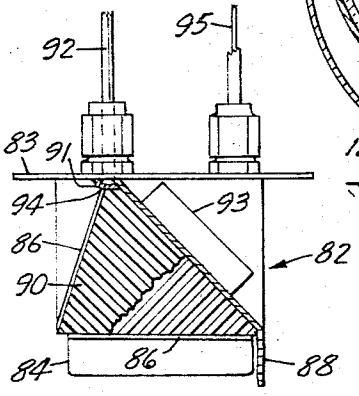


FIG. 5



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3,292,682

VAPORIZING OIL BURNER

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4 Claims. (Cl. 158—4.5)

This invention relates to a method for volatilization of fluid fuels and to burners employing the method.

In oil burners of the type used for domestic heating it is conventional either to spray the oil (a No. 1 or No. 2 fuel oil) under pressure into the fire box together with a suitable supply of air; or without pressure to employ a puddle of oil or to permit the oil to seep or trickle into a firepot. The former has the disadvantage that the spray is through a fine orifice which readily becomes plugged by fine particles or may become enlarged by wear or the diameter of which may also be changed by corrosion. The latter two methods have the common disadvantage that for an appreciable time before combustion the oil may be at temperatures in the cracking range without actually burning and this tends to produce soot and smoke, or may lead to foul odors or caking. In all cases it is desired to obtain a combustible mixture of air and fuel vapors.

It is an object of this invention to provide a method for forming combustible mixtures of vaporized fuel and air with substantial avoidance of cracking of the fuel.

A further object of this invention is to provide an oil burner in which the tendency to smoke is minimized.

Yet other objects of the invention will become evident from the disclosure herein.

In accordance with the above and other objects of the invention it has been found that by employing a cross-flow heat-exchanger in the flue line of an oil burner and preheating the intake air by the said heat-exchanger, and desirably further preheating the air by passage around the fire box and combustion chamber of the oil burner, the temperature of the air can be brought to a sufficiently high temperature that oil admitted into the air stream (as will become evident hereinafter) is substantially instantaneously volatilized and thoroughly mixed therewith to give a combustible mixture with substantially no cracking of the oil.

The success of this method depends upon the employment of a relatively simple device which permits of rapid distribution of the liquid oil over a very large area in intimate contact with substantially the entire air stream. This avoids the difficulties attendant upon having droplets of oil which as is well-known have a minimum surface and also the difficulties when greater masses, e.g. puddles, of oil are exposed to a stream of hot air.

The device in a preferred embodiment is basically a prism of triangular undulate ceramic sheets adhered at the points of intersection of ridges. One face of the prism which is the side from which the hot air stream enters, is smaller than either of the other faces. The latter faces are not necessarily equal in areas but should be within a ratio of not more than about 2 to 1. The faces through which the stream of gas passes should have a ratio approximately equal within about 50 percent to the ratio of the volume of hot combustible mixture produced to the volume of hot air. Suitable ceramic materials are available by the same procedures as described in my U.S. Patent No. 3,088,271.

The prism is disposed horizontally that is with the undulate sheets being generally vertical and the undulations non-horizontal and preferable at inclinations of about 45°. Oil is applied along an upper edge by means such as a slotted distributor which effects substantially uniform distribution along the entire edge.

The face of the prism which is not employed for air passage may be blocked off by application of ceramic or conveniently by an electrically heated primer which serves to initiate volatilization of the oil.

Similar structures are made of materials such as metal and even organic materials for particular purposes, for example, in humidifiers, chemical reactors and other such operations. It is generally not necessary that these prismatic vaporizers of the invention be absorbent because volatilization proceeds rapidly and substantially no wicking action can occur. It is preferred that these structures be no more porous than well-fired ceramics for use in the oil burner of the invention where the refractoriness of ceramics is particularly useful.

The uneven surfaces of ceramics are further advantageous as providing somewhat greater surface area for volatilization.

The operation of my invention will become evident from a consideration of the drawings herewith wherein:

FIGURE 1 is a top view of an oil burner of the invention.

FIGURE 2 is a side elevation broken away to show partial cross-sections along the line **2**—**2** of FIGURE 1.

FIGURE 3 is an end elevation broken away to show partial cross-sections along the line **3**—**3** of FIGURE 2.

FIGURE 4 is a cross-sectional view along the line **4**—**4** of FIGURE 2.

FIGURE 5 is a cross-sectional detail along line **5**—**5** of FIGURE 4.

Referring now to the figures, in which identical parts bear the same indicia, air is drawn into the outer casing **10**, having supports **12**, at port **14** through flanged closure **16** and passes around fire box or combustion chamber **20** and plenum **40** connected by duct **30** and attached to the under side of closure **11** of the outer casing **10**, to fan **18** rotated by motor "M" or other suitable means within fan casing **19** attached to the outer casing **10** over port **15** in the outer casing. In passing between the outer casing and fire box **20** and plenum **40** the air serves as insulation so that the outer casing is not much more than warm to the touch when the burner is operating. Also, the air is warmed slightly by heat which would otherwise be lost. The air as it enters the fan is thus slightly preheated and is blown upward through butterfly damper **50** (shown in partially open position as at the start up of the burner in FIGURES 1 and 3) into the cool end plenum **62** of the housing **60** (attached to the upper surface of closure **11**) and through cross-flow heat-exchanger **70** within housing **60** where it is heated by the flue gases (after the burner is operating) to a temperature above about 500° C. and passes into the hot end plenum **80** of housing **60**, the plenum serving as means connecting the cross-flow heat-exchanger and fire box, and then passes, with increase in linear flow rate, through fuel oil evaporator **90** where it evaporates sufficient fuel to form a combustible mixture which burns in fire box **20**. The very hot flue gases from fire box **20** pass through ceramic combustion grid **22** (which is very hot and assures complete combustion as well as acting as a flame arrestor) in duct **30** into plenum **40** and from there upward through cross-flow heat-exchanger **70** (where incoming air is heated as noted above) and into a suitable air heater or other device for recovery of sensible heat and disposal of flue gases, here represented by collar **98** to which such a device may be attached as indicated in FIGURE 2 by the duct **99**.

Returning to the details of construction, in FIGURE 2, it will be seen that fire box or combustion chamber **20** and plenum **40** have insulating ceramic linings and duct **30** is shown welded therebetween. It will be under-

stood that the method of construction is a matter of convenience and is not critical to the invention. Thus it is particularly convient to weld fire box **20**, plenum **40** and housing **60** to closure **11** which is then bolted to flange **13** of outer casing **10**. Housing **60** is provided with a first opening **64**, having flange **65**, within which heat exchanger **70** rests on the surface of closure **11** and is positioned by suitable clips and refractory packing, and with a second opening **66** having flange **67** within which the oil evaporator subassembly **82**, shown in cross-section in FIGURE 5, is positioned. Housing **60** is further fitted with thermostatic control means **52** in hot end plenum **80** adapted to control the opening of butterfly valve **50** by movement of arm **54** and shaft **56** adjustable as to length by positioning of yoke **58** attached to lever arm **55** having open and closed stopping means **57** and **59** respectively.

Oil evaporator subassembly **82** has base plate **83** which serves as closure of opening **66** and support for frame **84** having wing ledges **85** effecting closure of opening **17** through closure **11** into fire box **20**. Frame **84** has internal retaining means **86** for positioning oil evaporator **90** therein and attachment means, such as flanges **87**, for attachment of heater block **93**, which serves to retain oil evaporator or volatilizer **90** and oil distributor **91**, and for the further attachment of drip surface **88**.

Oil distributor **91** is provided with inlet **92** and distribution slot **94** and is conveniently constructed by folding a sheet of metal back on itself at the approximate point of attachment of the inlet, cutting one leg slightly below the bend and welding the cut off piece to the other leg so as to leave an aperture or small slot along the line of cutting.

Heater block **93** is provided with insulated leads **95** connected to a suitable source of electricity (not shown) and, in addition to incidentally retaining oil evaporator **90** as noted, is employed to provide heat to the fuel at start-up of the burner.

Ignition means are provided for the burner as shown in the figures by a solitary electrode **96** having well insulated lead **97** and spark plug **25** and are energized by the high voltage leads of a suitable, conventional, high voltage transformer (not shown), the entire body of the burner being attached to the mid-tap or ground lead of the transformer at any convenient point. Electrode **96** thus arcs to frame **84** or drip surface **88** (which is grounded to frame **84**) at a point near oil distributor **90** and spark plug **25** arcs in the vapor stream in fire box **20** thus doubly insuring ready ignition.

Those skilled in the art will readily appreciate that modifications in the design of burner incorporating fuel volatilizers are possible without the scope of the present invention which is only limited by the appended claims.

What is claimed is:

1. In a burner adapted for the combustion under forced draft of combustible mixtures of vaporized fluid fuel and air and provided with ignition means and a fire box, the combination of

(I) a cross-flow heat-exchanger adapted to pass at least a part of flue gases from said fire box in one direction and to pass intake air under forced draft in another direction at substantially right angles,

(II) connection means connecting said cross-flow heat-exchanger at the face of egress of intake air to said fire box,

(III) at least one prismatic fuel volatilizer consisting essentially of an assemblage of superimposed corrugated ceramic sheets of triangular shape having the axes of corrugation in adjacent sheets nonparallel and mutually at angles of from about 90° to about 120°, said sheets being ceramically adhered at points of contact of ridges of consecutive sheets, said fuel volatilizer having one face of lesser area than either other face and being positioned in said connection means with said axes of corrugation in perpendicular planes in directions other than horizontal and with said face of lesser area adapted to receive air after passage through said heat-exchanger and one other face adapted to discharge air into said connection means nearer said fire box and

(IV) means distributing fluid fuel substantially uniformly along an upper edge of said prismatic fuel volatilizer.

2. In a burner adapted for the combustion under forced draft of combustible mixtures of vaporized fluid fuel and air and provided with ignition means and a fire box, the combination of

(I) a cross-flow heat-exchanger adapted to pass at least a part of flue gases from said fire box in one direction and to pass intake air under forced draft in another direction at substantially right angles,

(II) air intake ducting means providing intake air to said cross-flow heat-exchanger, at least a part of said ducting means being external to and at least in part surrounding said fire box,

(III) connection means connecting said cross-flow heat-exchanger at the face of agress of intake air to said fire box,

(IV) at least one prismatic fuel volatilizer consisting essentially of an assemblage of superimposed corrugated ceramic sheets of triangular shape having the axes of corrugation in adjacent sheets nonparallel and mutually at angles of from about 90° to about 120°, said sheets being ceramically adhered at points of contact of ridges of consecutive sheets, said fuel volatilizer having one face of lesser area than either other face and being poitioned in said connection means with said axes of corrugation in perpendicular planes in directions other than horizontal and with said face of lesser area adapted to receive air after passage through said heat-exchanger and one other face adapted to discharge air into said connection means nearer said fire box and

(V) means distributing fluid fuel substantially uniformly along an upper edge of said prismatic fuel volatilizer.

3. As an article of manufacture, a liquid volatilizer consisting essentially of an assemblage of superimposed corrugated sheets of triangular shape having the axes of corrugations in adjacent sheets non-parallel and mutually at angles of from about 90° to about 120° and adjacent sheets being adhered at points of contact of ridges, the edges of said sheets defining faces of a prism.

4. A process for the volatilization of a vaporizable liquid material compirsing the steps of

(I) continuously supplying said liquid material to an upper edge of an assemblage of generally vertically disposed superimposed corrugated triangular sheets, the edges of said assemblage being defined by the apices of said sheets; the axes of corrugation of all sheets being at an angle from horizontal and of adjacent sheets being non-parallel and mutually at angles of from about 90° to about 120° and adjacent sheets being adhered at points of contact of ridges and

(II) passing carrier gas, at a temperature sufficient to provide heat of vaporization for said liquid material, through said assemblage.

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