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Beck

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[54] **PORTABLE GAS HEATER**

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[52] **U.S. Cl.**.. **219/365,** 137/341, 219/302, 219/305, 219/373, 219/379, 222/146 HE, 239/135

[51] **Int. Cl.**..... **H05b 1/00,** F24h 3/00

[58] **Field of Search** ..... 219/296–299, 219/302–309, 365, 366, 373, 374, 378–382; 239/133, 134, 135; 137/341, 624.11; 222/146 HE, 146 R

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[57] **ABSTRACT**

A portable electrically operated gas heater for heating gases for use in curing sand molds. An electrical heating element fits tightly inside a bore in a heat exchange tube having sufficient mass for providing a reservoir for storage of a substantial amount of heat. The heat exchange tube is provided with fins on its outside and an inner shell fits around the fins to define a gas heating passage. An insulative outer shell is secured to the outside of the inner shell. An inlet port to the passage is provided for receiving cold gas from a pressurized source through a control valve and an outlet port from the passage is provided for distributing the gas after contact with the heat exchange fins in the passage. An automatic reset timer is connected to the control valve and is operative to open the valve for a predetermined period of time to deliver a burst of gas. Heater control means including a thermostat is provided for controlling the energization of the heating element to maintain a predetermined tempertaure within the gas heating passage. The heater control means is operable independently of the timer for continual energization of the heating element, under control of the thermostat, to store heat in the reservoir prior to delivery of a burst of gas by the timer. This storage of heat permits the use of a lower wattage heating element than would otherwise be necessary in order to instantaneously heat the burst of gas.

1 Claim, 3 Drawing Figures

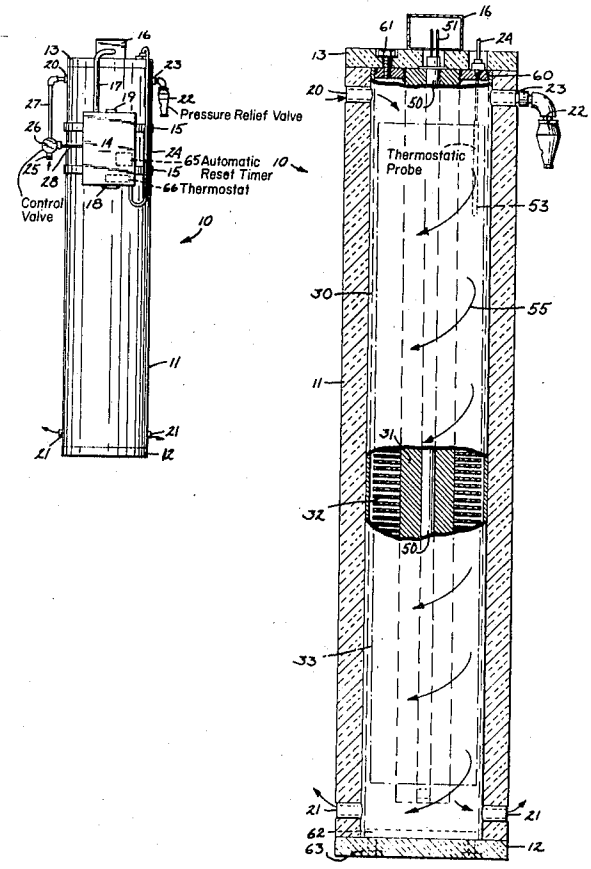


FIG. 1

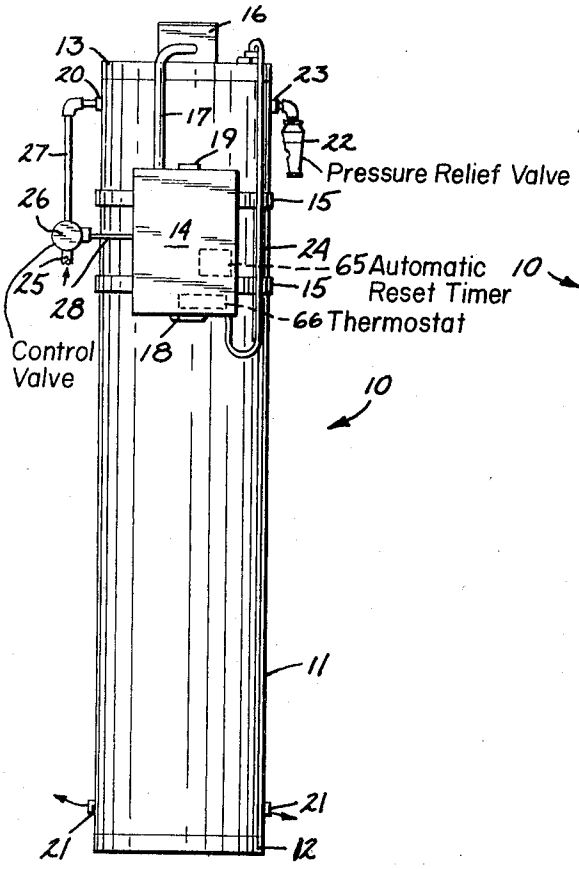


FIG. 2

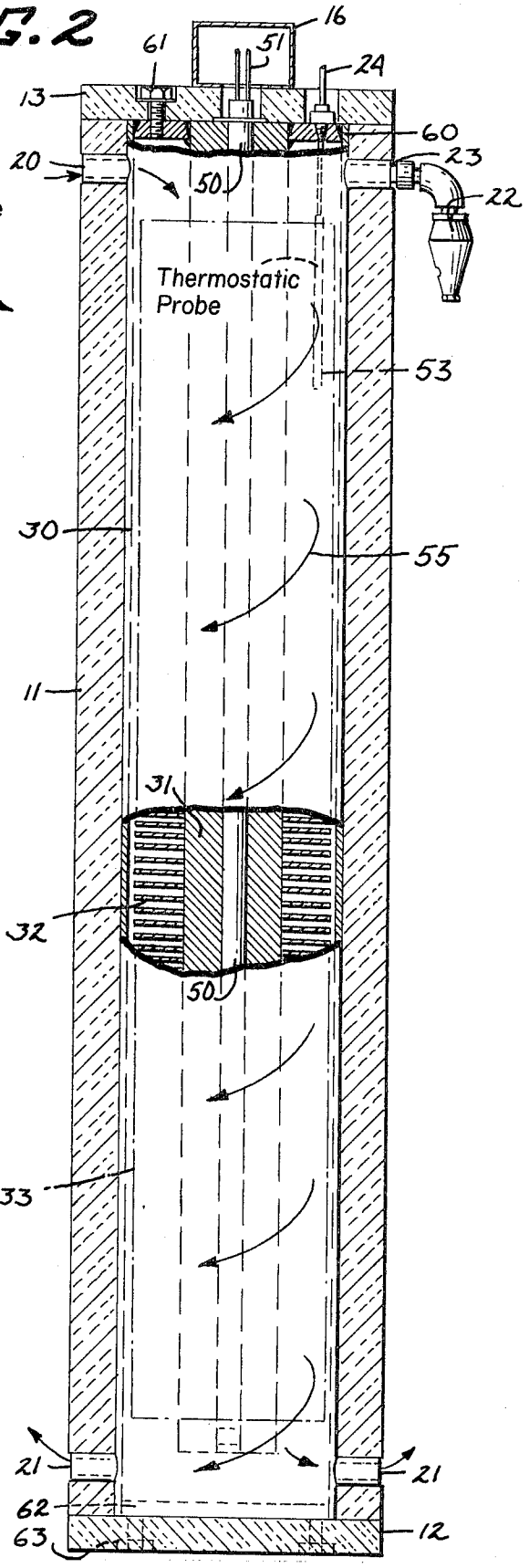
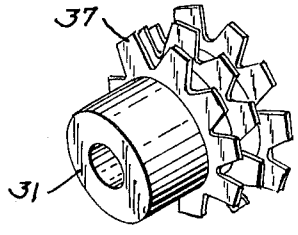


FIG. 3



PORTABLE GAS HEATER

BACKGROUND OF THE INVENTION

The present invention pertains generally to the field of heaters for heating gases, and more specifically to the field of devices particularly adapted for providing hot gases for use in curing molds.

In the production of sand molds in the metal founding industry, several different kinds of chemical binders may be mixed in with the sand, depending upon the type of process being used. After the sand is shaped, the mold is cured, which is frequently done by permeating hot air or other gases throughout the sand. For example, in the carbon dioxide process, a binder which is sensitive to carbon dioxide gas is mixed with the sand. The sand mixture is then placed in the molding machine and molded around the object to be cast. Hot carbon dioxide gas is carried to the molding machine by high temperature rubber tubing, and allowed to permeate through the sand, causing the binder to harden. The hardening process takes only about 15 seconds, after which the mold is ready for pouring. The present invention provides a portable gas heater for use in curing molds. Although the present invention is explained hereinafter in terms of applicability to the carbon dioxide process, it will be understood that the present invention is also applicable to other mold curing processes which use heated gases.

For proper operation, it is necessary that the carbon dioxide gas be delivered within certain high and low temperature limits. For greatest convenience and user efficiency, the heater should be portable so that it may be easily moved from one molding machine to another in the plant as may be required. The present invention provides a compact portable gas heater. In the preferred embodiment, an electric heating element is used rather than a gas burner, so that the unit may be readily connected to a source of power anywhere within the factory, without requiring pipes, tubing, etc. to bring fuel to a burner. The use of electric power has the further advantage of eliminating any possibility of production of carbon monoxide as by a burner, thereby resulting in greater safety of operation.

The fast curing times afforded with the carbon dioxide process results in an intermittent operation of the gas heater, with a relatively short on time and a longer off time. For example, when a single molding machine is connected to the heater according to the present invention, the rate of production of molds may be approximately 20 per hour. This means that the gas through the heater will be turned on once every three minutes for only a 15 second interval. The heater according to the present invention efficiently meets the foregoing operating requirements by providing a heat reservoir for storing heat during the idle time so that it will be instantaneously available when the gas is turned on for the 15 second period. The use of the heat reservoir allows the use of a relatively low wattage electrical heating element.

SUMMARY OF THE INVENTION

The present invention comprises an outer shell of insulative material generally cylindrical in shape. An inner shell inside the insulative material cooperates with a heat exchange tube disposed coaxially within, to define a gas heating passage. Heat exhange fins attached to the outside of the heat exchange tube project into the gas heating passage to provide the necessary heat exchange areas. The heat exchange tube has relatively thick walls to provide a heat storage capability. An electrical heating element fits coaxially inside the heat exchange tube. A cap is provided at the end to hold the various components in place. Gas inlet and outlet ports are provided. Controls for the heating element and for a gas inlet valve may also be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. **1** is a side view of a portable gas heater according to the present invention;

FIG. **2** is a side elevation view of the heater of FIG. **1**, with portions thereof broken away to illustrate features thereof; and

FIG. **3** is a detail view showing the fin construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, reference numeral **10** generally designates a portable gas heater according to the present invention. Heater **10** comprises a generally cylindrical housing or outer shell **11** made of an insulating material such as asbestos, an insulating bottom cap **12** and an insulating top cap **13**. An electrical control box **14** is attached to the heater by straps **15**, or any other suitable attachment means. A housing **16** on top of cap **13** covers the top of the heating element enclosed within. A conduit **17** carries the electrical power leads from control box **14** to the heating element (shown in FIG. **2**). A recessed male power plug **18** is mounted in the control box for connection to a 220 volt extension cord (not shown). A cold gas inlet port **20** is provided near the top of the heater, and a pair of hot gas outlets **21** are provided near the bottom. A pressure relief valve **22** connects to the interior of the heater through another port **23**. A control line **24** leads from control box **14** to a thermostatic probe within the heater (also shown in FIG. **2**). A pipe or hose **25** is provided for connection to a pressure tank of carbon dioxide gas. A valve **26** controls the flow of gas from conduit **25** through conduit **27** to inlet port **20**. Valve **26** is controlled by control box **14** via control line **28**.

Referring to FIG. **2**, in which like reference numerals designate the same elements as in FIG. **1**, the insulative outer shell **11** can be seen in cross section. About 1½ inch thickness of insulation is generally adequate for the temperatures normally used. Immediately to the inside of outer shell **11** is an inner shell **30** which is cylindrical in shape and which is preferably made of carbon steel. The outer shell may be made in halves and may be cemented to inner shell **30**, or held on by metal bands. Coaxially disposed inside outer shell **11** and inner shell **30** is a heat exchange tube **31**. Tube **31** is a relatively thick walled pipe made of carbon steel. Attached to the outside surface of tube **31** are heat exchange fins **32**. In FIG. **2**, for purposes of clarity, only a portion of the fins are shown, but it will be understood that the fins extend over substantially all the length of heat exchange tube **31**, as indicated by center line **33**.

The detailed configuration of the heat exchange tubes **32** are shown more clearly with reference to FIG. **3**. In the preferred embodiment, fins **32** are made from a serrated strip of steel which is spirally wound on edge

around heat exchange tube **31.** The notches between fins and between adjacent turns of the spiral provide numerous air passageways. The type of fins shown in FIG. **3** give maximum efficiency and the most compact form, however, other types of fins could be used.

Referring again to FIG. **2,** the heat exchange tube **31** contains a central bore within which is slideably positioned the heating element **50.** Preferably, cylindrical heating element **50** fits snugly within the central bore of the heat exchange tube, for maximum efficiency in heat transfer by conduction. Heating element leads **51** protrude from the top of heating element **50.** These leads connect to the control box **14** by conduit **17** as shown in FIG. **1.** A thermostatic probe **53** is positioned within the inner shell, with some of the fins being bent slightly to make space for the probe.

A top cap **60** has an aperture for receiving the top of heat exchange tube **31,** to which it is welded. Cap **60** is also welded to inner shell **30.** Insulating cap **13** is attached to top cap **60** by a plurality of bolts **61.** Insulating cap **13** also has a central aperture for the top of heating element **54,** and another aperture for control lead **24** which connects to thermostatic probe **53.** Insulative cap **13** seats over a flange **54** of heating element **50** to help secure it. If the heating element needs to be replaced, bolts **61** may be removed, permitting removal of insulating cap **13.** Heating element **50** may then be removed through the top.

At the lower end of the heater, a bottom cap **62** is welded to the inside of inner shell **30,** in the same manner as top cap **60.** A bottom insulating cap **12** is attached to cap **62** by bolts **63.**

In the preferred embodiment, the entire heater is only about four feet high and it can readily be mounted on a two-wheel dolly for easy movement from place to place. Alternatively, eye bolts can be used in the top as at **61** and other locations around the top of the heater so that the unit can be hung up at a fixed location if desired.

In one successful embodiment of the present invention, heating element **50** has a capacity of 5,000 watts, at 220 volts. The control box **14** includes a start button **19,** which is wired to open valve **26.** An automatic reset timer **65** is provided for keeping valve **26** open according to a preset time period. Preferably, the timer is adjustable over an interval of about zero to **60** seconds, and is normally set at about 15 seconds, depending upon the type of mold which is to be cured. Also inside control box **14** is a heater control means comprising a temperature regulating thermostat **66** which is connected to probe **53** and heating element **50,** and is normally set at 500° Fahrenheit, again depending upon the type of mold to be cured.

In operation, a connecting hose is connected from a standard compressed CO_2 cylinder to connection **25.** The pressure regulator on the CO_2 cylinder is adjusted to give the desired pressure, based upon experience and in consideration of the type ¾ mold which is to be cured. High temperature rubber tubing is connected from one or both of outlet ports **21** to the hot gas input ports on the molding machine. The START button on the control box **14** is depressed causing valve **26** to open. Gas then enters the heating passage and flows amongst the fins as indicated by flow arrows **55,** absorbing heat from the heat exchange fins. The thermostatic control **66** including probe **53** functions to control the current to the heating element, so that the desired temperature will be maintained.

As previously mentioned, heat exchange tube **31** has thick wall construction so as to provide a heat reservoir. In one successful embodiment of the present invention, the heat exchange tube is a 2¾ inch outside diameter steel tube with a 3/4 inch diameter central bore for receiving the heating element. This relatively large thickness allows for heat reservoir action by the heat exchange tube. During the intervals between bursts of gas, the heat exchange tube and fins are heated to 500°, as is the gas present in the heating passages. When the burst of gas is needed, the heat stored in the heat exchange tube is instantly available for heating the gas during the burst. This heat storage feature permits the use of a lower wattage heating element then would otherwise be necessary in order to instantaneously heat the burst of gas.

I claim:

1. A portable gas heater for supplying intermittent bursts of heated gas, comprising:

a. a generally cylindrical heat exchange tube having a central bore for receiving a heating element, said heat exchange tube having sufficient mass for providing a reservoir for storing a substantial amount of heat;

b. an electrical heating element positioned within said bore, said heating element contacting said heat exchange tube in direct heat conduction relationship therewith;

c. a cylindrical inner shell member coaxially positioned about said heat exchange tube but spaced apart therefrom to define a gas heating passage;

d. an outer insulative shell attached to the outside of said inner shell;

e. a plurality of heat exchange fins attached to the outside of said heat exchange tube and extending into said gas heating passage;

f. means for conveying cold gas into one end of said gas heating passage and for conveying heated gas from the other end;

g. a control valve connected to said conveying means for controlling the flow of gas therethrough;

h. a control system including an adjustable automatic reset timer connected to said control valve, said timer operable when energized to open the control valve for a predetermined period of time to deliver a burst of gas; and

i. heater control means including a thermostat for controlling the energization of said electrical heating element to maintain a predetermined temperature within said gas heating passage, said heater control means operable independently of said timer for continual energization of said electrical heating element under control of said thermostat, to store heat in said reservoir prior to delivery of a burst of gas by said timer.

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