Nov. 12, 1968 T. SCHMIDT 3,410,541

HEATER FOR GASEOUS FLUIDS

Filed July 11, 1967

FIG. 1

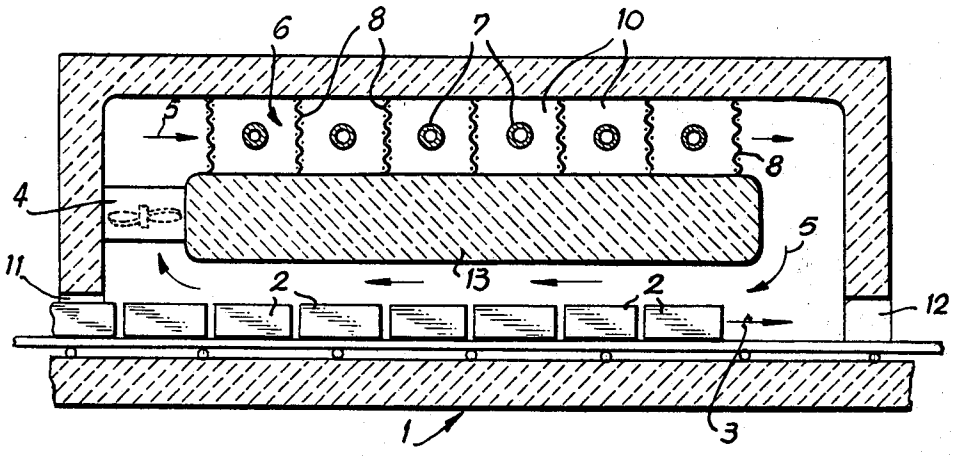


FIG. 2

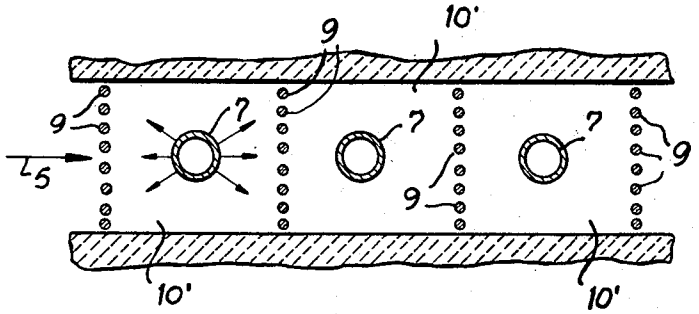
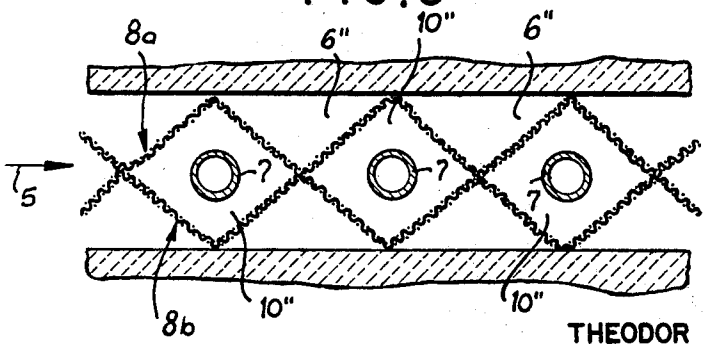


FIG. 3



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3,410,541

HEATER FOR GASEOUS FLUIDS

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ABSTRACT OF THE DISCLOSURE

Heating chamber wherein a gas stream is circulated past a series of heating elements, such as radiator tubes, each disposed between apertured partitions of high thermal conductivity, such as a grid of metal bars or a wire screen, which are heated by direct radiation from the element and communicate part of their heat to the passing gases.

My present invention relates to a heater for gaseous fluids, e.g. as used to generate a stream of hot gas for the treatment of goods in a tunnel oven or the like.

In the heating of gaseous media it is customary to let the gas flow pass a series of radiant heating elements, such as radiator tubes traversed by a hot fluid or a flame, in a direction generally perpendicular to these heating elements which must be sufficiently numerous and closely spaced to accomplish the desired increase in gas temperature. Even with a relatively narrow guide path, which forces the gases to pass close to the radiators at the expense of a considerable flow resistance, there exists a definite temperature gradient along which heat is transmitted by conduction and which also gives rise to convection currents. The resulting turbulence and nonuniformity of heat distribution is frequently considered disadvantageous but could heretofore be overcome only by a duplication of the heaters along traverse planes.

The general object of my present invention is to provide means for more economically insuring the virtually uniform heating of a gas stream in the general manner described above.

This object is realized, pursuant to my present invention, by the provision of apertured partitions subdividing at least a portion of the flow path into a series of adjoining compartments each occupied by at least one heating element, preferably a radiator tube located substantially at the center of the compartment. The partitions, whose apertures should of course be large and numerous enough to minimize interference with the gas flow, consist of a highly heat-conductive material, preferably a nonscaling metal, and may be in the form of wire screens, grids of parallel or intersecting bars, perforated sheets or the like. When these partitions are positioned so close to the associated heating elements as to be effectively irradiated thereby, their good thermal conductivity heats them to an approximately uniform temperature which in turn results in a similarly even heating of the gases passing through their interstices. Thus, the gas stream is preheated on entering each compartment, before being irradiated by the heating element thereof, and is thereafter reheated on leaving the compartment whereby residual heat gradients are reduced or eliminated.

A particularly effective arrangement involves the positioning of the partitions at acute angles to the direction of gas flow whereby the contact time is increased. In such a case the compartments may be given a generally diamond-shaped contour, with two partitions lying in diverging planes ahead of the heater element and two other partitions lying in converging planes beyond the heater.

The invention will be described in greater detail with reference to the accompanying drawing in which:

FIG. 1 is a cross-sectional view of a tunnel oven including gas-heating means according to the invention;

FIG. 2 is a fragmentary view similar to part of FIG. 1 but drawn to a larger scale and showing a modification; and

FIG. 3 is another large-scale fragmentary view similar to FIG. 2, illustrating a further modification.

In FIG. 1 I have shown a tunnel oven **1** with an inlet **11** and an outlet **12** for goods to be heated therein by a circulating gas stream **5**, the goods being progressively advanced in the direction of arrow **3** so as to be contacted by the gas in counterflow. A blower **4** circulates the gas stream through a series of compartments **10** defined by apertured partitions **8** extending across a flow channel **6** formed between the top wall of the oven and a horizontal partition **13**. Heating elements **7**, here shown as radiator tubes, extend at right angles to the gas flow at the center of respective compartments **10**.

In FIG. 1 the partitions **8** have been shown as wire screens. FIG. 2 illustrates compartments **10'** separated by arrays of vertically spaced horizontal metal bars **9** forming the partitions. In either case, the heaters **7** are disposed close enough to the associated partitions to irradiate them so that their temperature is almost the same as that of the heaters themselves. The gas stream **5** (e.g. air) recirculated by blower **4** is thus heated with a high degree of uniformity throughout its cross-section.

As illustrated in FIG. 3, wire screens **8***a*, **8***b* may be disposed at acute angles (here about 45°) to the direction of gas flow so as to diverge ahead of the heating elements **7** and converge beyond them, thereby defining compartments **10''** of generally diamond-shaped outline. These compartments alternate with triangularly contoured compartments **6''** also forming part of the flow channel. The latter compartments do not include heating elements and therefore serve merely for the further equalization of temperature. Owing to the considerable inclination of the partitions, the time of contact between them and the gases **5** is appreciably increased.

Although the heating elements have been illustrated as radiator tubes, it will be understood that the partitions herein disclosed will aslo be operative in combination with other heating means, e.g. those of the electric-resistance type. Also, the gas may be admitted to the heating chamber by gravity flow or forced-circulation means other than the blower **4**.

These and other modifications, readily apparent to persons skilled in the art, are intended to be embraced within the spirit and scope of my invention as defined in the appended claims.

I claim:

1. A heater for gaseous fluids, comprising a chamber with a plurality of apertured partitions of highly heat-conductive material forming a series of compartments therebetween, said chamber forming a path for the successive passage of a gas flow through said compartments by way of said partitions, and radiant heater means in each of said compartments positioned to irradiate the respective partitions thereof, said chamber having an inlet and an outlet for goods to be treated by said gas flow, and circulation means being arranged to move said gas along a substantially closed circuit in countercurrent to said goods.

2. A heater as defined in claim **1** wherein said heating means comprises a radiator tube disposed substantially centrally within each compartment at right angles to the direction of gas flow.

3. A heater as defined in claim **1** wherein said partitions comprise wire screens.

4. A heater as defined in claim 1 wherein said partitions comprise grids of metal bars.

5. A heater for gaseous fluids, comprising a chamber with a plurality of apertured partitions of highly heat-conductive material forming a series of compartments therebetween, said chamber forming a path for the successive passage of a gas flow through said compartments by way of said partitions, and radiant heater means in each of said compartments positioned to irradiate the respective partitions thereof, said partitions extending at acute angles to the direction of gas flow.

6. A heater as defined in claim 5 wherein said partitions lie in diverging planes ahead of said heating means and in converging planes beyond said heating means.

7. A heater as defined in claim 6 wherein said chamber is provided with circulation means for said gas flow in said path outside said compartments.

8. In an industrial furnace for the heat treatment of metals wherein metallic bodies in a heat-treatment chamber are subjected to a heated gas, the improvement which comprises heating means traversed by said gas prior to

entry into said chamber and including a plurality of spaced-apart radiant heating elements; means for heating said elements independently of said gas whereby heat is radiated from said elements; and a plurality of heat-conductive open-work partitions traversed by said gas and disposed between said elements for radiant heating thereby to transfer heat by conduction to the gas traversing said heating means.

9. The improvement defined in claim 8 wherein said partitions comprise wire screens.

10. The improvement defined in claim 8 wherein said partitions comprise grids of metal bars.

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