July 14, 1964 O. HULTGREEN 3,141,089

INFRARED HEATER

Filed May 3, 1961 2 Sheets-Sheet 1

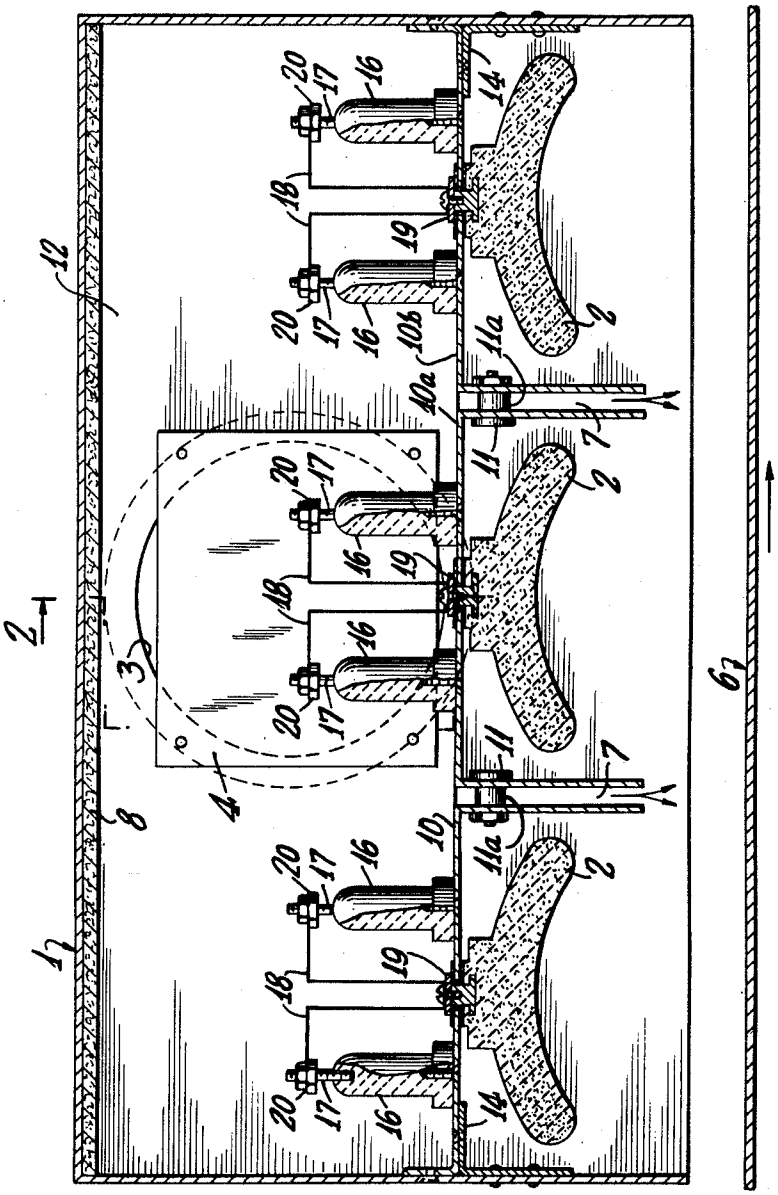

FIG. 1

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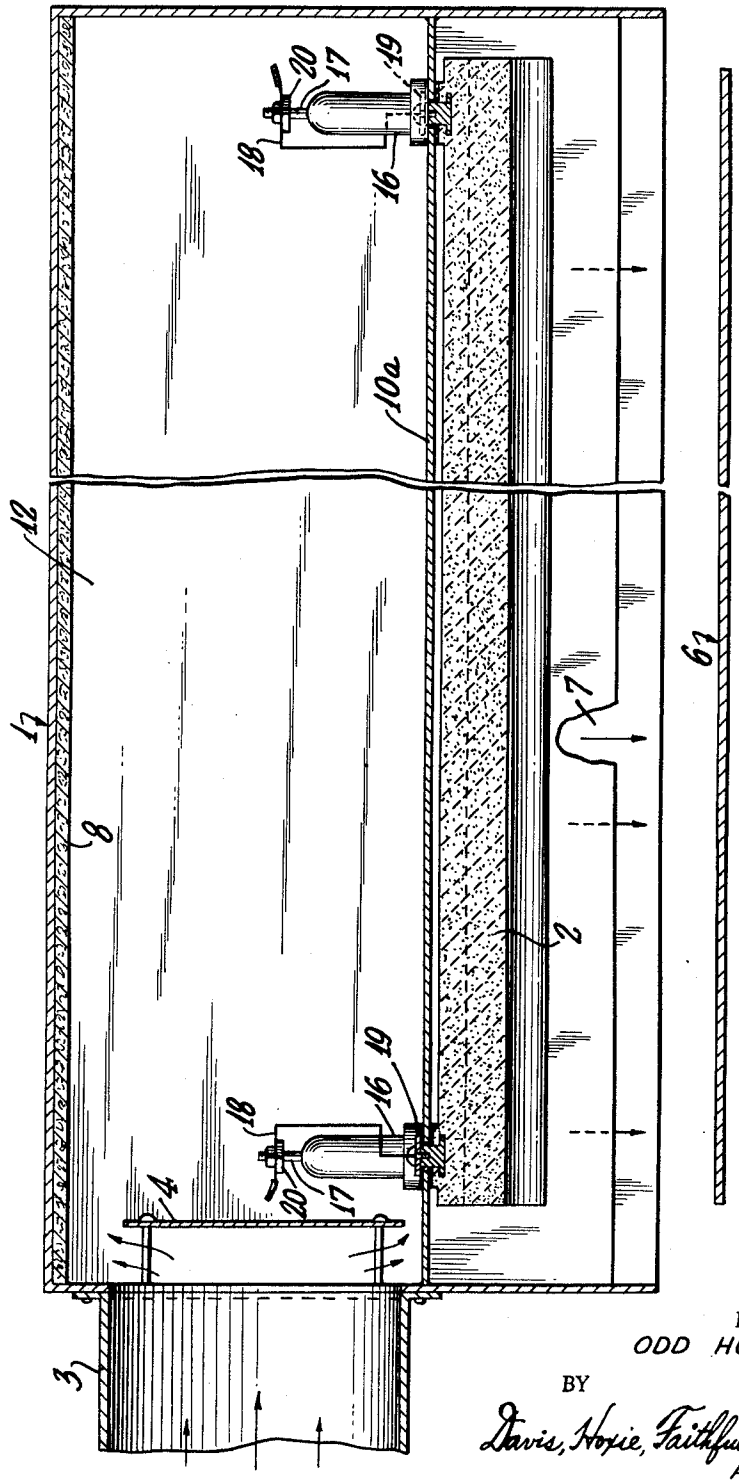

FIG. 2

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3,141,089

INFRARED HEATER

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This invention relates to infrared heating units and more particularly to an improved apparatus of this type having prolonged life and adapted for high-speed drying of moving webs.

Infrared heaters as commonly made consist of an infrared emitter, a housing supporting the emitter, and wiring connections for electrically energizing the emitter. The housing also acts as a reflector to redirect the energy from the emitter element toward the surface of the moving web or other article to be heated. The housing may have the shape of an inverted receptacle with an open bottom, the infrared emitter being supported in the housing and connected to bus bars leading into the housing. The entire drying unit may be suspended above the moving web so that the latter passes opposite the open end through which the radiation is directed.

These heating units operate at high temperature, sometimes as high as 4000° F. As a result, difficulties have been encountered in providing proper insulation and in dissipating the heat absorbed by the supporting structure, particularly in the areas surrounding the power connectors of the energy source. It has been found that the region of the junction of the power lead-in wiring and the ceramic infrared emitter is critical in this respect, and failure of the unit more often occurs here under excessive temperatures. Thus, prior units of this type have been handicapped by a reduced operating life due to this excessive heat. In addition, personnel working in the area of the infrared heater have been subject to the danger of severe burns due to the extremely hot surfaces.

Heat insulation has proved insufficient for infrared heaters for several reasons. Generally, such insulation costs are high and constitute a substantial portion of the unit cost. In addition, the weight and physical size of the heater is increased by the addition of an effective amount of insulation material. Also, insulation of the housing chamber containing the electrical connections above the emitter results in a higher temperature in the chamber and consequently creates problems of design in respect to expansion and contraction. Finally, insulation fails to solve the problem of protecting the power connections and the ceramic emitters.

The principal object of the present invention is to produce a more efficient heating unit of this type which overcomes the above-noted problems.

In a heating unit made according to the invention, the housing is provided with an inlet for introducing a gaseous cooling medium (normally air and hereinafter referred to as air) into the chamber above the electrically energized infrared emitter, this cooling air being caused to circulate past the electrical power connectors. This circulation acts to absorb heat from the connectors so as to reduce their operating temperature and prolong their life. The air thus heated is then caused to flow through orifices which direct the heated air upon the web surface. In other words, after the air has been heated incident to its cooling action on the electrical connectors, it is used to assist in the drying operation by acting as a source of additional heat and providing an air draft which reduces the vapor barrier over the surface of the web. In addition, the temperature reduction allows the use of materials such as aluminum.

For a better understanding of the invention, reference may be had to the accompanying drawings in which:

FIG. 1 is a vertical sectional view of a preferred form of the invention; and

FIG. 2 is a sectional view on line **2**—**2** in FIG. 1.

Referring to the drawings, the reference numeral **1** designates a metallic housing in the form of a box which is open at the bottom. Arranged along the inside of the housing **1** are flanged metal plates supporting ceramic heating elements **2** which are infrared emitters, these plates being designated **10**, **10***a* and **10***b*. The supporting plates **10**–**10***a*–**10***b* extend lengthwise of the housing and over the entire width of the web to be dried. While I have shown three such plates supporting corresponding heating elements **2**, any other desired number may be employed. Secured to the side walls of housing **1** are longitudinal angle brackets **14** which slidably support the outer edge portions of plates **10** and **10***b*; and since all the plates are interconnected (as described in more detail presently) the entire assembly of plates and heating elements may be slid as a unit from the housing by making one of its end walls removable. Also, this arrangement accommodates relative movements of the heater parts incident to thermal expansion or contraction, thereby preventing the creation of internal stresses in the supporting structure.

The plates **10**–**10***a*–**10***b* supporting the heater elements **2** are joined by releasable connecting means **11**. Spacers **11***a* are provided between opposed vertical flanges of adjacent plates to form slots **7** by leading downward from an upper chamber **12** to points above the surface of web **6**.

Each plate **10**–**10***a*–**10***b* supports porcelain insulating members **16** located in upper chamber **12**, each of these members having a terminal post **17**. The terminal posts **17** on each plate are electrically connected to the corresponding heating element **2** by wires **18** extending downward through an insulating collar **19** located in an opening in the plate. Energizing of the corresponding heating element **2** is expected through wiring, such as bus bars **20**, connected to the terminal posts **17** and extending through a wall of chamber **12** to an electrical current source (not shown).

Chamber **12** is insulated by a layer of asbestos **8** on the roof to prevent upward radiation. An end wall of the chamber has an opening **3** through which cool air is pumped into the chamber and distributed through the chamber by means of baffle **4**. Thus, the cooling air circulates through the chamber and around the electrical connections **17**, **18**, **19** and **20**, so as to cool them. The heated air then flows through slots **7** and impinges on the surface of web **6**.

The slots **7** extend the full width of the web **6** and cause heated steams of air to impinge on the web, thereby assisting in the removal of vapors from the web and facilitating the drying operation.

The bottom surfaces of the plates **10**–**10***a*–**10***b* are reflective, causing the infrared radiation of elements **2** to be directed downward onto the web. This tends to reduce the temperature within the chamber **12** by reflecting radiational heat therefrom.

Since the new heating unit is operable at a lower temperature than conventional units, the housing **1** and the other metallic elements may be made of aluminum or other metal having a high coefficient of thermal expansion.

The utilization of heat generated in the chamber **12** provides a more efficient operation in that it reduces the drying time, that is, allows a faster rate of travel of the web **6**. The new infrared heater can be used for many purposes and is not restricted to heating moving webs containing an evaporatable fluid.

I claim:

1. An infrared heating unit comprising a housing hav-

ing an opening for passage of infrared radiation, plate means in the housing defining therewith a substantially closed chamber, bracket means mounting said plate means for sliding movements in the housing, electrically operable infrared emitter means located at a side of said plate means opposite said chamber and positioned for passage of infrared radiation from said emitter means through said opening, said slidable plate means forming a slot leading from said chamber in the direction of said opening and spaced from said emitter means, said chamber having a cooling air inlet, an air supply duct located externally of said chamber and leading to said inlet, and electrical connectors in said chamber mounted on said slidable plate means and through which said emitter means are adapted to be energized, said connectors being in the path of air flow from said duct to said slot, whereby said connectors and plate means are slidable as a unit in the housing and are cooled by cooling air forced through said inlet and whereby heated air is directed through said slot and housing opening.

2. A heating unit according to claim 1, in which the infrared emitter means are supported by said plate means.

3. A heating unit according to claim 1, in which said plate means include a plurality of releasably connected plates slidable as a unit on said bracket means, the infrared emitter means including a plurality of heating elements supported by respective plates.

4. A heating unit according to claim 1, in which said plate means include a plurality of releasably connected plates slidable as a unit on said bracket means, the infrared emitter means including a plurality of heating elements supported by respective plates, said plates being disposed in substantially parallel adjacent relation and having opposed flanges of adjacent plates forming said slot.

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