July 1, 1941. R. E. McILRATH 2,247,816

HEATING UNIT

Filed June 20, 1940

Fig. 1

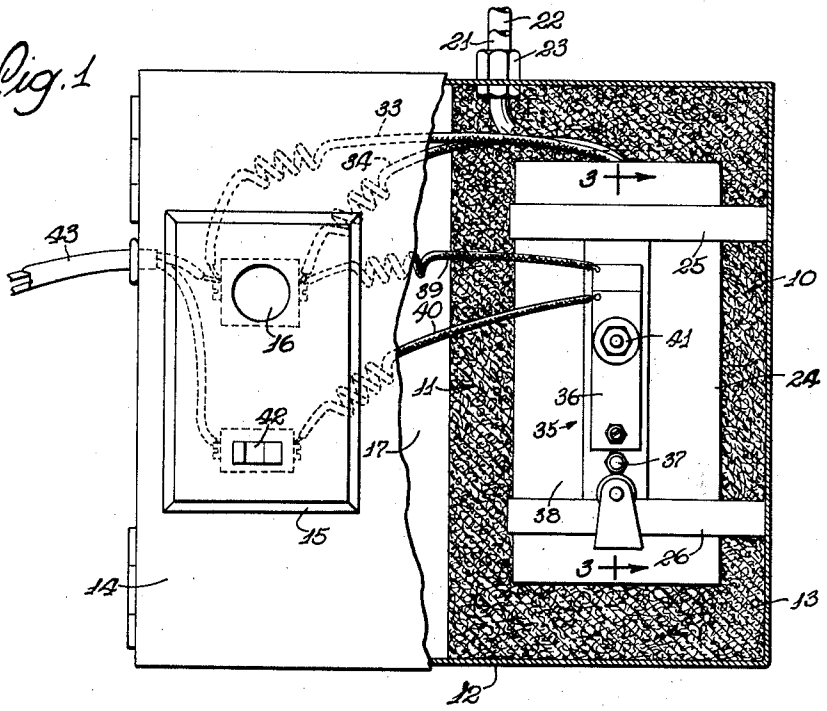


Fig. 2

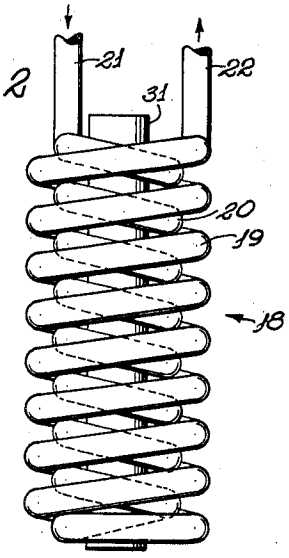
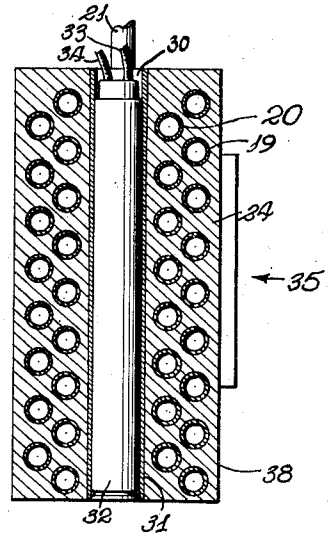


Fig. 3



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HEATING UNIT

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6 Claims. (Cl. 219—39)

The invention relates to heating units and more particularly to units of this nature adapted for heating a stream of fluid medium.

The particular form of heating unit selected for illustrating the present invention finds particular, but by no means exclusive, utility in connection with pressure reduction apparatus utilized for carbon dioxide supply in carbonate beverage bottling works. Ordinarily the carbon dioxide is supplied in containers at a relatively high pressure, and for bottling purposes the pressure must be substantially reduced. This pressure reduction is essentially a heat absorption operation and, consequently, means must be provided for heating the gas in order to prevent freezing of the gas and frosting of the supply lines.

The customary procedure heretofore employed to attain this end, has been to circulate the carbon dioxide through a coil immersed in a pot of water heated by a burner. The disadvantages of such an arrangement are obvious. The water evaporates and, at best, the unit is untidy, messy and subject to spilling, particularly undesirable in a beverage bottling works.

Accordingly, the general object of the invention is to provide a novel unit of the electric plug-in type for heating a confined stream of fluid medium in a circulating or fluid dispensing system, which is of a compact unitary character and which overcomes the difficulties encountered in prior practice.

A further object of the invention is to provide a heating unit of the type set forth in which extremely efficient heat transfer is effected and controlled in a novel manner so that the circulating fluid medium emerges from the unit at a uniform temperature regardless of the quantity circulated.

A more specific object of the invention is to provide a heating unit embodying a fluid circulating passage embedded in a cast billet of metal of high thermal conductivity, having a centrally located heating element and control means for the heating element responsive to the skin temperature of the billet to maintain a substantially constant temperature in the mass of the billet metal.

The invention also resides in a novel method for constructing the parts, which is simple, time saving and inexpensive.

Further objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is an elevational view of a heating unit embodying the present invention and having a front wall broken away to show the underlying construction.

Fig. 2 is an enlarged fragmentary side view of the fluid circulating passage and associated parts.

Fig. 3 is an enlarged fragmentary sectional view along the line 3—3 of Fig. 1.

Although the novel heating unit herein contemplated is capable of a wide variety of applications, it finds particular utility in connection with pressure reducing apparatus used for gas supply systems. Accordingly, the heating unit illustrated in the drawing and hereinafter described in detail is of the type suitable for heating a gas after it has been cooled by a pressure drop. I do not intend, however, to limit the invention to such disclosure but aim to cover all modifications, alternative constructions and methods falling within the spirit and scope of the invention, as expressed in the appended claims.

The present invention contemplates heating of a confined stream of fluid medium, such as carbon dioxide, in a fluid circulating passage formed in an ingot or billet of cast metal having good heat transfer qualities. A heating element is located internally of the billet and is controlled by a thermostatic means responsive to the external temperature of the billet to maintain a constant temperature irrespective of the quantity of fluid circulating through the passage.

Referring to Fig. 1 of the drawing, the heating unit, generally indicated at 10, may be mounted for convenience in one side compartment 11 of an insulating box 12, packed with suitable heat insulating material 13, such as asbestos, and closed by a suitable hinged front wall 14. A control panel 15 is associated with the front wall 14, and carries a pilot light 16 and suitable switches and connections, adapted to be received in the other side compartment 17 of the box 12 when the wall 14 is in closed position.

The fluid heating passage is defined by a coil of metallic tubing 18 which may be of copper or other suitable tube metal of high thermal conductivity. In the instant disclosure the coil is wound in the form of a double helix with the outer spiral 19 nested in the inner spiral 20 (see Figs. 2 and 3), one serving in the capacity of a flow coil and the other a return. The respective opposite ends 21 and 22 of the tube define adjacent intake and outlet openings for the stream of fluid medium to be circulated, and are passed through the box 12 through suitable coupling connections 23.

The billet 24 is of cast metal of high thermal conductivity, such as aluminum, and is suitably supported in the box 12, as by brackets 25 and 26. The coil 18 is embedded in the billet 24 with the walls of the tubing intimately fused with the surrounding metal of the billet, thus providing for efficient and unobstructed heat transfer from the mass of billet metal to the fluid circulating in the tubing. This result may be attained by casting molten metal around the coil of tubing. The billet is formed with a central cavity 30 generally concentric with the coil 18. In the present instance, the cavity is defined by a cylindrical sleeve or tube 31, the external surface of which may be fused with the billet when it is cast. Preferably, the sleeve and billet are made of the same metal, such as aluminum.

The heating element 32 is of the electric resistor type and, as shown herein, is in a conventional cartridge form for insertion into the cavity 30. Suitable leads 33 and 34 connect the heater to the control panel.

To maintain a substantially constant temperature in the mass of the billet metal intervening between the heating element 32 and the external wall of the billet, in which mass of metal the coil is embedded, means responsive to the skin temperature of the billet is provided for controlling the energization of the heating element. To this end, a thermostat 35 of conventional form, embodying a bimetal strip 36 and contacts 37, is secured to the external wall 38 of the billet and connected to the control panel by leads 39 and 40.

Heat is conducted from the centrally located heating element 32 radially outwardly through the mass of the billet where it is absorbed by the circulating stream of gas and also radiated in some, though small, degree from the external surface of the billet. Consequently there is a temperature drop from the center to the skin of the billet. By controlling the energization of the heater in response to the skin temperature of the billet, a uniform fluid temperature is assured regardless of the quantity circulated, because heat must first pass through the mass of the billet containing the fluid circulating coil, heat the fluid and pass to the outer surface of the billet before it affects the thermostat to deenergize the heater. The thermostat may be adjusted by experiment to operate at a temperature which, due to the external disposition of the thermostat, will be somewhat lower than the desired fluid temperature. A thermostat adjusting screw 41 is provided for this purpose.

The heater leads 33 and 34 are suitably connected through the pilot light 16, a cut-off switch 42, and thermostat 35 to a power line 43.

When installing applicant's device in a carbon dioxide system, all that is required is that the unit be mounted in a location convenient for connecting the adjacent intake and outlet openings 21 and 22 in the supply line adjacent the pressure reducing means. The leads are plugged in to a source of electric current. As the stream of carbon dioxide circulates through the coil 18 it is efficiently heated to a predetermined uniform temperature, irrespective of any irregularity of flow. The thermostat blade warps in and out to make and break the circuit, as revealed by the pilot light, in accordance with the heat demand.

I have provided a simple and inexpensive method for constructing a heating unit of the type herein disclosed. The method contemplates winding metallic tubing in the form of a helix on a sleeve, of the type disclosed at 31, which serves as a mandrel, to form the coil. The tubing utilized has sufficient resiliency to spring back in spaced relation to the sleeve upon release of the winding force and at the same time maintain its coil formation. Molten metal is then cast in the form of a billet to embed the coil between the sleeve and an external mold. Preferably the sleeve and the billet are of the same high heat conductivity metal such as aluminum and the tubing may be of copper. During the casting step the outer walls of the coil of tubing and the sleeve are intimately fused with the mass of billet metal so that resistance to efficient heat transfer is minimized at these points resulting in highly efficient thermal conductivity from the centrally located heating element to the fluid medium circulating in the tubing. The sleeve serves the function of a sand core during the casting operation and provides a smooth finished surface for the interior of the billet, obviating the necessity for drilling or boring out the cavity. It is to be noted that the sleeve 31 has a triple function. It serves as a mandrel for winding the coil and as a core for producing the cavity in the casting, and in addition obviates the necessity of drilling or boring to produce a finished interior surface.

It will thus be seen that the unit may be economically and simply produced by the method of the present invention. No machining is necessary. The use of intricate machinery and tools is dispensed with. The materials and tools are few and of low cost. At the same time, it will be seen that a very compact and highly efficient heat transferring unit has been provided, all of the areas through which heat conductivity occurs being intimately fused to avoid resistance to heat flow.

I claim as my invention:

1. A heating unit comprising, in combination, a coil of metallic tubing defining a passage for a stream of fluid medium to be heated, a cast billet of metal of high heat conductivity in which said coil is embedded with the walls of the tubing intimately fused with the surrounding metal of the billet, said billet having a cavity therein generally concentric with said coil, an electric resistor type heating element in said cavity, and means, including a thermostat, responsive to the skin temperature of the billet for controlling the energization of said heating element to maintain a substantially constant temperature in the mass of the billet metal intervening between said heating element and thermostat and in which mass of metal said coil is embedded.

2. A heating unit comprising, in combination, metallic tubing defining a passage for a stream of fluid medium to be heated, a billet of metal of high heat conductivity in which said tubing is embedded, said billet having a central cavity therein, an electric resistor type heating element in said cavity, and means including a thermostat responsive to the external surface temperature of said billet for controlling the energizing of said heating element to maintain a substantially constant temperature in the mass of the billet metal intervening between said heating element and said thermostat and in which mass of metal said tubing is embedded.

3. A heating unit comprising, in combination, an elongated sleeve, a coil of metallic tubing generally concentric with said sleeve, said tubing having sufficient resiliency to spring back in

spaced relation to said sleeve after it has been wound on said sleeve, a billet of metal of high heat conductivity in which said coil is embedded and in which said sleeve serves as a hollow core, and an electric heating element in said sleeve.

4. The method of making a heating unit embodying a fluid circulating passage and a central cylindrical heater chamber, which comprises winding a coil of metallic tubing of resilient material tightly about an elongated sleeve, releasing the coil to permit its enlargement due to the resiliency of the material to a diameter larger than the exterior diameter of the sleeve, and casting a billet of metal about said coil and said sleeve with the coil spaced from the sleeve.

5. A heating unit comprising, in combination, an elongated sleeve having a smooth interior surface, a coil of metallic tubing generally concentric with said sleeve, said tubing having sufficient resiliency to spring back in spaced relation to said sleeve after it has been wound on said sleeve as a mandrel, a cast billet of metal of high heat conductivity in which said coil is embedded and in which said sleeve serves as a hollow core, and a removable heater cartridge inserted in said sleeve.

6. The method of making a heating unit embodying a fluid circulating passage and a central cylindrical heater chamber, which comprises winding a coil of metallic tubing of a resilient material tightly about a mandrel in the form of an elongated sleeve having a smooth internal surface, releasing the coil to permit its enlargement due to the resiliency of the material to a diameter larger than the exterior diameter of the sleeve, and casting a billet of metal about the coil and sleeve with the coil concentric with but spaced from the sleeve, whereby to fuse intimately the metal of the billet with the walls of the sleeve and the tubing so as to promote the transfer of heat to said coil from a heater inserted tightly in said sleeve.

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