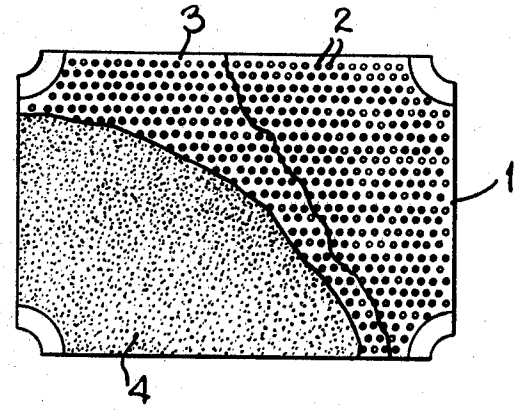
Oct. 14, 1969 MASAMI YAMAMURA ET AL 3,472,601

RADIANT GAS BURNER ELEMENT

Original Filed Oct. 22, 1965 4 Sheets-Sheet 1

Fig. 1.



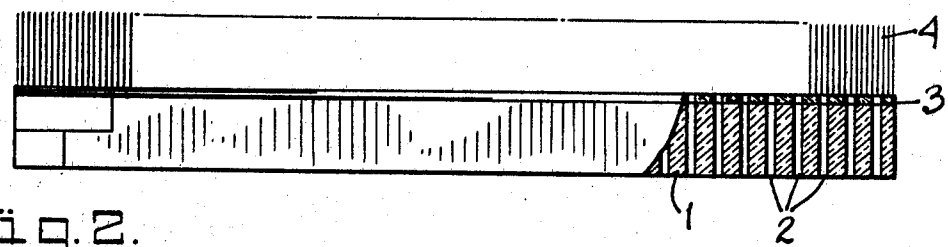


Fig. 2.

Fig. 3.

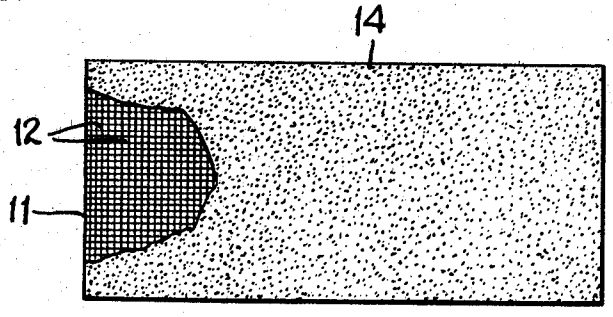
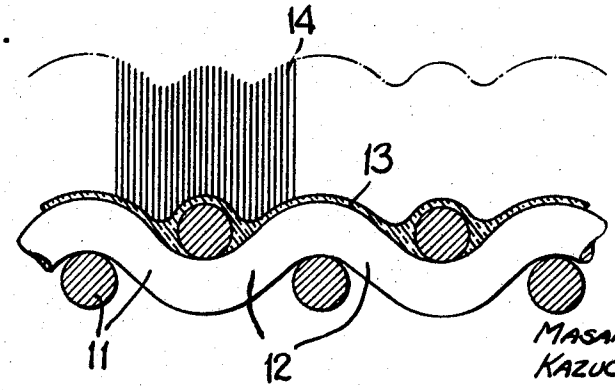
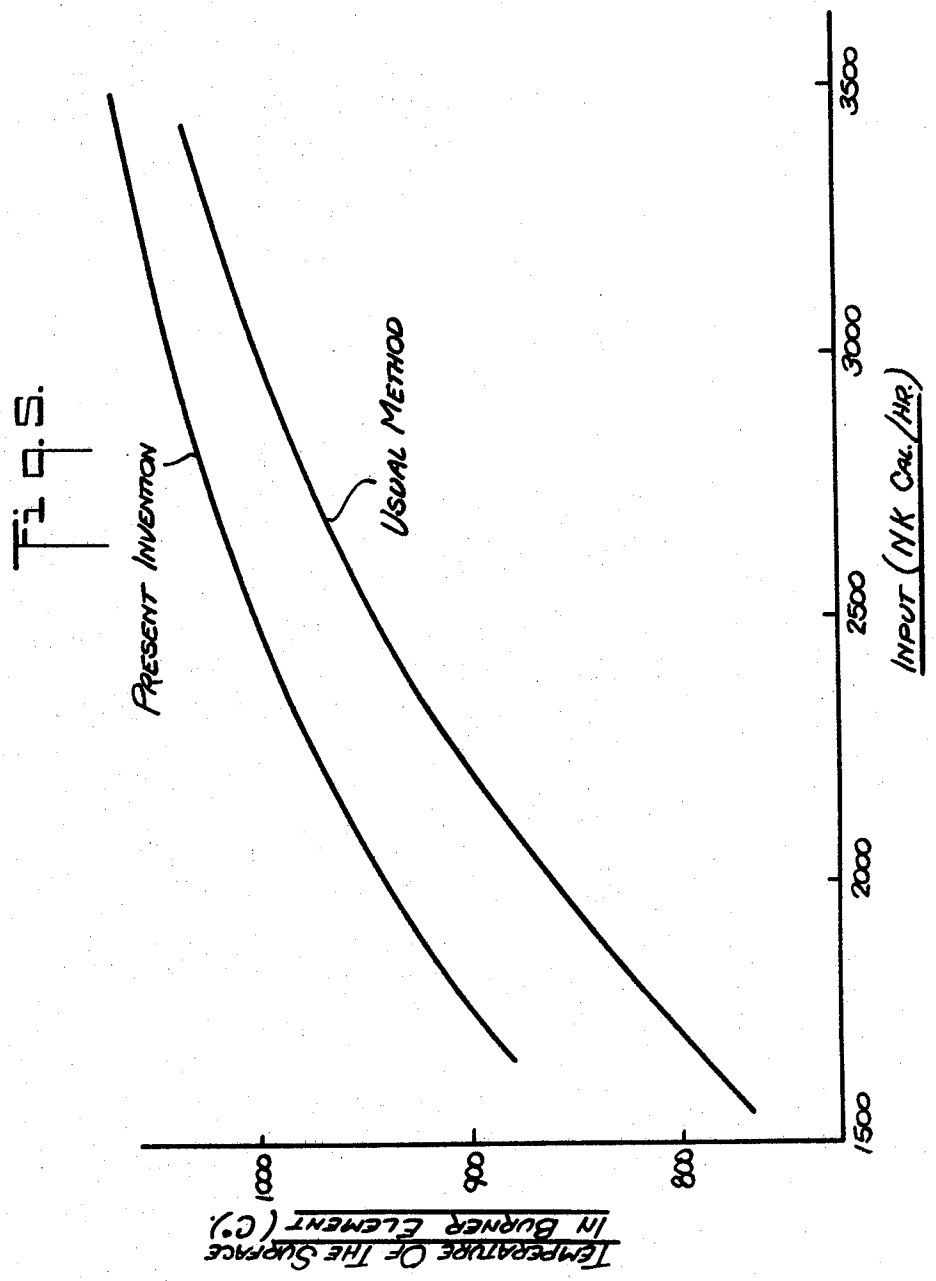


Fig. 4.



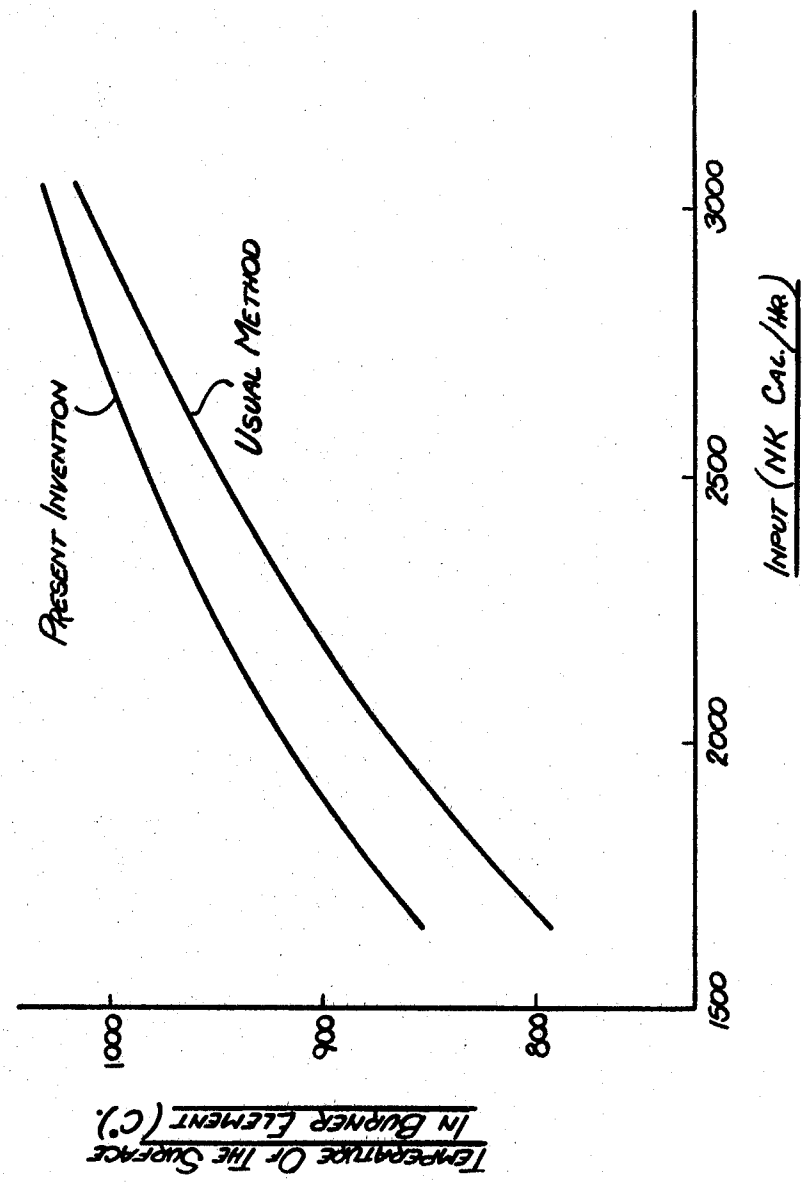
INVENTORS
MASAMI YAMAMURA
KAZUO OGAWA

Fig. 5.



INVENTORS
MASAMI YAMAMURA
KAZUO OGAWA

Fig. 6.



INVENTORS
MASAMI YAMAMURA
KAZUO OGAWA

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RADIANT GAS BURNER ELEMENT

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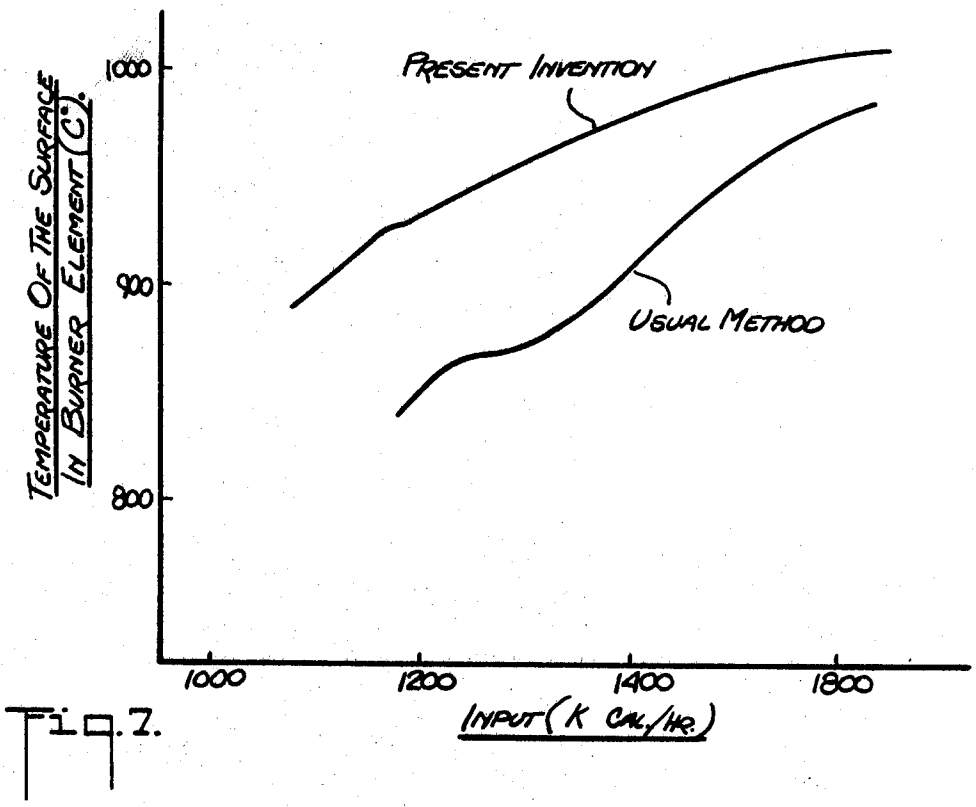

Fig. 7.

INVENTORS
MASAMI YAMAMURA
KAZUO OGAWA

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RADIANT GAS BURNER ELEMENT

Masami Yamamura, Nagoya-shi, and Kazuo Ogawa, Asahi-machi, Japan, assignors to Sango Toki Kabushiki Kaisha

Continuation of application Ser. No. 502,231, Oct. 22, 1965. This application Dec. 12, 1967, Ser. No. 690,033

Int. Cl. F23d *13/12*

U.S. Cl. 431—328 8 Claims

ABSTRACT OF THE DISCLOSURE

A burner element comprises a base having perforations perpendicular to the surface of the base and thermally stable filaments arranged perpendicularly to and bonded to the surface of the base by an intermediate ceramic bonding layer, each of the filaments having one end bonded to the base and the other end free to provide an increased burning and radiation area and to suppress flare-ups.

This application is a continuation of application Ser. No. 502,231, filed Oct. 22, 1965, and now abandoned.

The present invention relates to a burner element for gas or liquid fuel, which is provided with a burning surface comprising a base carrying a high concentration of thermally resistant ceramic or metal wires. The base is constituted of ceramic, metal, metal gauze or the like, having a number of perforations which serve as fuel paths.

The objects of the invention are to enlarge the burning surface for perfect burning of fuel and to increase infrared radiation and to prevent overheating of the base to ensure for good durability thereof.

The detailed features and advantages of the invention will become more apparent upon reference to the following description and appended drawings showing some embodiments of the invention, wherein:

FIG. 1 is a plan view of a first embodiment of the invention in which view part of the burner element is cut away,

FIG. 2 is the cross-sectional view of the above,

FIG. 3 is a side view of a second embodiment of the invention in which view part of the burner element is cut away,

FIG. 4 is an enlarged view of a part of the burner element shown in FIG. 3,

FIGS. 5, 6 and 7 are graphs of the surface temperature of the burner element as a function of the input gas flow rate.

In FIG. 1 and FIG. 2, showing the first embodiment of the invention, a lead-bolosilicate bonding layer **3** is attached to the surface of ceramic base **1**. Ceramic base **1** is in flat plate form and is provided with a number of fuel paths **2**. Ceramic wires **4**, such as glass fibers or thermostable metal wires are densely arranged on and perpendicular to the surface of the base **1**, for example, by means of an electrostatic flocking method, and fixed thereon by means of sintering a bonding layer **3** by heating.

Ceramic base **1** is composed of—

Compositions:	Percent
SiO_2	64.1
Al_2O_3	21.5
Fe_2O_3	1.6
MgO	11.5
R_2O	1.0

and has thickness of about 5 mm.~12 mm., where diameter of fuel paths is 1–1.5 mm.

Bonding layer **3** is composed of—

Composition:	Percent
SiO_2	46.6
Al_2O_3	8.3
B_2O_3	11.2
Na_2O_3	2.8
K_2O	1.6
CaO	6.6
PbO	22.5

and is 0.3–1 mm. in depth.

Ceramic wires **4** are composed of—

Composition:	Percent
SiO_2	51.9
Al_2O_3	45.1
Fe_2O_3	1.3
TiO_2	1.7
R_2O_3	0.2
B_2O	0.1
CaO	0.1

and each wire is 19μ in diameter, 3 mm. in length, and the concentration or distribution density of the wires is about 10,000–8,000 wires/cm.^{2}.

In FIG. 3 showing the second embodiment of the invention, a lead-monoxide bonding layer **13** is attached on the surface of a metal base **11** provided with a number of fuel paths **12**, and ceramic wires **14**, such as glass fibers are densely arranged on and perpendicular to the surface of the base **11**, for example, by a flock-coating method, and fixed thereon by means of sintering the bonding layer **13** by heating.

Metal base **11** is formed cylindrically of gauze material of about 24-mech, in which the diameter of the wires is 0.7 mm., and that of the fuel paths through netting is 1–0.6 mm.

Bonding layer **13** is composed of—

Composition:	Percent
SiO_2	47.9
Al_2O_3	7.4
B_2O_3	20.6
KNaO	18.7
CaF_2	5.2
CaO	0.1
MnO	0.1

and the depth of the layer is 0.2–0.5 mm.

Ceramic wire **14** is composed of—

Composition:	Percent
SiO_2	98.5
Al_2O_3	0.6
Na_2O	0.1
B_2O_3	0.2

and each wire is 30–19μ in diameter and 5 mm. in length, and the concentration of the wires is about 6,000 wires/cm.^{2}.

FIG. 5, FIG. 6 and FIG. 7 show the relations between the temperature of the burner surface and the input of heat under varying conditions.

FIG. 5 is the case of using coal gas with the burner arranged 12 mm. before heat resisting glass.

FIG. 6 is the case of using coal gas with the burner arranged 8 mm. before wire netting.

FIG. 7 is the case of using butane gas with burner arranged 8 mm. before wire netting.

In FIG. 7 for example the curve of the temperature of the surface burner element and the input shows the effective economy for using the present invention of a burner element.

Assuming a desired surface temperature of 900° C., the usual method would require an input of 1375 NK cal./hr. while the present invention only requires some 1,100 NK cal./hr. FIGS. 5 and 6 show simular gains.

As for back fire, in the usual burner back fire occurs at about 1,000° C. of surface temperature and an input of 3,500 NK cal./hr. in the case of using coal gas arranged glass before the burner, but in the case of using this invention, back fire never occurs until 3,700 NK cal./hr. and thus, the element is very excellent in promoting safety and defending against back fire.

Faults are known that in the conventional metal burner element, the temperature of the burning surface is not able to be made high in fear of oxidizing corrosion thereof and flash-back due to high thermo-conductivity and that the conventional ceramic burner elements utilizing porous ceramic material have had defects of failure and abrasion due to lack of strength. It will be apparent from the foregoing that according to this invention, the enlarged burning of surface planted ceramic wires, similar to a velvety surface, promotes perfect burning of fuel by fully contacting it with the secondary air without flaming-up and infrared radiation increases by ignition of the extremities of the wires.

Furthermore, burner elements of this invention are out of danger of thermal damage of the base on account of the insulation effect of thickly planted ceramic wires between the burning surface and the base, and ceramic wires and metal wires (for thermal endurance) promote perfect burning of fuel by catalytic action thereof. Therefore through use of a burner element according to the invention, fuel gas of either high or low pressure will be available with an advantage, particularly for a burner of a gas stove.

What we claim and desire to be secured by Letters Patent is:

1. A burner element comprising a base having perforations perpendicular to the surface of the base, said perforations defining flow paths for gas fed to the burner element, thermally stable filaments arranged perpendicularly to and bonded to the surface of the base by means of an intermediate ceramic bonding layer, said filaments

comprising wires and each of said filaments having one end free and an opposite end bonded to the surface of the base, the free ends jointly forming a surface increasing the burning and radiation area of said burner and suppressing flaring-up.

2. A burner element according to claim 1, in which wires are metallic.

3. A burner element according to claim 1, in which said wires are constituted of a ceramic.

4 A burner element according to claim 1, in which said base is metallic.

5. A burner element according to claim 1, in which said base is constituted of a ceramic.

6. A burner element according to claim 1, in which the free ends of said filaments define a velvety surface.

7. A burner element according to claim 1, in which said filaments have a distribution density of about 8,000 to 10,000 filaments per square centimeter.

8. A burner element according to claim 7, in which said filaments have a diameter of about 19 microns and a length of about 3 millimeters.

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FREDERICK L. MATTESON, JR., Primary Examiner
H. B. RAMEY, Assistant Examiner