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RADIANT GAS BURNER TILE

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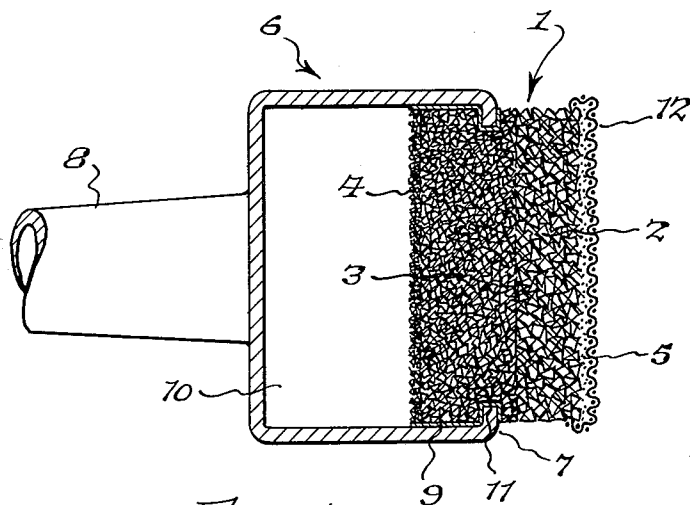


Fig. 1.

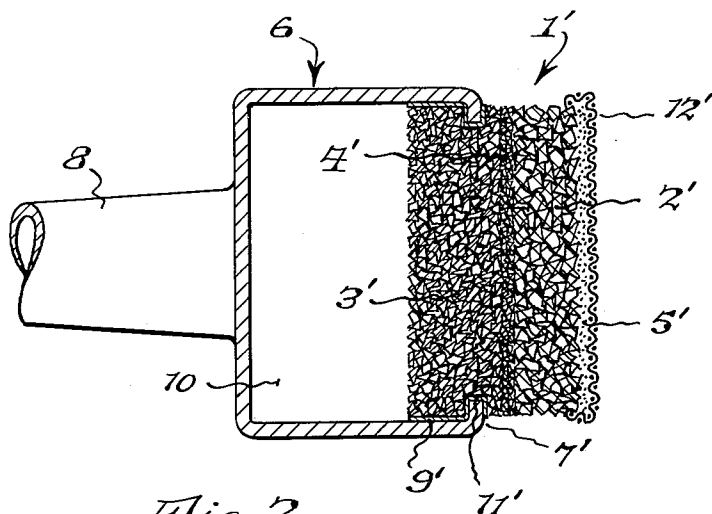


Fig. 2.

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RADIANT GAS BURNER TILE

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5 Claims. (Cl. 158—1116)

This invention relates to ceramic bodies through which a mixture of combustible gases is passed and burned close to the face thereof after emergence therefrom. Such bodies are built into the walls or other portions of ovens or may be placed on ceilings of covered walk ways for example when it is desired to transfer heat in the form of radiant energy to bodies or areas at lower temperatures than and at moderate distances from the face of the burner tile. In order that this may be done effectively, it is desirable that the ignited gases burn as near to the exposed face of the burner tile as possible or even burn within the pores of said tile which are immediately adjacent the exposed face thereof. In this way the sensible heat in the burning gases is transferred to the solid tile, raising its temperature, so that the heat is then transmitted in radiant form to areas remote therefrom.

Numerous attempts have been made to utilize this principle but have been only partially successful because the exposed face of the burner has not radiated heat sufficiently or because the ignited flame has struck back through the tile, igniting the gases on the wrong side thereof, thus causing explosions or otherwise destroying the unit.

One objective of our invention is to provide a burner tile capable of transforming a maximum proportion of the sensible heat from the burning gases into radiant energy and transferring this to the desired area. Another objective is to provide a tile through which the flame does not strike back from the hot face into the chamber in which the combustible gases are premixed with air or oxygen. A further objective is to provide a tile through which a minimum of heat escapes from the furnace unused. Another objective is to provide a tile structure such that the rate of flow of combustible gases there-through is decreased a minimum amount due to heating of these gases as the operation proceeds. Still another objective is to provide a burner tile whose face does not develop local areas of high and low temperature but rather glows uniformly all over with high emission of radiant heat.

In the accompanying drawings FIG. 1 is a sectional elevation of one example of a construction of our burner embodying our invention. FIG. 2 is a similar section of a burner of modified construction.

In FIG. 1, 1 indicates the ceramic portion of our burner tile as a whole. This comprises a face portion 2 made of relatively coarse granules of a refractory material having a high emissivity, such for example as 10 to 30 grit silicon carbide suitably bonded having front and rear faces, and a rear insulating or barrier layer 3 of insulating fire clay grog bonded with a low temperature ceramic binder to hold it in rigid but permeable form which is bonded to the rear face of the face portion 2. The unit permeability of this portion 3 is somewhat lower than that of portion 2 in-order to make sure that flame from the ex-

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posed face shall not work its way back through the tile into entering gas chamber 10.

The tile as here illustrated has a further combustion control layer 4 of quite fine grained insulating material adjacent chamber 10 to further insure against flame working back through the tile into the chamber. Layer 4 should be relatively thin, perhaps $\frac{1}{8}$ inch, as it is desirable not to restrict gas flow and build up back pressure any more than necessary for safety. It is within the scope of our invention to make the granules of layer 3 so small that the velocity of gas flow through the pores in that layer is above the velocity of flame propagation so that the flame cannot work back through that layer. In such a case the separate controlling layer 4 may be omitted.

Alternatively a fine flame control layer similar to 4' may be built into the tile as shown in FIG. 2, between layers 2' and 3' or two such control layers may be provided both between layers 2' and 3' and at the gas entering face of layer 3'. Since except as above described the constructions shown in FIGS. 1 and 2 are identical, the parts of the ceramic block in FIG. 2 which are identical with those of FIG. 1 are designated with prime marks so that one description will make both constructions readily understood.

Block 1 has a groove 11 cut along two or more edges to furnish a seat for a flanged edge 7 which forms a part of combustion gas box 6 which is made of suitable metal. In order to assure a tight fit to prevent leakage of gas we provide a pad 9 of felted asbestos or refractory wool around the sides of the tile.

A premixed combustible mixture such as natural gas and air is introduced into the gas chamber 10 of box 6 through inlet pipe 8 or they may be introduced separately and mixed in chamber 10. From 10 they flow outward through the pores of the tile to the face of layer 2 where they are ignited and allowed to burn. Some combustion works back into the pores of layer 2 as it heats up, thereby raising the temperature of this layer and causing it to radiate heat rapidly. The pores of layer 3 are however preferably so fine that gas velocity through them is high enough to prevent flame from working back into this layer and the pores of layer 4 are as explained above very fine so as to completely insure against flame striking back through this layer.

In order to insure combustion taking place as near as possible to the exposed face of portion 2, we may lightly coat that face with finely divided catalytic material 5 such as 100 mesh cerium oxide which can be attached by flame spraying or may be dusted on with a temporary binder and fired either along with the tile or later. The effect of this material is to cause maximum flame temperature to develop quickly and in close contact with the tile face.

We prefer in making our burner tile to make it not over $2\frac{1}{2}$ inches thick, divided with $\frac{1}{8}$ to $\frac{1}{2}$ inch thickness of coarse grit SiC (for example 10 to 30 mesh) in layer 2. For layer 3 we use 24 to 30 mesh grog made of crushed insulating fire brick or mullite making the layer approximately $1\frac{1}{2}$ inches thick and for layer 4 we use $\frac{1}{8}$ inch of 24 to 80 mesh grog similar to that of layer 3.

As an example of the method of manufacturing our tile, we may proceed as follows:

First we mix together,

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90 parts by weight of 10-30 mesh SiC.
10 parts by weight of 200 mesh SiC.
3 parts by weight of dextrin.

and place a layer of this mix $\frac{1}{4}$ inch deep in the mold in which the tile is to be formed.

Next we mix together,

90 parts by weight of 24-30 mesh mullite.
10 parts by weight of Albany slip clay.
3 parts by weight of dextrin.

and place a layer $1\frac{1}{2}$ inches thick of this material on top of the SiC layer already in the mold.

Finally when a third, gas control layer is desired we similarly mix together,

88 parts by weight of 24-80 mesh mullite.
12 parts by weight of Albany slip clay.
3 parts by weight of dextrin.

and place $\frac{1}{8}$ inch of this material in the mold on top of the foregoing layers. We then press the various layers together under 1000 p.s.i., remove the pressed piece from the mold and fire it to 2300° F. for 4 hours to mature the bond. The tile is thereafter ready for use after insertion in box 6.

Obviously the compositions, grit sizes, binders and firing procedures may be varied as may be desired as will be understood by those familiar with the ceramic art. It is important that high strength be maintained and that materials be so matched that rapid temperature changes shall not damage the block. We in general find that silicon carbide makes an excellent hot facing and that backings may be of mullite, fireclay grog, alumina or other compositions with lower thermal conductivity than the silicon carbide.

Our burner assembly may be suspended from an outer wall by mechanical supports attached to the box 6 or may be enclosed in any desired manner, either alone or in groups. Since such supports are not a part of this invention they have not been shown.

In operation we like to attain a temperature on the hot face of 1800-2000° F. which causes the heated face to radiate heat very rapidly. We find that with the gas and air pressures properly adjusted, these temperatures can be maintained with a rear face temperature on the entry face not in excess of 400° F. The flow of gases through such devices tends to decrease as the temperature rises. This is true in our burner also but with the fine grained control layer shown this change is far less than when it is omitted.

We find that the hot face of our burner arrives at a substantially uniform temperature over its entire area, the silicon carbide serving to carry heat laterally from any particularly hot spot to its surrounding areas.

When the velocity of the combustible gases is maintained at such a high value as to make it impossible for combustion to be completed while they are in contact with the refractory, there is a considerable amount of sensible heat still released in the burning gases after they leave the burner tile. In such a case, we find it desirable to place a network of heat resistant wire 12, such as nickel or Inconel screen out in front of our SiC face. This extracts much of the residual heat from the gases and transfers it as radiation either directly to the desired area or back to the SiC from whence it is reradiated to the spot to be heated. This network may be secured in any desired manner to the ceramic body, for example, by providing the body with a groove on its edges and the edges of the network may be bent to extend into this groove.

Variations may be made in our burner, either in materials, such as the use of other component materials or the mechanical arrangement of the various parts within the limits of the following claims.

We claim:

1. A multi-layer burner block for combustible gas burn-

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er units which permits passage of combustible gases there-through, comprising:

(a) a facing layer means of bonded silicon carbide granules having a front and a rear face, the size of said granules and the porosity of the layer means being such that the combustible gases will burn as they are passed therethrough;

(b) a thermal insulating layer means of bonded ceramic granules which is bonded to the rear face of said facing layer means and through which the combustible gases are passed to said facing layer means;

(c) said ceramic granules being of smaller size than said silicon carbide granules and having open pores therebetween;

(d) a thin combustion control layer means of fine bonded ceramic particles bonded to the back of said thermal insulating layer means; and

(e) the granular size and pores of said combustion control layer means being substantially smaller than said thermal insulating layer means and being capable of inhibiting combustion of the combustible gases as they pass therethrough.

2. A multi-layer burner block for combustible gas burner units which permits passage of combustible gases there-through, comprising:

(a) a facing layer means of bonded silicon carbide granules having a front and a rear face, the size of said granules and the porosity of the layer means being such that the combustible gases will burn as they are passed therethrough;

(b) a thin combustion control layer means of fine bonded ceramic particles bonded to the rear face of said facing layer means;

(c) a thermal insulating layer means of bonded ceramic granules which is bonded to the back of said combustion control layer means and through which the combustible gases are passed to said facing layer means;

(d) the ceramic granules of said insulating layer means being of smaller size than said silicon carbide granules and having open pores therebetween; and

(e) the granular size and pores of said combustion control layer means being substantially smaller than said thermal insulating layer means and being capable of inhibiting combustion of the combustible gases as they pass therethrough.

3. A multi-layer burner block for combustible gas burner units which permits passage of combustible gases there-through, comprising:

(a) a facing layer means of bonded silicon carbide granules having a front and a rear face, the size of said granules and the porosity of the layer means being such that the combustible gases will burn as they are passed therethrough;

(b) a barrier layer means of bonded ceramic granules which is bonded to said rear face of said facing layer means and through which the combustible gases are passed to said facing layer means;

(c) said ceramic granules being of smaller size than said silicon carbide granules;

(d) the pores of said barrier layer means being such that the velocity of combustible gases passing there-through prevents the flame in said facing layer means from traveling back therethrough; and

(e) said barrier layer means being substantially thicker than said facing layer means and being of sufficient thickness to provide thermal insulation between said facing layer means and the combustible gases at the rear of said barrier layer means.

4. The multi-layer burner block for combustible gas burner units as set forth in claim 3, wherein,

(a) said front face of the facing layer means has a thin coating of finely divided catalytic material.

5. The multi-layer burner block for combustible gas burner units as set forth in claim 3, wherein,
(a) said ceramic granules are mullite.

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