

United States Patent

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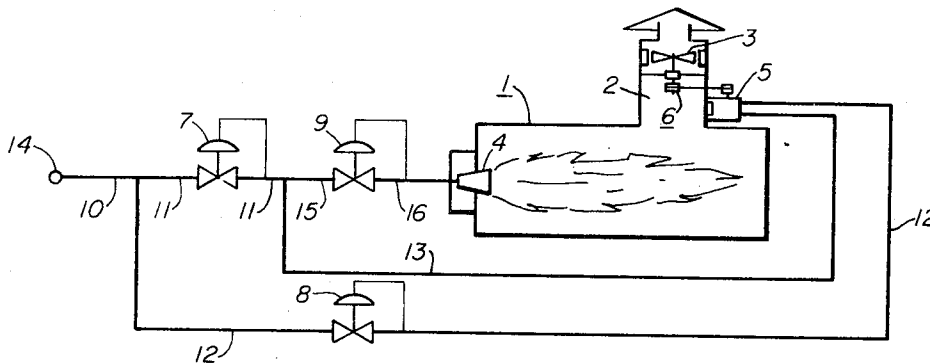
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[54] **METHOD AND MEANS FOR INDUCING DRAFT IN A STACK**
7 Claims, 3 Drawing Figs.

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431/2, 431/157
[51] Int. Cl. F23I 17/00
[50] Field of Search 431/2, 157,
158, 253, 20; 110/162

ABSTRACT: A fan is arranged in the exhaust stack of a fluid fuel burning heater to induce draft. The energy of a high pressure fuel line is tapped to power a fluid-driven motor which in turn drives the fan. The fuel is then burned in the heater. Fuel line pressures and flow rates are controlled as required.



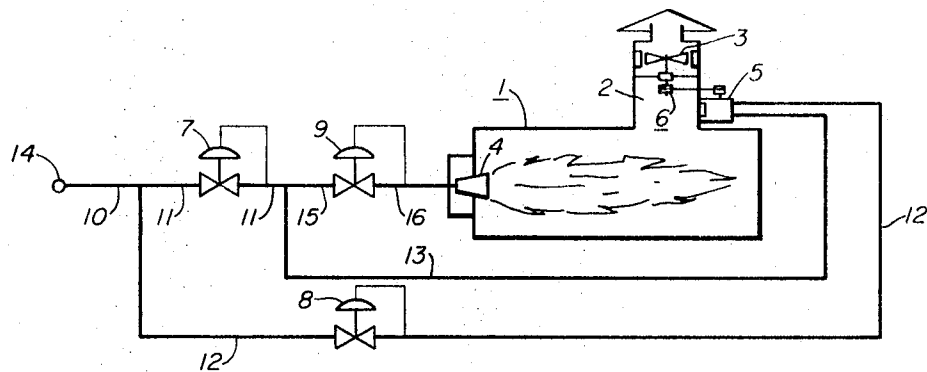


Fig. 1.

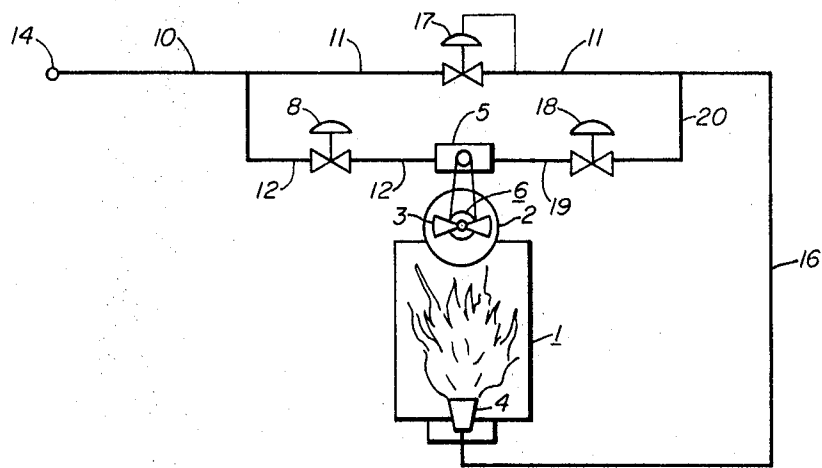


Fig. 2.

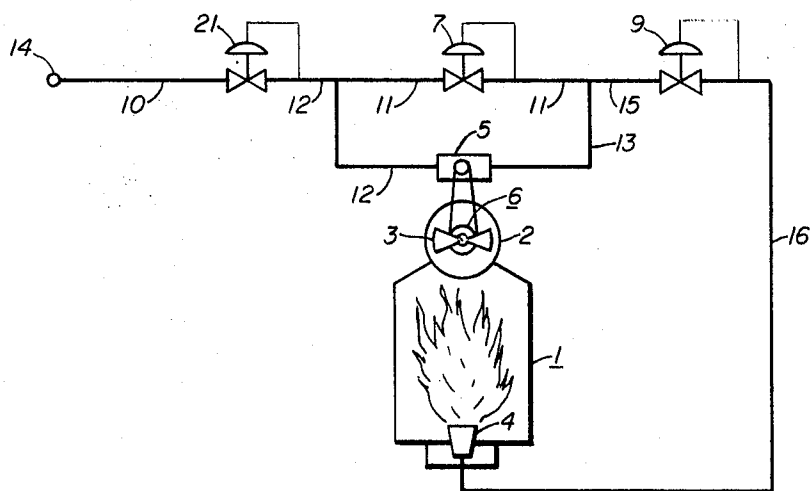


Fig. 3.

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METHOD AND MEANS FOR INDUCING DRAFT IN A STACK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The instant invention relates to utilizing a fan to induce draft in an exhaust stack of a heater to reduce the height of the stack. More particularly, the invention relates to utilizing the pressure of a high fluid pressure fuel line as an energy source to operate a fluid-driven motor which drives the fan. The fuel is burned in the heater after it has expended a portion of its energy through the motor; pressures and volumes of the fuel passing to the burner are regulated. 2. Description of the Prior Art

The environmental demands of society and industry have long been in conflict. For example, the demand by the population for pleasing and orderly living space is sharply contrasted to the demand for full exploitation of mineral resources by industry.

This conflict has been resolved in certain areas in regard to secondary recovery of oil by steam flooding. Steam flooding requires steam generators of unsightly proportions. Local ordinances have thus limited the height of such units above ground level to minimize their visual impact. Since large heaters of this type require tall stacks to provide sufficient draft for the heater, to satisfy the new laws a method must be found to reduce stack height. This must be done economically and, if possible, without additional equipment such as compressors, since many locales also enforce antinoise laws. Areal space available is also limited in populated regions. For these and other reasons, operators have found setting heaters in open pits to be unsatisfactory.

It is recognized that a properly designed exhaust stack is critical in the efficient operation of a heater which burns gaseous fuel. The parameters of stack design are well known. For example, stack height and diameter affect the draft through the stack, and thus control both the exhaust of products of combustion from the heater and fresh air flow into the heater. When the natural flow due to draft through a stack (the "stack effect") is insufficient to handle the volume of gasses required, an induced draft may be produced mechanically by fans. This technique is commonly used to increase the flow through a stack of a given or particular size.

Since stack effect varies as the height of the stack, one solution has called for reducing stack height by replacing natural draft with induced draft. It is to this solution that the instant invention is directed.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a heater with a reduced height stack by use of an improved induced draft system for the stack.

Another object of the invention is to provide a fan operated by a fluid-powered motor as the cooperating means for inducing draft in the stack of the heater.

Another object is to utilize energy of the unburned high pressure fluid of the fuel line as the energy source to drive the fluid-powered motor.

Another object is to regulate the pressure drop of the fluid in the various segments of the fuel line so that a portion of the unburned fluid driving the fluid-powered motor is also available to the burner of the heater.

The invention contemplates a heater system in which gas is the fuel. This fuel gas is available at the source at a pressure which is high relative to the pressure at which the gas is used by the burner mechanism of the heater.

A fluid-powered motor is interposed in the fuel line and is driven by the pressure energy of the high pressure fluid in the fuel line. The motor in turn drives a fan which is situated so that draft is induced in the exhaust stack of the heater. Then fuel is regulated on the discharge side of the fluid-powered motor and burned by the heater. The dimensions of the stack may be minimized, since natural draft alone is not relied upon.

The invention also contemplates the use of pressure regulator valves in the fuel line. These valves reduce the high pressure of the gas as it is supplied from the source to the lower pressures required by the motor and burner elements of the system. The valves also insure adequate volumes of gas are present for the work to be done by the system.

The invention utilizes a fluid-powered motor. Such "fluid-powered" motors are often called "air motors," and will be referred to hereinafter as air motors. These motors, which are driven by the pressure energy of a compressed fluid rather than by a fuel burned by the motor, are well known as a source of motive energy. Typical air motors are available from Gast Manufacturing Company, P. O. Box 17, Benton Harbor, Mich. Please note also that "fluid" is used herein in its common and dictionary sense to mean gas or liquid. It is contemplated that the particular type of heater in the preferred embodiment will utilize a gas or vapor as fuel.

The present invention focuses then upon a system in which an air motor provides the driving force for a fan in an induced draft stack of a heater. The invention offers a novel combination whereby stack height may be reduced, and solves certain problems inherent in the integration of a source of compressed gas with a heater system.

Other objects, advantages, and features of this invention will be apparent to one skilled in the art upon consideration of the specification, claims and drawings attached hereto, wherein:

FIG. 1 is a sectioned schematic illustration of a heater system embodying the invention, and showing all components in elevation;

FIG. 2 is a schematic illustration of a heater system depicting a second embodiment of the invention, and showing the valves, motor, and piping network in elevation and the heater-stack representation in plan;

FIG. 3 is a schematic illustration in the style of FIG. 2 depicting a third embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

1. The structure.

FIG. 1 discloses a heater system in which the stack height has been reduced by the use of a fan-induced draft. The heater unit of the system and its various components not shown are generally identified by the numeral 1.

The stack 2 is situated to exhaust the products of combustion of the heater. The fan 3 is shown positioned in the stack to provide the stack with sufficient draft, and to draw sufficient fresh air into the heater 1 to service the burner 4 requirements. An air motor 5 is attached to the stack and arranged to drive fan 3 through a power train 6.

Pressure regulator valves 7, 8, 9 are positioned in the fuel line 10 to supply proper quantities of fuel gas at the correct pressures to the air motor 5 and burner mechanism 4 of the system. The particular design requirements to provide such gas volumes are not specified as not pertinent to the inventive concept. It is within the skill of the practitioner of the valve and heater arts to determine values for parameters such as fuel line pressures and diameters, burner size, and fuel pressure valves through the burner.

In the preferred embodiment, valve 7 has been placed in segment 11 of the fuel line 10. Segment 11 is used as a bridge across the loop of fuel line formed by segments 12, 13. Valve 7 reduces the high pressure of the gas as it comes from the source indicated at 14 to a pressure substantially equal to the line pressure on the discharge side of the air motor. Valve 8 is located in fuel line 12 on the intake side of the air motor. Valve 8 reduces the high source pressure of line 10 to a pressure compatible with the operational characteristics of the air motor. Valve 9 in segment 15 then reduces the line pressure of line 15 due to the air motor discharge and valve 7 to a pressure suitable for introduction to the burner assembly 4 via line 16. Design features of the valves to perform this pressure control function in a given case are also within the abilities of the rou-

2. The Relationship of Structure and Function.

The concept of the invention lies in the particular arrangements disclosed to utilize the potential energy of high pressure gas of a gas fuel line. This energy is "scavenged," in effect, by combination of the high pressure fuel gas with an air motor to drive a fan to induce draft in a stack of a heater which then burns the gas. Valves are integral to the combination for pressure and volume control of the gas in its dual role as a power source to a motor and a heat source to a burner. The effect and desired result of this combination is to permit the most economical reduction in size of the heater stack to conform to laws regulating the conformation of industrial equipment installations.

The structural elements of the novel combination convert high pressure gas into states whereby it best serves its dual function. The valve 8 of the preferred embodiment functions to reduce the gas line 10 pressure to a pressure compatible to the operation of motor 5. The gas pressure proceeds to perform its work to induce draft in stack 2. It is expended thereafter through discharge line 13, and is returned to fuel line 15 at a pressure further reduced due to work done at motor 5.

The fuel gas, rather than the motor or fan, should be viewed as the agency which performs work; the motor and fan are only the instrumentalities of the fuel gas as the energy source. The use of fuel in this particular role is important to the concept of the invention.

Also of prime importance to the concept is the use disclosed above of valve 7. Valve 7 on the one hand converts the high pressure in line 10 to a pressure substantially equal to (i.e., within one or two pounds of; the discharge line pressure will vary slightly) the discharge line 13 pressure. Valve 7, however, also serves to insure that burner 4 will have a sufficient volume of fuel available; it acts, in effect, as a gate to a volume reservoir, as well as a pressure regulator. It is seen that absent the "bridge" of line 11, peak fuel demands might not be met by the volumes available from the downstream loop segment 13 alone.

Of course, lines 12, 13, 15, 16 could be sized in diameters sufficient to handle peaks of fuel demand. But such pipe diameters in such an application could be awkwardly large and heavy, wasteful of limited space available on certain package heater units where space is at a premium, and expensive. Furthermore, in requiring larger valves 8, 9, large diameter pipe may render valves 8, 9 subject to much increased possibility of failure, as well as cost, weight, difficulty of procurement and maintenance, and so on. An alternate method of providing always adequate fuel supply to burner 4 becomes necessary, and is provided as discussed above by valve 7 in line segment 11. Valve 9 is present to reduce the pressure in lines 11, 13, 15, 16 to a pressure compatible with the burner requirements.

The cooperation of all components of the combination is now apparent. Presume burner 4 receives a signal from the heater 1 control mechanism (not shown) to increase its output. Burner 4 opens and pressure in line 16 is reduced; valve 9 thus opens to keep the pressure in line 16 at its predetermined constant value, and so admits more fuel; valve 7 may or may not open, depending on the degree of action of valve 9. The pressure is also reduced in line 13; more fuel thus moves through motor 5 as valve 8 opens to attempt to keep the pressure in lines 12, 13 constant; fan 3 turns faster and the products of the higher fuel use are exhausted and more fresh air is drawn in to permit the increased fuel to burn. When the heater controls signal a return to the lower burn rate, the above process is reversed. Burner 4 constricts; the pressure in line 16 is increased; valve 9 constricts; and so on.

It is noted that the several controls and accessories of the heater 1 are not disclosed in the written specification or drawings for the sake of simplicity. Such devices are well known in the art of heater regulation and are not germane to the instant invention. They include such as the pilot system, safety shutdowns, temperature sensors and controllers, "fine-tuning" needle valves to the burner, strainers and filters, and various indicators and gauges.

The inventive concept of combining high pressure fuel gas with an air motor to power a fan to induce draft in the stack of a heater which thereupon burns the gas is not obscured by omitting a lengthy explanation on this point. It is felt, to the contrary, however, that an explanation of the use of valves 7, 8, 9 in the two preceding paragraphs, though also not germane to the concept, will assist in the practice of the invention to an extent which makes their inclusion desirable.

3. Actual Reduction to Practice.

The system of FIG. 1 has been built and laboratory tested. Field tests are under way at this writing. Pressures encountered have been in the neighborhood of 1000 p.s.i. in line 10. Valves 7, 8, 9 were set to regulate, respectively, from 1000 to 30 p.s.i., from 1000 to 100 p.s.i., and from 30 to 20 p.s.i. In lab tests, motor 5 was rated at 6 HP at 2500 r.p.m. Fan rotation was varied by sizing the sheaves of the power train 6 for various operating conditions during the several tests conducted. For example, varying heater output or size, stack height, stack diameter, and other such engineering and design parameters required varied fan speeds, since draft varies as do such parameters.

4. Alternative Embodiments.

FIGS. 2 and 3 depict embodiments of the invention altogether equivalent to the preferred embodiment of FIG. 1.

In FIG. 2, additional perspective on the system is gained by presenting the heater and stack elements in plan. Valve 17 in bridge line 11 reduces the source 14 pressure to that required by the burner 4, since valve 18 in discharge line 19, 20 of motor 5 is upstream of the loop segment 20 juncture with the burner fuel supply line 16.

In FIG. 3, a second alternative embodiment finds valve 21 upstream of loop 12, 13. It is thus the only valve which regulates the maximum pressure of source 14. Compare FIG. 1, where valves 7 and 8 both encounter the source pressure. Valve 22 in bridge line 11 regulates volume as explained above, and regulates pressure to a level substantially equal to the pressure in motor discharge line 13. Valve 23 in line 15, 16 functions to reduce the motor discharge pressure to the pressure necessary at burner 4.

Many other combinations are obvious from a review of the drawings and the technique of formulating the alternative embodiments of FIGS. 2 and 3. For example, valve 9 of FIG. 3 could be situated in line 13 to correspond in that one regard to the configuration of FIG. 2 rather than FIG. 1.

SUMMARY

The concept of the invention is seen to provide an economical solution to the problem of reduction of stack height of a heater which is supplied a high pressure fuel. The concept offers a system wherein numerous advantages features reside. It is, for example, a compact, low weight, easily maintained unit of minimum cost.

The concept of the invention should not be limited to the embodiments of the specification. It is obvious that the concept is preserved in a forced draft, as compared to an induced draft, unit. Enhancement of stack effect is analogous in either instance. Similarly, the invention may be practiced in a heater burning a vaporous or liquid fuel by use of an "air" motor adapted to such a state fuel.

From the foregoing it will be seen that this invention is well adapted to attain the ends and objects set forth, together with other advantages which are obvious and inherent to the method and apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the invention.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted in an illustrative and not in a limiting sense. This invention having been described, what is claimed is:

I claim:

1. A fluid burning heater system, including,
a source of fluid under pressure for use as fuel for the heater
of the system,
a burner assembly mounted at the heater to burn the fuel, 5
a stack connected to the heater to receive the products of
combustion from the burner,
a fuel line connected between the fuel source and burner as-
sembly,
a fluid-powered motor interposed in the fuel line to be 10
operated by the fuel under pressure,
and a fan connected to the fluid-powered motor to be
rotated to induce draft in the stack,
whereby the height of the stack is maintained at a minimum
with adequate stack effect. 15
2. The system of claim 1, including,
a section of conduit connected to the fuel line to bypass the
fluid-powered motor with at least a portion of the fuel,
and a valve in the bypass section of conduit controlled to in- 20
sure a sufficient volume of fuel will be available to the
burner assembly.
3. The system of claim 2, including,
a valve in the fuel line upstream of the motor to adapt the
fluid pressure of the fuel line to a pressure compatible to 25
the motor,
and a valve in the fuel line downstream of the motor to
adapt the discharge pressure of the fluid-powered motor
to a pressure compatible to the burner assembly.
4. A fluid burning heater system, including,
a source of fluid under pressure for use as fuel for the heater 30
of the system,
a burner assembly mounted at the heater to burn the fuel,
a stack connected to the heater to receive the products of
combustion from the burner,
a fluid-powered motor to be powered by the fuel under 35
pressure,
a fuel line connected between the fuel source and burner as-
sembly,
a loop of conduit connected at both ends to the fuel line to 40

- contain the motor and supply fuel under pressure for its
operation,
a valve in the segment of fuel line which traverses the ends
of the loop to insure a sufficient volume of fuel will be
available to the burner assembly,
and a fan connected to the motor to be rotated to induce
draft in the stack,
whereby the height of the stack is maintained at a minimum
with adequate stack effect.
5. The system of claim 4, including,
a valve in the fuel line upstream of the motor to adapt the
pressure of the fuel line to a pressure compatible to the
motor,
and a valve in the fuel line downstream of the motor to
adapt the pressure in the fuel line to a pressure compati-
ble to the burner assembly.
6. A method of inducing draft in the exhaust stack of a fluid
fuel burning heater system by utilizing a portion of the poten-
tial energy of the fuel under pressure, including,
conducting the fuel from its source to the burner of the
heater,
diverting a portion of the fuel prior to its introduction to the
burner for utilizing its pressure energy,
transducing the pressure energy of the diverted portion of
the fuel by operating a motor and fan structure connected
to the exhaust stack of the heater system to induce draft
in the stack,
returning the diverted portion of the fuel to the fuel con-
ducted from the source to the burner of the heater,
and burning a combination of the fuel volumes in the
burner,
in order that adequate stack effect may be maintained with
a minimum height of stack.
7. The method of claim 6, including,
regulating the fuel pressure to insure compatibility with the
fuel pressure transducing means and with the burner,
and regulating the fuel volume to insure sufficient fuel is
available to the burner.

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