

April 8, 1969

J. H. DAVIS ET AL

3,437,415

RADIANT GAS BURNER

Filed Aug. 18, 1967

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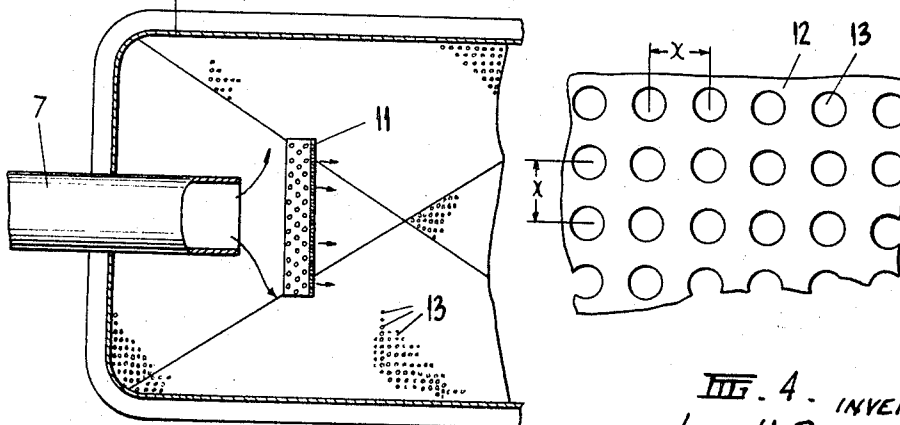
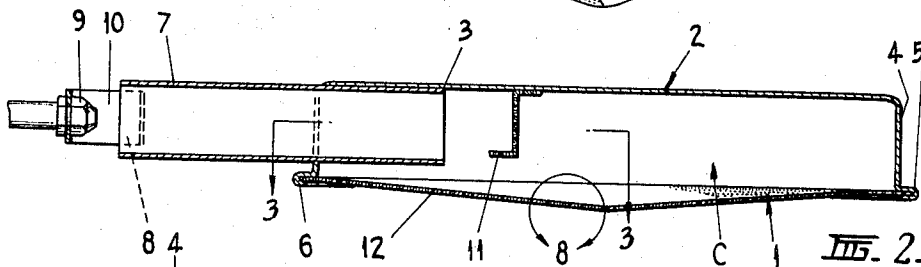
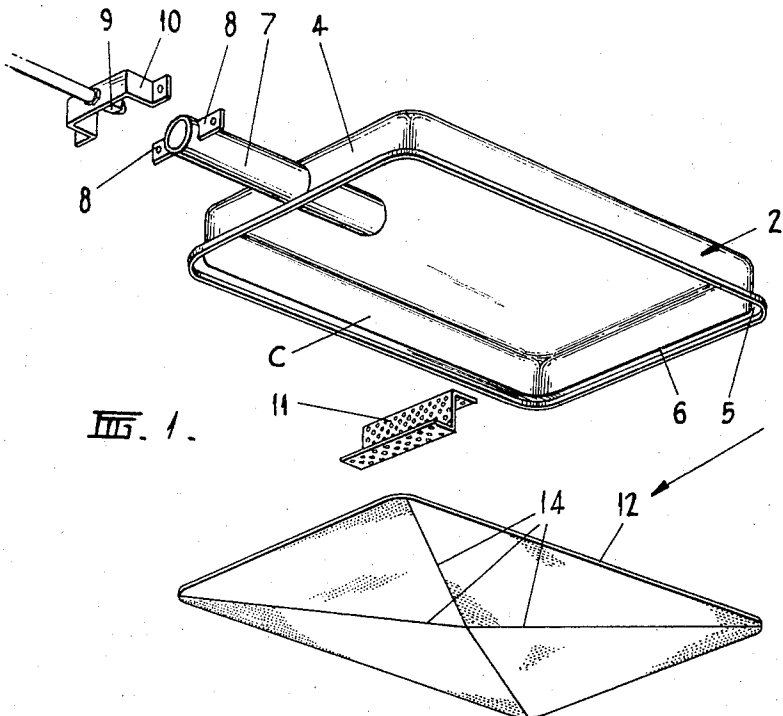


FIG. 3.

FIG. 4. INVENTORS
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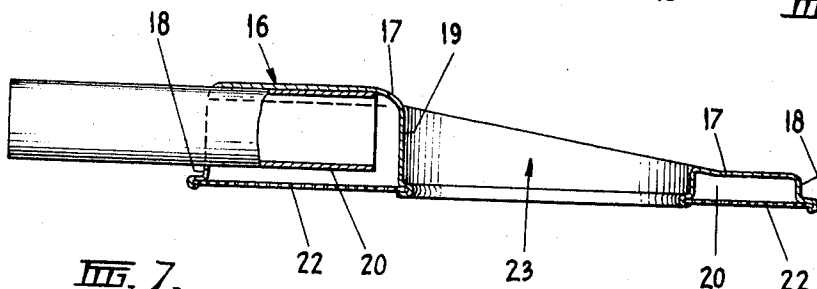
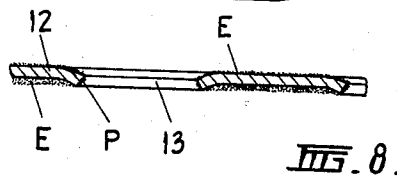
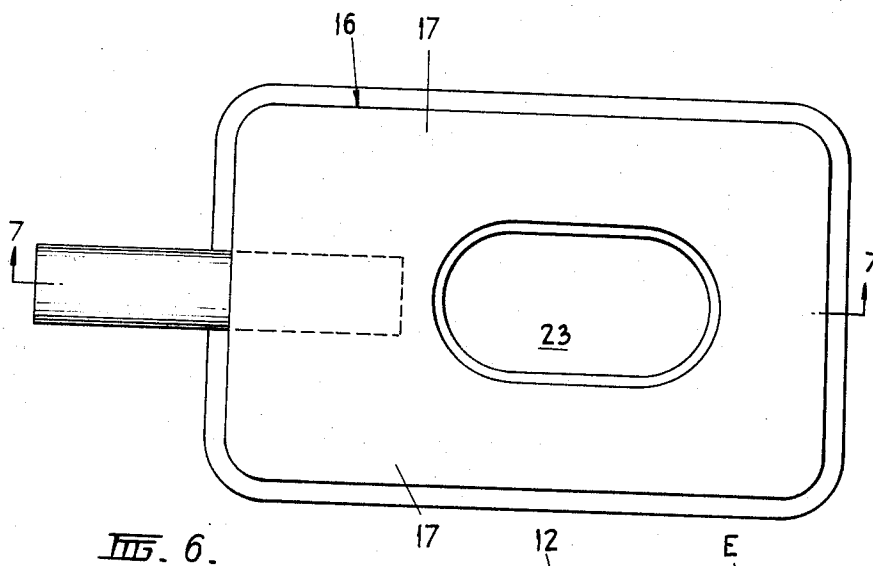
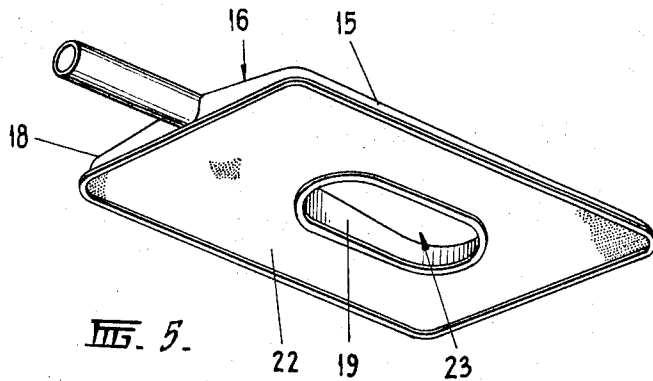
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Sheet 2 of 2



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3,437,415

RADIANT GAS BURNER

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Filed Aug. 18, 1967, Ser. No. 661,695

Claims priority, application Australia, Aug. 22, 1966, 9,972; Feb. 21, 1967, 17,965

Int. Cl. F23d 13/12, 13/44; B05b 1/14

U.S. Cl. 431—328

5 Claims

ABSTRACT OF THE DISCLOSURE

A radiant burner comprising a body defining a chamber having one open face, means for delivering a combustible mixture to the chamber, a single thin perforated radiant member covering said open face so that the mixture will issue through the perforations to be burnt adjacent the outer face of said member to heat said member such that the temperature of the mixture in the chamber does not exceed the flash point thereof, at least said outer face being coated with a black heat resistant material.

This invention relates to a radiant burner of the type having a gas-pervious radiant member through which a gas-air or other combustible mixture is passed and which is heated by combustion of the combustible mixture adjacent the outer face thereof so as to emit infrared radiation.

In the past it has been found impossible to use a single thin plate or wire mesh radiant member because the temperature of the inner face thereof rises to such a value that the combustible mixture behind the radiant member ignites causing "flash-back" to the gas nozzle. The problem has been overcome by having the radiant member in the form of a thick slab of porous refractory material having a temperature gradient which maintains the temperature of the inner face below the ignition temperature of the combustible mixture. However, burners incorporating such radiant members have not been altogether successful because of the bulkiness, weight, cost and slow heating characteristics of such refractory material slabs.

Another disadvantage with previously known radiant burners is that the gases produced by combustion must pass across the face, around the sides of the burner and up through the top of the stove. These gases thus tend to disturb the operation of the other gas jets in the stove.

According to one aspect of the invention, there is provided a radiant burner comprising a body defining a chamber, means for delivering a combustible mixture to said chamber, a single thin perforated metal radiant member arranged so that the combustible mixture will flow through the perforations in said member to be burnt adjacent the outer face of said member to heat said member, said member and/or said means supplying said mixture being such that the temperature of the mixture within the chamber does not exceed the flash point of said mixture.

More particularly, said radiant member is formed from sheet metal having a plurality of closely spaced small apertures therein.

Preferably, said perforations are formed by a punching operation which produces a raised projection about the periphery of each perforation on one face of the radiant member, said one face being directed outwardly and at least said one face is coated with a heat-resistant material.

More particularly, both faces of said radiant member are coated with said heat-resistant material, the coating

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on said one face being thicker than the coating on the other face by virtue of the fact that said raised projections act to retain said coating material on said one face, and wherein said one face coating is black.

According to one form of this aspect of the invention said burner body has a substantially flat top wall and a side wall extending around the periphery of said top wall to define said chamber which thus has one open face, said radiant member being secured to said side wall to cover the open face of the chamber, said means for delivering said combustible mixture preferably comprising a pipe opening through said side wall into said chamber.

According to another aspect the invention provides a method of making a radiant burner according to the invention comprising forming said burner body and said perforated radiant member from sheet metal, coating said radiant member with a heat-resistant protective material, coating the surface of said body defining said chamber with a protective material and removing the moisture from said coating by heating the body, securing the radiant member to the body, coating the outer surface of said body with a protective material and firing or otherwise finishing the coatings on said body.

According to a further aspect, the invention provides a radiant burner comprising a body defining a chamber, means for delivering a combustible mixture to said chamber, a perforated radiant member arranged so that the combustible mixture will flow through its perforations to be burnt adjacent the outer face of said member to heat said member, said burner having a flue passage passing through the chamber and opening through the radiant member at one end and through the burner body at the other end.

In order that the invention may be more readily understood, preferred embodiments will now be described with reference to the accompanying drawing wherein:

FIGURE 1 is an exploded perspective view from beneath of a radiant burner suitable for the griller of a domestic stove and embodying the invention showing the various components thereof;

FIGURE 2 is a sectional elevation of the assembled burner;

FIGURE 3 is a partial sectional view taken along line 3—3 of FIGURE 2;

FIGURE 4 is an enlarged view of the radiant member of the burner showing the spacing of the perforations;

FIGURE 5 is a perspective view from beneath of a modified radiant burner embodying the invention;

FIGURE 6 is a plan view of the burner of FIGURE 5;

FIGURE 7 is a sectional elevation taken along line 7—7 of FIGURE 6; and

FIGURE 8 is an enlarged cross section of part of the radiant member.

Referring firstly to FIGURES 1 to 4, the radiant burner 1 comprises a generally rectangular pressed sheet metal burner body 2 having a flat top wall 3 and a continuous wall 4 extending around the periphery of the top wall 3. The wall 4 has a short outwardly extending flange 5 at its free edge which terminates in a depending extension 6, the purpose of which will become apparent below. The wall 4 thus forms a generally rectangular chamber C having an open face defined by the point of connection between the wall 4 and the flange 5.

An inlet tube 7 extends through the wall 4 at one short side of the body 2 into the chamber C. Adjacent the inlet end of the tube 7, two diametrically opposed brackets 8 are secured to provide support for a gas jet 9 through a bracket 10. The gas jet 9 is arranged in spaced relation to the inlet end of the tube 7 so that as gas issues from the jet 9, air is entrained in the stream in known manner.

Thus a gas-air mixture, the ratio of which is controlled by the positioning of the jet and the rate of issue of gas therefrom, may be delivered to the chamber C through the tube 7.

To provide for even distribution of the gas-air mixture in the chamber C, a perforated sheet metal baffle plate 11 is secured to the top wall 3 inside the chamber C adjacent the discharge end of the tube 7. The baffle plate 11 is wider than the diameter of the tube 7 and is arranged symmetrically with respect to the longitudinal axis of the tube and transversely to the flow of mixture from the tube 7. The configuration of the plate 11 and its position in the chamber are such as to distribute but not substantially inhibit the flow of mixture in the chamber C.

A thin perforated sheet metal radiant member 12 is sealingly secured to the flange 5 of the burner body 2 by inwardly crimping the downward extension 6 of the flange 5 about the edge of the member 12. The member 12 may be sealed with respect to the body 2 in any suitable manner. A preferred method of sealing will be described hereinafter. The radiant member is formed from a sheet of 24-gauge mild steel having perforations 13 one thirty-second of an inch in diameter, the centres of adjacent perforations being spaced by fifty five thousandths of an inch represented by distance x in FIGURE 4. This produces a mesh having three hundred and eighty perforations per square inch and this may further be defined as a thirty one percent open mesh. In the present embodiment the member 12 measures approximately eleven inches by seven inches.

As will be evident from FIGURES 1 and 2, the radiant member 12 is outwardly dished with respect to the chamber C by bending the member 12 through a small angle along four lines 14 each of which extends from one corner of the radiant member 12 to its centre.

Prior to fitting to the body 2, each side of the radiant member 12 is spray coated with black heat-resistant porcelain enamel which is then fired. The enamel coating has a calcine-alumina or other suitable heat-resistant base and functions to suppress corrosion of the member 12 in use. This ensures that the diameter of the perforations 13 and the thickness of the member 12 do not change and accordingly the radiant member 12 will emit a substantially consistent radiation. Since the coating is black it also improves the radiation emitted by the member.

The perforations 13 are formed by a suitable punching operation which shears circular areas out of the sheet of mild steel. The shearing effect produces a substantially continuous raised projection P about the periphery of each of the perforations 13. (See FIGURE 8). The projections P act to allow a thicker coating of porcelain enamel E to be retained on this face of the member 12 as will be clear from FIGURE 8. Thus, this side of the member 12 is directed outwardly in the assembly since the outer face is of course subjected to higher temperatures than the inner face.

In use the gas-air mixture flows from the inlet tube 7 and fills the chamber C to eventually issue through the perforations 13 to the outer face of the radiant member 12. When the mixture is ignited, it heats the radiant member 12 causing it to emit substantially long wave infrared radiation. The radiant member 12 is not heated to incandescence as in the prior art devices, the temperature thereof under operating conditions being maintained below the flash point of the mixture in the chamber C.

The operating temperature of the radiant member 12 is maintained below the flash point of the mixture by suitably selecting the rate of flow of the combustible mixture from the inlet tube 7 to the chamber C. In the present embodiment the maximum allowable rate for town gas having a 67 wobbe rating is 14000 B.t.u./hr. This rate may be safely varied between about 85% to 100% of the maximum valve to provide different grilling rates. Below 85% it has been found that the rate is insufficient to maintain a stable flame and above 100%, the temperature of

the radiant member 12 becomes equal to or exceeds the flash point of the mixture and "flash-back" occurs.

It has been found that mild steel is a particularly suitable material for the radiant member 12. It is believed that the good thermal conductivity of the mild steel enables the radiant member 12 to release its heat rapidly thus assisting in keeping the temperature of the member 12 below flash point and increasing its ability to radiate. It is also evident that the ability of the radiant member to radiate is increased by having the outer face thereof coated with black, heat-resistant enamel.

It will be seen that the above described radiant burner having only a single radiant member operates to emit infrared radiation at a radiant member temperature lower than the prior art burners and does not suffer from "flash-back" as in the previously known single radiant member burners. The applicant has found that the burner of the present invention effectively grills with little or no increase in cooking time and in some instances less cooking time. It has also been found that the lower temperature at which the burner operates substantially reduces spattering of the fats in meat to a minimum. This is of advantage since the griller tray accordingly requires less cleaning.

The manufacture of the burner described above is carried out in the following manner: The burner body 2 is formed in the configuration shown in FIGURE 1 by suitably pressing a sheet of metal. The inlet tube 7 is welded or otherwise fixed in position and the baffle 11 is spot welded to the top wall 3 of the body 2 as shown in FIGURES 2 and 3. The inner surface of the body 2, the portion of the inlet tube 7 extending into the chamber C and the baffle 11 are spray coated with a heat-resistant vitreous enamel. The body is then placed in an oven operating at a temperature of about 300° to 400° F. and the moisture is removed from the coating. This is known as a "bisque" coating.

The perforated radiant member 12 is formed from mild steel as shown in FIGURES 1 and 4 and 8. Both sides of the member 12 are spray coated with a black heat-resistant vitreous enamel which is then fired at a temperature of about 1400° F. As mentioned above, the side of the member 12 which has the raised projections P produced by the punching operation has a thicker coating. The member 12 is positioned with this side facing outwardly and so that its edges are supported by the flange 5. The extension 6 is then crimped about the edges of member 12 to hold it in place.

Since the coating on the body is not fully fired, that is, it is only "bisque," it is less likely to crack or flake at the crimped areas although some degree of special care must be exercised in the crimping operation. If any flaking does occur, the particles will be trapped between the crimped extension 6, the flange 5 and the edges of the member 12.

The outer surface of the body 2 is then spray coated with heat resistant enamel and this fills any openings between the crimped extension 6 and the member 12 to seal the member 12 with respect to the body 2. It also tends to seal any cracked or flaked portions of the crimped parts from the atmosphere.

The whole burner is then fired at a temperature of approximately 1400° F. to vitrify the enamel on the outer and inner surfaces of the body 2 and to complete the above-mentioned seal.

The burner 1 of FIGURES 1 to 4 may be modified by blocking the perforations 13 in a centrally disposed generally rectangular area of the radiant member 12 and measuring about four inches by two inches. This may be done by applying additional enamel to this area of the radiant member 12 until the perforations are blocked. Blocking this area of the radiant member 12 achieves a substantially improved distribution of the flame front adjacent the outer face of member 12 and thus reduces the development of hot and cold spots in the radiant member. However, it does not substantially reduce the heating

effects of the burner or the area over which the heat will be distributed.

Referring now to FIGURES 5 to 7, the modified burner 15 is seen to include a generally rectangular pressed sheet metal burner body 16 which is formed with a top wall 17, an outer continuous wall 18 and an inner continuous wall 19 depending from the top wall 17 and which together define a generally annular open-faced chamber 20.

An inlet tube 21 extends through the wall 18 at one short side of the body 16 into the chamber 20. The tube 21 is arranged so that its inner end is positioned a short distance from the adjacent portion of the inner wall 19.

A thin sheet metal radiant member 22, having the same thickness and perforations as radiant member 12, is sealingly secured to the walls 18 and 19 by crimping to cover the open face of chamber 20. The radiant member 22 is coated with heat resistant enamel in the same manner as was member 12. Thus, the burner 15 has an almost centrally disposed passage 23 defined by the wall 19, the purpose of which will be explained below.

In use the gas-air mixture flows from inlet tube 21 and is distributed in the chamber 20, the portion of wall 19 adjacent the tube 21 operating to substantially replace baffle 11 of the first embodiment. The rate of flow of mixture is controlled as in the first embodiment. The burner 15 operates in substantially the same manner as the first described burner 1 but it is found that the configuration of the chamber 20 and the radiant member 22 enhances the evenness of distribution of the mixture in the chamber and through the perforations in the radiant member 22 to produce a more even flame front. The effect of this is to avoid the production of hot and cold spots in the radiant member 22. Also, notwithstanding the fact that the area of the radiant member is less, the heating effect of the burner and the area over which the heat is effective is not substantially changed.

The passage 23 operates as a flue for the combustion gases at the face of the radiant member 22. Thus, where the burner 15 is used as a grill for a stove, the gases will flow upwardly through the passage 23 and out the usual ventilation openings in the drip tray under the jet burners. Since the combustion gases do not have to pass across the face of the burner and around the sides as in the first embodiment, the flame front is less disturbed and thus further stabilized.

The burner 15 need not be of the configuration shown in FIGURES 5 to 7. For example, the burner 1 may be modified by forming aligned apertures in the radiant member 12 and top wall 3 and sealingly securing a suitable tube between the two to define a flue passage.

The method of making the burner 15 is substantially the same as described with reference to burner 1 with obvious modifications.

It should be understood the invention is not limited to the dimensions or other data given in the embodiments described above. The radiant member need not be formed from mild steel since many metals, including alloys, may be used to achieve the same result. The protective coating on the inside face of the radiant member need not be black since the only purpose of this coating is to suppress corrosion. Similarly, the size and spacing of the perforations may be altered to suit the particular material used and/or to suit the rate of input of the combustible mixture and the type of mixture. Of course, as mentioned above, the rate input may be altered to suit a particular radiant member. Also the inlet tube need not pass through a short side of the body and the combustible mixture may be delivered to the chamber by some means other than a tube. For example a gas jet may be mounted with the necessary spacing adjacent an aperture in the wall of the burner body.

Furthermore, it will be evident that the burner is not limited to use with town gas-air mixture. In fact any combustible mixture, such as natural gas and air, propane and air, may be used, the rate of input and/or the radiant member being altered as required.

As mentioned previously, the radiant burner according to the invention may be effectively used in applications other than grilling. For example, the burner could be particularly advantageously used in the industrial heating field.

We claim:

1. A radiant burner comprising a body defining a chamber, means for delivering a combustible mixture to said chamber, a single thin perforated metal radiant member arranged so that the combustible mixture will flow through the perforations in said member to be burnt adjacent the outer face of said member to heat said member, at least one of said member and said means supplying said mixture being such that the temperature of the mixture within the chamber does not exceed the flash point of said mixture, said perforations being formed by a punching operation which produces a raised projection about the periphery of each perforation on one face of the radiant member, said one face being directed outwardly and coated with a heat resistant material, the coating being thicker than would normally be the case by virtue of said raised projections acting to retain said coating material on said one face.

2. A radiant burner according to claim 1, wherein said burner body has a substantially flat top wall and a side wall extending around the periphery of said base to define said chamber which thus has one open face, said radiant member being secured to said side wall to cover the open face of the chamber, said means for delivering said combustible mixture comprising a pipe opening through said side wall into said chamber.

3. A radiant burner according to claim 2, wherein said radiant member is secured to the side wall by crimping the free edges of said side wall about the edges of the radiant member.

4. A radiant burner according to claim 1, wherein both faces are coated with said heat resistant material and the coating on said one face is thicker than the coating on the other face.

5. A radiant burner according to claim 4, wherein at least said thicker coating on said one face is black.

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U.S. Cl. X.R.

239—590.3

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,437,415
DATED : April 8, 1969
INVENTOR(S) : JAMES H. DAVIS ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 1, line 5 change the names of the
assignee to read:

-- Craig & Seeley Limited --

Signed and Sealed this

Third Day of March 1981

[SEAL]

Attest:

RENE D. TEGMEYER

Attesting Officer

Acting Commissioner of Patents and Trademarks