May 30, 1967 N. M. HUFF ETAL 3,322,112

INFRARED GAS BURNER

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Fig. 1

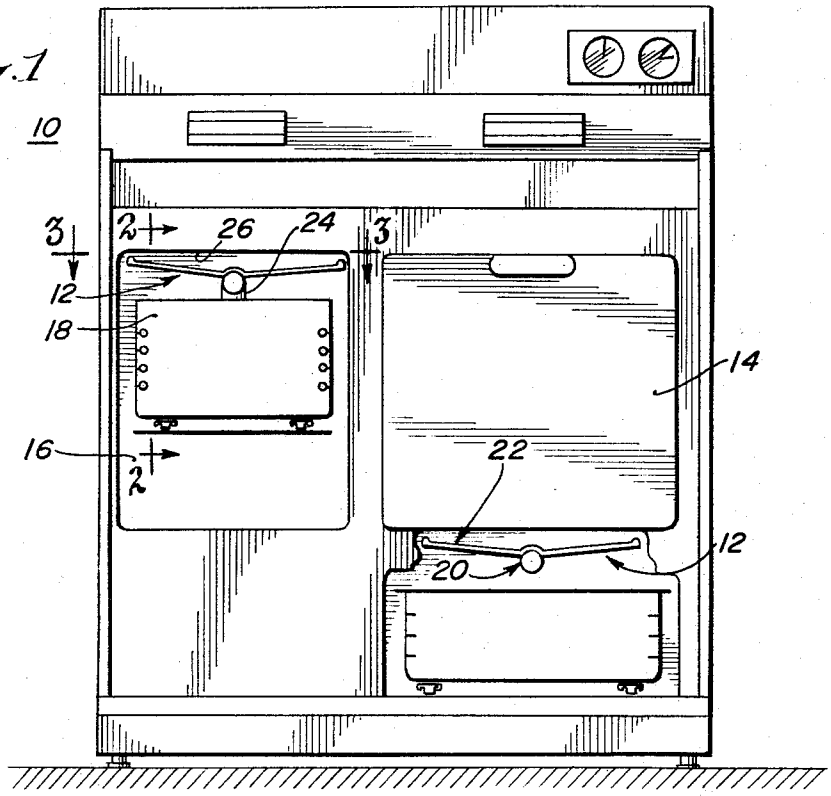

Fig. 2

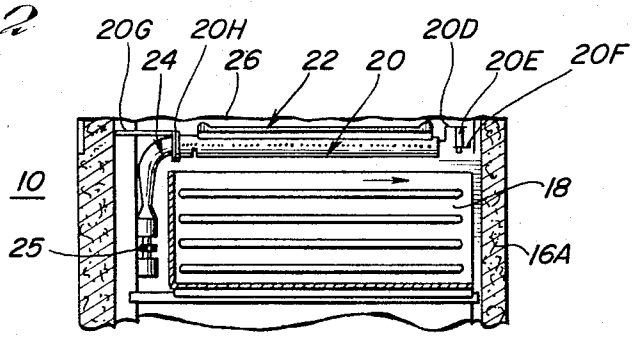

Fig. 6

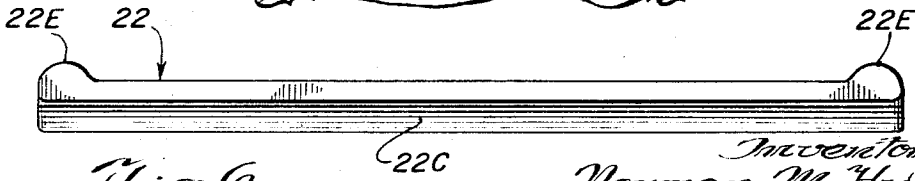

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Fig. 3

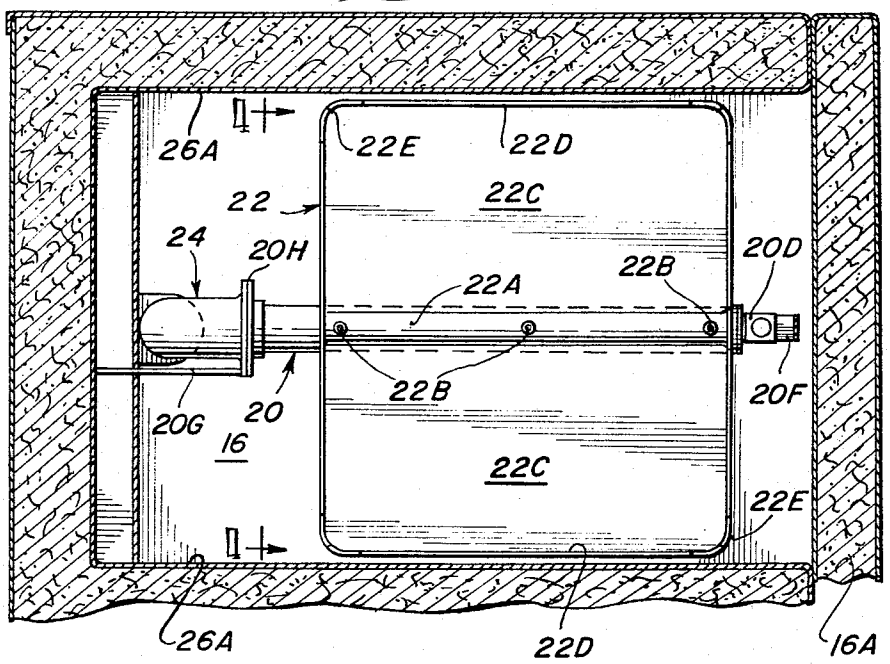

Fig. 5

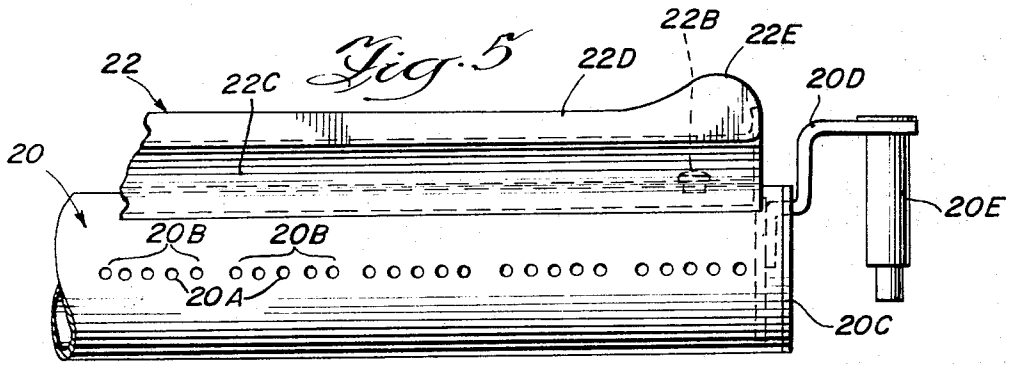

Fig. 4

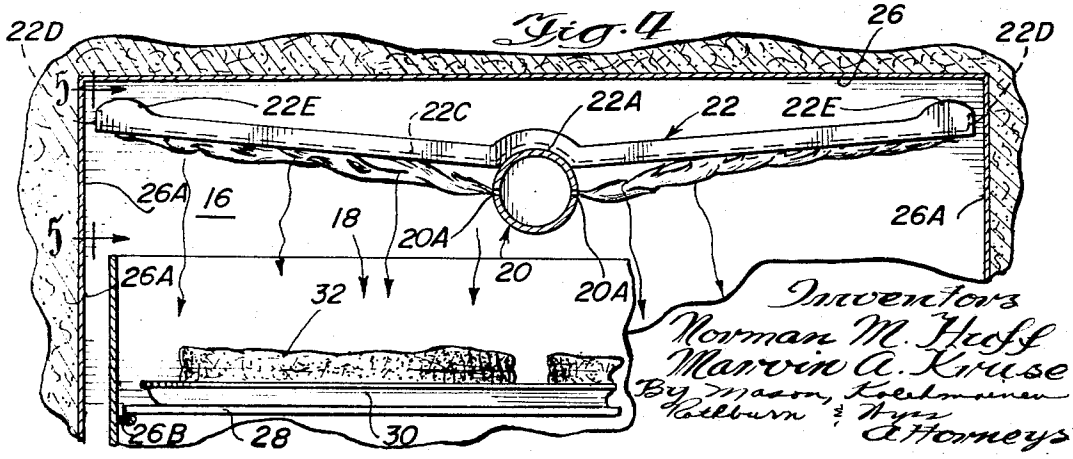

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Fig. 7

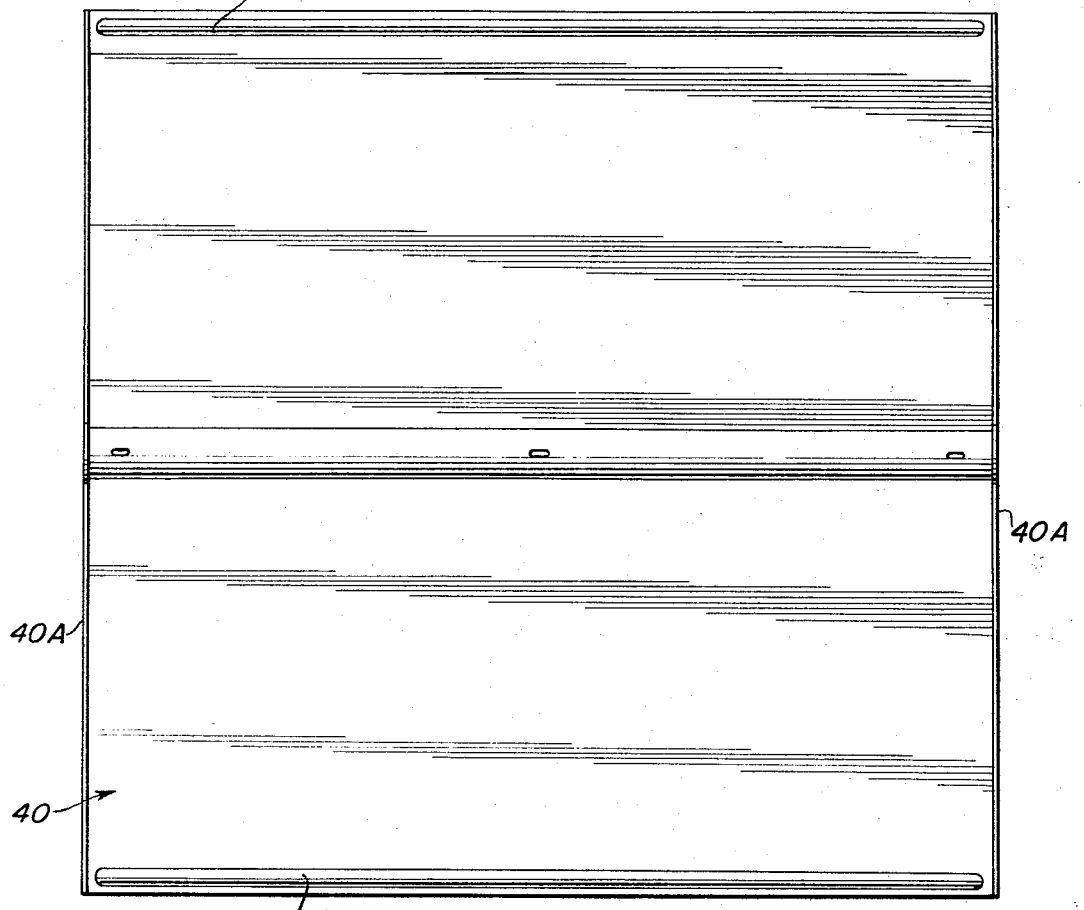

Fig. 9

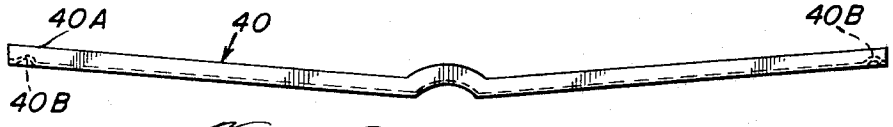

Fig. 8

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INFRARED GAS BURNER

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Filed Apr. 13, 1965, Ser. No. 447,739
6 Claims. (Cl. 126—41)

The present invention relates to an infrared gas burner and has for its primary object the provision of a new and improved burner of this character that is economical to manufacture and which operates efficiently.

An object of the present invention is the provision of an infrared gas burner comprising an elongated burner and imperforate overlying plate providing, when used as a broiler burner, a relatively large broiler area operating at a temperature of between 1000° and 1200° F. surface temperature to provide radiation in the far infrared range, i.e., approximately 2.5 to 6.5 microns to insure the greatest degree of heat absorption by the food being broiled.

A further object of the present invention is the provision of a burner of the character aforesaid in which the burner temperature is realized with a minimum gas flow rate and with medium primary air to produce a fairly well lengthened and not too hard flame and which will generally operate at full on, but which is also operable at turndown rates and in which cooking or broiling will be regulated by rack positioning of the food.

A still further object of the present invention is the provision of a new and improved infrared broiler burner including an elongated tubular horizontally disposed burner above which is located an imperforate plate having a pair of "wings" inclined upwardly at an angle of about five degrees from the horizontal and in which the burner ports provide a generally laminar gas flow so that the gas flames have what might be described as a scrubbing relationship with the underside of the plate wings in order to insure efficient combustion of the gas within the limits of acceptable carbon monoxide formation.

A further object of the present invention is the construction of a burner as aforesaid in which the plate and burner are so located and arranged so as to provide an effective laminar flow and scrubbing action of the gas flames.

A further object of the present invention is to provide a burner having increased emissivity of radiation provided by porcelain enamel coating of black or dark grey color.

A further object of the present invention is to construct an infrared burner which acts efficiently as an energy transformer, radiator and distributor of infrared energy.

A further object of the present invention is to provide an infrared burner in which warpage of the burner plate is minimized as by a peripheral upwardly extending flange portion which may be combined with either longitudinal ribs or, particularly, with heightened flange corners adapted to contact the top of the oven, thereby to limit warpage and to provide adequate clearances for circulation of oven combustion products.

In brief, the infrared gas burner of the present invention includes, in combination, a horizontally disposed elongated tubular burner element having a series of small ports thereof disposed in a substantially horizontal plane and a radiation plate secured to the upper side of the burner element. The radiation plate has a central arcuate portion encircling approximately the upper ninety degrees of the tubular element and oppositely disposed imperforate side portions or wings extending laterally and upwardly from the side portion at angles of about five degrees from the horizontal and relative to which the flames move outwardly with a scrubbing action during operation of the burner. The burner plate has an upwardly extending flange around substantially its entire periphery and in one embodiment the flange has corner portions extending upwardly beyond the remainder of the flange for engagement with associated portions of the range in which the burner is installed for the purpose of minimizing and limiting warpage of the plate. The plate is heated to a temperature of between 1000° and 1200° F. to provide radiation in the far infrared range, i.e., 2.5 to 6.5 microns, to provide optimum heating of the food to be broiled. Also, the burner plate may be coated, as by porcelain enamel coating or heat resistant paint of black or dark gray color to increase the radiation emissivity.

Other objects and advantages of the present invention will become apparent from the ensuing description of illustrative embodiments thereof, in the course of which reference is had to the accompanying drawings, in which:

FIG. 1 is a front view, partly broken away and parts omitted, of a gas range equipped with two burners constructed and arranged in accordance with the present invention, one of the burners, the one at the left, being a high broiler and the one at the right being installed as a conventional combination oven and broiler burner with the burner of the invention disposed below the oven bottom and above the broiler drawer so that it may be used either for broiling or baking purposes;

FIG. 2 is a fragmentary cross sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged horizontal cross sectional view taken along the line 3—3 of FIG. 1, but with the broiler drawer omitted;

FIG. 4 is a fragmentary further enlarged vertical cross sectional view taken along the line 4—4 of FIG. 3, but showing the broiler drawer;

FIG. 5 is an enlarged fragmentary view taken along the line 5—5 of FIG. 4, but illustrating the front end of the burner;

FIG. 6 is a side elevational view of the burner plate alone; and

FIGS. 7, 8 and 9 are top, side and end plan views of a modified form of burner plate.

Referring now to the drawings and first primarily to FIGS. 1, 2 and 3, the burner of the present invention may be used for both conventional combined oven and broil burners and burners used solely for broiling. Both types of burners are installed in the gas range indicated as a whole by reference character **10** in FIG. 1. At the right hand side of FIG. 1 there is illustrated a combination oven and broiler burner **12** constructed in accordance with the present invention so that it can be used, in conventional manner, either for broiling or baking purposes. The broiler drawer door has been omitted but the usual oven door **14** above the burner has been shown. At the left of range **10** there is illustrated a second burner **12** constructed and arranged in accordance with the present invention and shown mounted in a compartment **16** having a door **16A**, shown only in FIGS. 2 and 3. This second burner is used for broiling only—the arrangement providing what is commonly known as a high broiler. The compartment **16** is provided with a broiler drawer **18**, not shown in detail. While not illustrated, an arrangement of two burners may be disposed in a single compartment with a broil burner at the top of the compartment and a bake burner at the bottom. Other possible arrangements may be utilized.

The burner **12** of the present invention includes two primary elements, these being an elongated tubular burner element **20** and a radiation plate **22** secured to the upper side of and overlying the burner element. The burner element **20** is of tubular construction, may have a length of

about fourteen inches, a diameter of 1¼ inches and a wall thickness of about .035 inch and may be made of aluminized steel. The tube is disposed horizontally and it has a series of small ports **20A** arranged in thirteen groups **20B** of five each. The ports are located centrally of and on opposite sides of the tube so that gas is projected in a generally horizontal direction from the ports. The ports are drilled with a No. 47 drill and are .078 inch in diameter. The front end of the tube is closed by an end cap **20C**, see FIG. 5, to which is attached a bracket **20D** having secured to it a dependent supporting and locating pin or stud **20E**. The latter fits into an apertured supporting bracket **20F**, see FIGS. 2 and 3, secured in suitable manner to the interior of the range.

The burner tube **20** is supported at its rear by a support rod **20G** adapted to be mounted at the rear of the compartment and secured to coupling flange elements **20H** by means of which the rear end of the burner tube is secured to the upper end of an angulated venturi tube **24**, see FIG. 2, by means of which gas is supplied to the burner. The lower end of the venturi is supplied with gas through a gas inlet nozzle **25** in known manner.

The burner plate **22** has a central arcuate portion **22A** overlying the upper ninety degrees of the burner tube **20** with the opposite edges of the arcuate portion disposed about 7/16 of an inch above the burner ports **20A**. It has been found that this distance is quite critical in order to obtain the desired combustion of gas and scrubbing action of the flames at the underside of the plate. The central portion of the plate is attached to the burner tube as by a number of rivets **22B**.

The burner plate includes oppositely disposed imperforate side portions or "wings" **22C** extending laterally and upwardly from the central portion at an angle of about five degrees from the horizontal. It has been found that this angle is also quite critical in order to make the gas flames angle slightly upwardly toward and along the underside of the imperforate portions to produce a scrubbing action, somewhat as indicated in FIG. 4. If the relationship between the ports and plate and the gas flow is not designed properly, the flames will not burn properly and there will be excessive production of carbon monoxide and the plate also will not be heated properly.

For a burner such as illustrated, the plate may have a length of fifteen inches with a width of about fourteen inches. It is spaced substantially from the front and rear of the compartment and but about an inch or less from the side walls **26A** of the compartment **16**. The spacing at the rear is particularly important from the standpoint of there resulting no interference with the pilot burner and associated controls, not shown, associated with the ignition of the burner. A steel plate having a thickness of about .025 to .065 inch has been found to be satisfactory.

To minimize warpage without undue restriction of flow of combustion products, the plate is provided with a peripheral flange **22D** having upwardly projecting rounded corners **22E** adapted to engage associated range structure in the event of a predetermined warpage, thereby to prevent undesirable further warpage. This arrangement is illustrated in FIGS. 1, 2 and 4, particularly the latter, from which it can be seen that the corners, upon warping upwardly, will engage the top **26** of compartment **16**. It has been found that generally but one corner rises upwardly to engage the oven while the diagonally opposite corner moves downwardly. However, once upward movement of a corner is restricted, the downward movement of the other corner is at the same time restricted or minimized. It is not known just why this occurs. It should be noted further that when upward movement of one corner is restricted by an upwardly extending corner portion, the remainder of the burner plate is spaced from the wall to insure continued relatively free movement of the products of combustion out of the compartment.

Referring now more particularly to FIG. 4, it will be noted that a broiler shelf or rack **28** is illustrated as being

supported in the broiler drawer **18**. The rack is adapted adjustably to receive a pan or the like **30** upon which is placed the meat **32**, for example, to be broiled. It will be noted that the radiation which is normal to the wings **22C** is quite effectively directed over the entire area of the meat.

Improved results are obtained by coating the burner plate **22** with a porcelain enamel or heat resistant paint of black or gray color. Alternatively, the plate could be coated with red enamel or heat resistant paint to give the impression of visible heat, although the plate should be heated between 1000° and 1200° F., in order to provide radiation in the far infrared range, approximately 2.5 to 6.5 microns, which provides optimum cooking of the meat.

A second embodiment of the burner plate is illustrated in FIGS. 7, 8 and 9. The plate is indicated as a whole by reference character **40**. It is substantially the same as the previously described burner except that the peripheral flange portions **40A** of uniform height are associated only with the ends of the plate, while longitudinal upwardly extending ribs **40B** are provided at opposite edgs of the plate for strengthening the plate and for minimizing possible warpage.

From the foregoing detailed description of the invention it may be noted that the burner may be made simply and inexpensively and can be readily installed in desired position in a domestic gas range. In use, the gas flow is such that the flames rise slightly and have a scrubbing action along the underside of the radiant plate **22**, as depicted in FIG. 4. Substantially complete combustion takes place and there is no excessive production of carbon monoxide. Also, the entire area of the plate is quite well heated to a temperature of about 1100° F. to provide the desired radiation in the far infrared range, which is best for effecting heat absorption by the food being broiled. The products of combustion rise in the oven or broiler compartment and undue warpage of the burner plate **22** is prevented by engagement of a compartment wall or bottom by one of the corner portions **22E**. As heretofore explained, the products of combustion are free to be exhausted from the compartment.

It has been found preferable to install the burners in symmetrical horizontal position. The vertical location depends somewhat upon flue location and general circulatory behavior of the products of combustion. The best positioning of the burner may actually be determined by try out in a particular compartment design. Generally, it has been found preferable that the burner be mounted as high as possible in the compartment, with due regard being given to meeting combustion restrictions, in order to obtain the greatest degree of space flexibility. If combustion requirements permit, the corners of the plate should be within ⅛ inch of the top of the compartment so that the top wall would be engaged by the plate corner upon ⅛ inch warpage. Also, in order to obtain maximum effective radiation, the plate should be coated with porcelain enamel approaching a dull jet black in color.

The five degree upward inclination of the plate wings has been found to be quite critical. This angular rise provides for good combustion without the formation of excessive quantities of carbon monoxide. The gaseous flow from the ports is laminar and tends to flow along the underside of the wings without turbulence and undesired impingement. The primary air generally needs to be adjusted to a "medium" rate to provide adequate temperature distribution patterns. The flames attained with the medium primary air are fairly well lengthened and less "hard" in heating behavior.

The vertical placement of the wings above the center burner ports is also critical. It has been found that the wings should be about 7/16 inch above the centerline of the ports in order to obtain the desired flow. The dimensions may differ with different constructions and different types of steel.

While the present invention has been described in connection with the details of certain embodiments thereof, it should be understood that these details are not intended to be limitative of the invention except insofar as set forth in the accompanying claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An infrared gas burner, including in combination, a horizontally elongated straight tubular burner element of circular cross-section having a series of small ports at each side thereof disposed in a substantially horizontal plane parallel to the axis of the burner, and a radiation plate secured to the upper side of said burner element, said plate having a medial arcuate portion encircling approximately the upper ninety degrees along substantially the length of the tubular element, said plate having also oppositely disposed smooth imperforate side portions extending laterally and upwardly from the medial portion at an angle of about five degrees from the horizontal and along which the flames from said ports move in laminar flow outwardly with a scrubbing action and are confined to the underside of said plate during operation of the burner, said plate having upstanding peripheral portions along the side and end edges of said side portions.

2. An infrared cooking unit comprising a cooking compartment having a top, an infrared gas burner in said compartment adjacent said top and including an elongated tubular burner element having a series of small ports at each side thereof disposed in a substantially horizontal plane relative to the burner, and a radiation plate secured to the upper side of said burner element, said plate having a central arcuate portion encircling approximately the upper ninety degrees of the tubular element, said plate having also oppositely disposed imperforate side portions extending laterally and upwardly from the central portion at an angle of about five degrees from the horizontal and along which the flames move outwardly with a scrubbing action during operation of the burner, said plate having upwardly extending corner portions normally spaced from the top of said compartment but engageable with the top upon some warpage of the plate, thereby to minimize further and undesirable warpage.

3. An infrared cooking unit comprising a cooking compartment having a top, an infrared gas burner in said compartment adjacent said top and including an elongated tubular burner element, and a radiation plate secured to the upper side of said burner element, said plate having oppositely disposed imperforate side portions extending laterally and upwardly from the central portion at an angle of about five degrees from the horizontal and along which the flames move outwardly with a scrubbing action during operation of the burner, said plate having upwardly extending corner portions normally spaced from the top of said compartment but engageable with the top upon some warpage of the plate, thereby to minimize further and undesirable warpage.

4. A radiation plate for attachment to a tubular gas burner element, having a central portion for attachment to the upper side of the burner element and oppositely disposed imperforate side portions extending laterally and upwardly from the central portion at an angle of about five degrees from the horizontal, said plate having an upwardly extending flange around substantially its entire periphery, said flange having corner portions extending upwardly beyond the remainder of the flange.

5. A radiation plate for attachment to a tubular gas burner element, having a central arcuate portion for attachment to the upper side of the burner element and oppositely disposed imperforate side portions extending laterally and upwardly from the central portion at an angle of about five degrees from the horizontal, said plate having an upwardly extending flange around substantially its entire periphery, said flange having corner portions extending upwardly beyond the remainder of the flange, said corner portions being smooth and rounded.

6. An infrared gas burner as set forth in claim 1 wherein the underside of said plate is provided with a heat resistant and heat emissive coating.

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