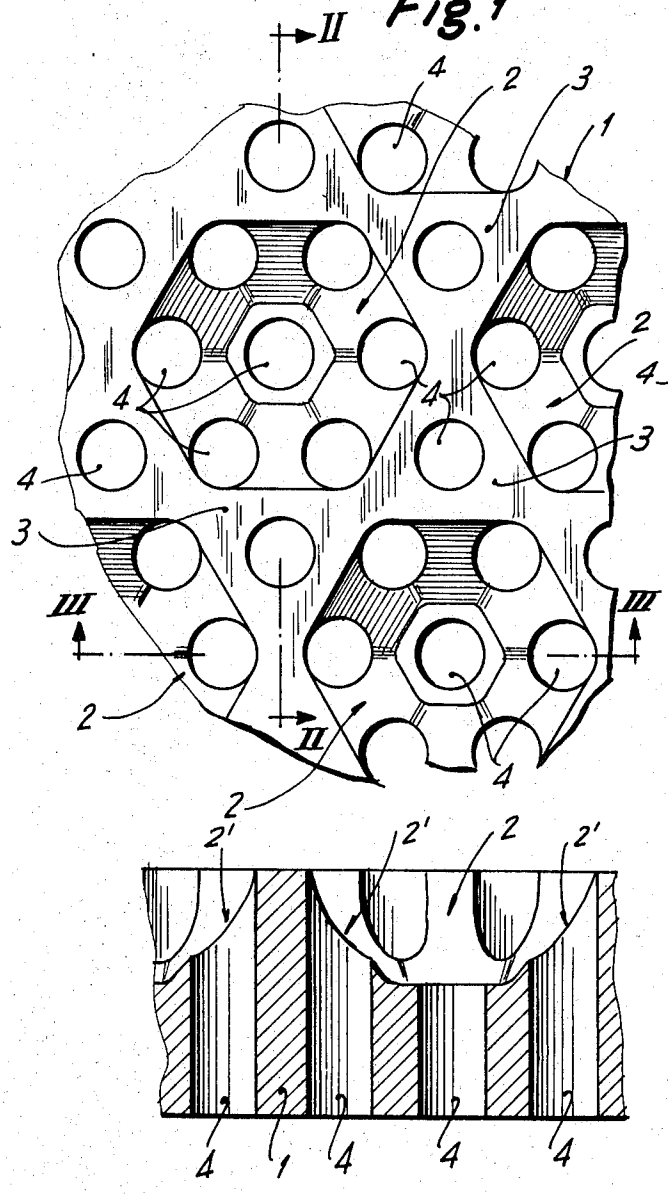
Jan. 26, 1971 D. C. ROCA 3,558,252

RADIATING ELEMENT

Filed July 29, 1968 2 Sheets-Sheet 1

Fig. 1



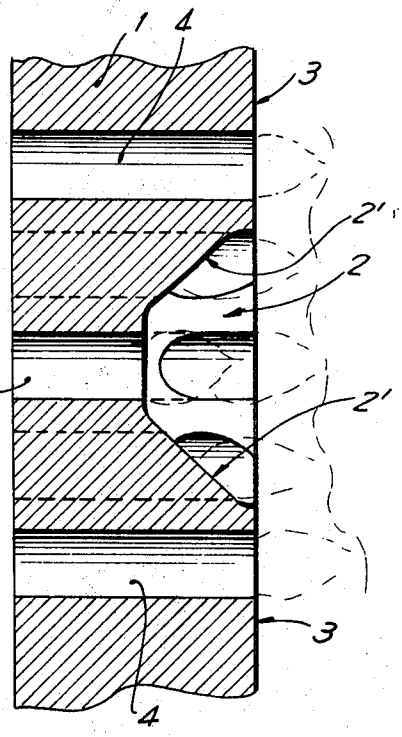


Fig. 2

Fig. 3

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RADIATING ELEMENT

Filed July 29, 1968 2 Sheets-Sheet 2

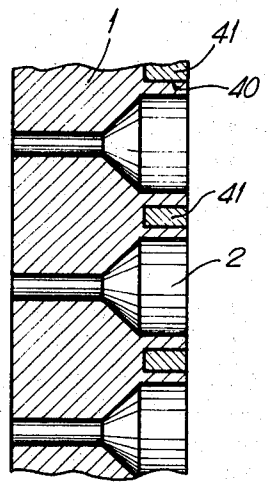

FIG. 4

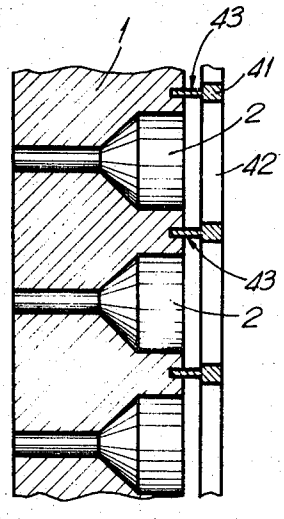

FIG. 5

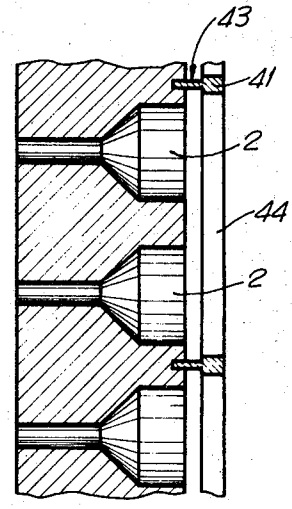

FIG. 6

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3,558,252

RADIATING ELEMENT

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Int. Cl. F23d 3/12
U.S. Cl. 431—328 9 Claims

ABSTRACT OF THE DISCLOSURE

A radiant element provided with a face from which infrared rays are to be emitted, fitted with a plurality of polygon-shaped cavities, the side faces of which have a predetermined degree of inclination convergent toward the interior, the total area of the inner side surfaces being greater than the cross-sectional areas of the associated cavity, so that the available area from which infrared rays can be emitted is thereby increased. The cavities are each provided with several feeding ducts, the outlets of which are staggered in different planes within the respective cavity, to supply each cavity with a combustible gaseous fluid under pressure, so that when undergoing combustion in the respective outlets, the flames are at different levels from the general plane of the front face at which feeding further conduits have their outlets, whereby an autopiloting effect of the inner flames towards the outside flames and vice-versa is created, as a consequence of which the addition of primary air to the combustible mix is enriched so obtaining a more complete combustion and, therefore, improved performance, and avoiding possible leaks and small explosions of portions of non-burned gas at the outlets of the ducts.

BACKGROUND OF THE INVENTION

The present invention relates generally to radiating elements, and more particularly to an infrared radiator.

The efficiency of the radiant surface in an infrared radiating device, that is a heater operating by emission of infrared rays, depends upon the "yield" of emission which can be obtained. The apparatus operating on this principle is usually fed by gaseous fluids, such as natural or manufactured gas, or gaseous mixes based on gasoline, petroleum or the like. These gaseous mixes or gases are burnt in the apparatus and the resulting heat is radiated from the radiant surface. The most commonly used radiating element for such devices consists of a ceramic plate which is provided with a plurality of apertures or orifices through which the combustible gaseous mix passes. At the front of the radiant surface of the plate, the mix is subjected to combustion and when the front face of the plate becomes heated, it will emit infrared rays. In order to improve the output of such plates it is known to place a metallic grid over this front face, very near thereof, so creating a combustion chamber with a supplementary and forced addition of secondary air.

However, the well-known constructions of this type are subject to several disadvantages. Thus, the temperature and thereby the obtained intensity of emission of radiant energy have heretofore resisted all attempts at increasing in them the optimum values at a minimum possible flow of combustible gaseous fluid.

It is therefore a general object of the present invention to provide a radiating element for the emission of infrared radiation which overcomes the aforementioned disadvantages known from this art.

A more particular object of the invention is to provide such a radiating element wherein the temperature of combustion, and therefore the emission of infrared rays, is increased significantly over similar factors known in prior-art constructions.

Another object of the invention is to achieve the combustion of the combustible gaseous fluid inwardly of the radiant surface or front face of the radiating element, eliminating the need for applying the front metallic grid.

SUMMARY OF THE INVENTION

These and other purposes of the present invention are achieved, in accordance with one feature thereof, in the provision of a radiating element having a face from which infrared rays are to be emitted, said face having a given radiant area. A plurality of cavities is provided in this face and each of these cavities has a predetermined cross-sectional area at the face of the radiating element and an inner end portion remote from this face. The cavities are each bounded by an inner polygon-shaped surface consisting of curved or otherwise mutually inclined faces, and the combined cross-sectional areas of the cavities the face of the radiating element, whereas the combined surface areas of the inner circumferential surfaces exceed such predetermined fraction so that, as a result of the equal a predetermined fraction of the radiant area of provision of the cavities, the available radiant area is significantly increased. These cavities are each provided with several conduits for supplying a combustible gaseous fluid under pressure, said conduits being regularly distributed all over the radiant surface, so that a predetermined number of conduits, with their outlets at different levels, communicates with each cavity, the fuel outlets of these conduits in each cavity being staggered with reference to the planes of the bottom wall of the cavity and the outside radiant face of the element, so that upon establishing the gas combustion at the outlet of each conduit, the flames are at different levels which provides an autopiloting effect of the inner flames towards the outer flames and vice-versa.

As a consequence of this, the addition of primary air to the combustible mix is enriched, thus obtaining a more complete combustion and therefore a higher output. At the same time, when the combustion is originated in the cavities, it produces the emission of increased radiation from the radiant face and the respective inner inclined faces.

The cavities are separated from one another by thin wall portions of refractory material. Such refractory material may be a ceramic material or any other material which is capable of withstanding an elevated temperature of 1,100° C. without oxidation.

The novel features which are considered as a characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary front view of an element according to the invention;

FIG. 2 is a fragmentary section taken on the line II—II of FIG. 1;

FIG. 3 is a fragmentary section taken on the line III—III of FIG. 1;

FIG. 4 is a view similar to FIG. 2 but illustrates another embodiment;

FIG. 5 is similar to FIG. 4, showing a further embodiment; and

FIG. 6, similar in view to FIG. 5, illustrates yet another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, it will be seen that reference numeral **1** designates a radiating element according to the present invention. This radiating element **1** may be of plate-like configuration, the outline being selected as desired and being of no consequence for the purposes of the present invention. The element **1** is assumed to consist of a refractory ceramic material and, as shown, the front face from which the infrared radiation is to be emitted, is provided with a plurality of cavities **2**. In the illustrated embodiment these cavities **2** are assumed to be arranged in form of a hexagon, aligned with their diagonals, so that between adjacent cavities **2** there are formed plateaus or thin wall portions **3** which determinate the general plane of the front face of element **1**. However, other arrangements are also possible, with the cross section of each cavity having a configuration other than the hexagonal outline shown in FIG. 1. Thus, other polygonal cross-sectional configurations are also suitable for the cavities **2** and may include a square cross section, a rectangular cross section, a circular cross section, a star-shaped cross section or the like.

Each of the cavities **2** is separated from the adjoining cavities by the plateaus **3**, and bounded by an inner circumferential surface **2'** which consists of a plurality of mutually inclined facets and has a predeterminated degree of conicity so as to be convergent toward the bottom **2''** of the cavity **2**.

The front face of the radiating element **1** is provided with a plurality of through ducts **4** in form of bores or channels provided in the element **1**. These ducts **4** are regularly distributed over the entire front face of the radiating element **1** so that, combined with the arrangement of the cavities **2**, their outlets are distributed regularly on the bottom **2''**, the facets of the surfaces **2'** and the plateaus **3**, whereby these outlets are staggered at different levels intermediate the bottoms **2''** of the cavities **2** and the general plane of the front face of the element **1** which is determined by the plateaus **3**.

When a combustible gaseous fluid is introduced under pressure through the ducts **4** into the cavities **2**, the flow rate of the fluid will decrease as soon as the fluid expands within the space in the cavities **2**. This reduction in the flow rate assures that the same becomes equal to the rate of flame propagation, so that the combustion of the gaseous fluid takes place at different levels at different distances away from the general plane of the radiating front face, whereby an autopiloting effect of the inner flames towards the outer flames and vice versa is created, significantly elevating the level of output of the new radiating element by allowing an almost instantaneous combustion of the gaseous fluid when the same leaves the ducts **4**, since the addition of primary air to the combustible fuel mix enriches the same, obtaining as a result a better utilization of the gaseous fluid.

It should be added the inventive arrangement of the cavity walls **2** establishes a ray refraction between the facets of the respective surfaces **2'**, originating a temperature increase of the plate which is considerably higher than would be the case if the radiation were to originate strictly from the front face subject to the radiating element and the space, as in the case of the known constructions.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications, differing from the types described above.

Thus, the embodiment shown in FIG. 4 has an element similar to that identified with reference numeral **1**, and therefore identified with the same numeral. The cavities are also again designated with numeral **2**.

Here, however, the element **1** is provided on its front face with recesses **40** surrounding the cavities **2**, and

in these recesses a grid **41** of material resistant to elevated temperature is received. Of course, the grid **41** is simply embedded in the material of element **1**, it being immaterial how the embedding is effected.

In FIG. 5 I have shown an embodiment where the element **1** and the grid **41** are again present, with the openings **42** in grid **41** each surrounding are of the cavities as in FIG. 4. However, in FIG. 5 the grid **41** is not embedded in element **1**, but is instead slightly spaced from the front face thereof by means of the spacer portions **43** which hold the grid **41** to the element **1**.

FIG. 6, finally, shows an embodiment which is largely the same as that in FIG. 5, except that the openings **44** of grid **41** are so large that they each communicate with more than one of the cavities **2**.

While the invention has been illustrated and described as embodied in a radiating element, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

What is claimed is:

1. In a structure of the character described, particularly an infrared radiator, a radiating element having a face from which infrared rays are to be emitted, said face having a given radiant area, provided with a plurality of discrete polygon-shaped cavities each having a bottom face and a circumferential side face composed of a plurality of mutually inclined facets all of which are convergent towards the respective bottom face, and said cavities being so arranged that between adjacent ones of said cavities plateaus are established which determine the general plane of said face of the radiating element; a plurality of throughgoing fuel supply ducts provided in said element and each having an outlet opening, said outlet openings being distributed over the entire area of said face in a regular pattern so that some of said outlet openings terminate in the respective bottom faces, some of said outlet openings terminate in the respective facets and the remaining ones of said outlet openings terminate in the respective plateaus whereby, when a combustible gaseous fluid under pressure is introduced through said ducts into said cavities, the fluid flow rate will decrease on expanding of the gaseous fluid in said cavities and become equal to the flame propagation rate, so that the combustion of the gaseous fluid will take place at different levels at different distances with reference to the general plane of said front face, creating an autopiloting effect of the inner flames towards the outer flames and vice versa.

2. In a structure as defined in claim **1**, wherein said element consists of a refractory material.

3. In a structure as defined in claim **1**, wherein said cavities each comprise an inner portion and an outer portion extending from the respective inner portion to said front face, said outer portions each having a cross-sectional area greater than said inner portions, whereby gaseous fluid supplied to the inner portion of the respective cavities and being ignited therein expands upon entering the respective outer portions so that the flow rate of such fluid is reduced to equal the rate of flame propagation.

4. In a structure as defined in claim **5**, wherein said inner portions each converge in direction inwardly from the respective outer portions.

5. In a structure as defined in claim 1, wherein said element comprises two superimposed plate portions, one of said plate portions having said front face and being provided with said cavities and said ducts, and the other of said portions plate consisting of a material resistant to elevated temperatures and constituting a grid embedded in said front face of said one plate portion surrounding the respective cavities therein.

6. In a structure as defined in claim 1, wherein said element comprises two connected superimposed plate portions, one of said plate portions having said front face and being provided with said cavities and said ducts, and the other of said plate portions overlying said front face and consisting of a material resistant to elevated temperatures, said other plate portion consisting a grid provided with a plurality of apertures each surrounding one of said cavities and constituting an extension of the respective cavity.

7. In a structure as defined in claim 6, wherein said other plate portion is slightly spaced from said front face of said one plate portion.

8. In a structure as defined in claim 1, wherein said

element comprises two connected superimposed plate portions, one of said plate portions having said front face and being provided with said cavities and said ducts, and the other of said plate portions overlying said front face and consisting of a material resistant to elevated temperatures, said other plate portion comprising a plurality of mutually inclined wall portions defining between themselves a grid having a plurality of apertures each of which communicates with a plurality of adjacent ones of said cavities in said front face of said one plate portion.

9. In a structure as defined in claim 2, wherein said refractory material is a ceramic material.

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