Aug. 17, 1965 E. R. KOPPEL 3,200,874

PREMIXED GAS INFRARED BURNER

Filed Oct. 1, 1962 2 Sheets-Sheet 1

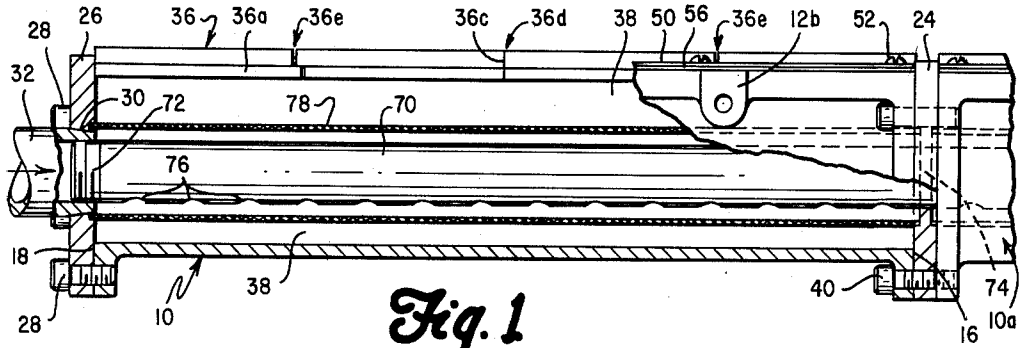

Fig. 1

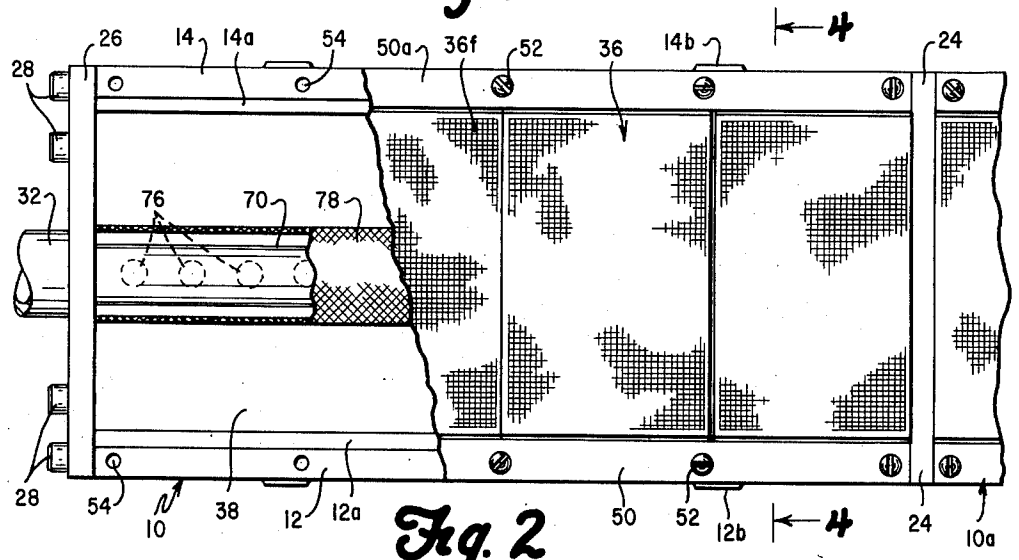

Fig. 2

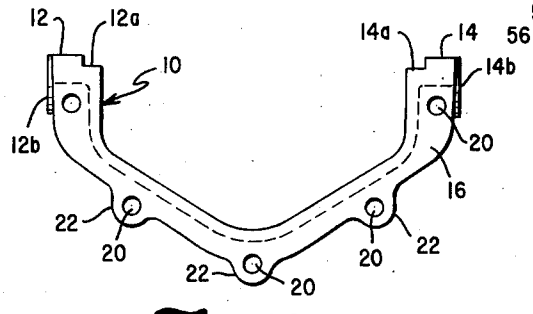

Fig. 3

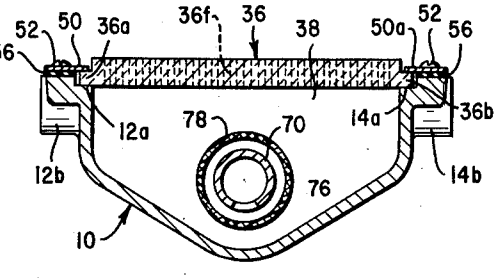

Fig. 4

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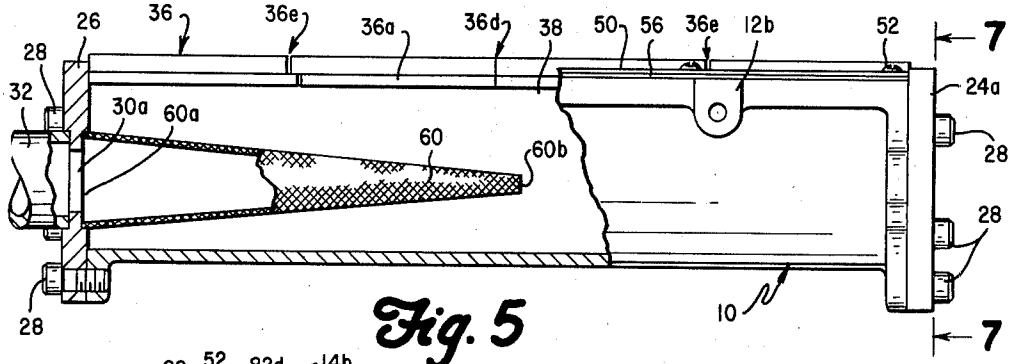

Fig. 5

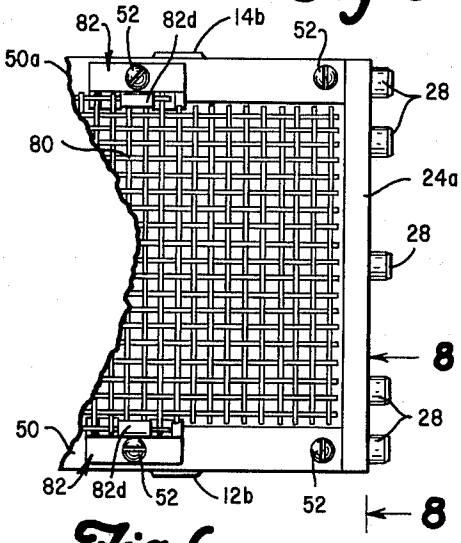

Fig. 6

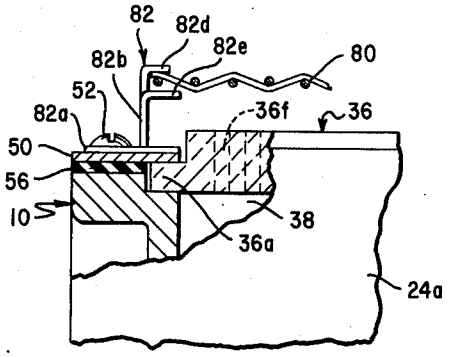

Fig. 8

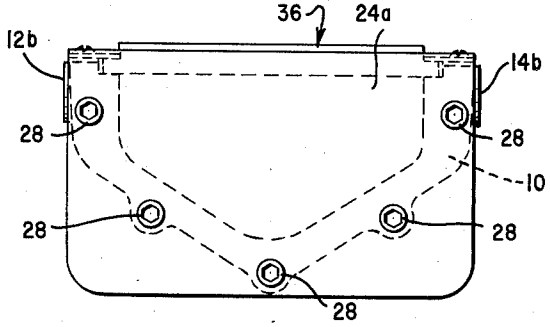

Fig. 7

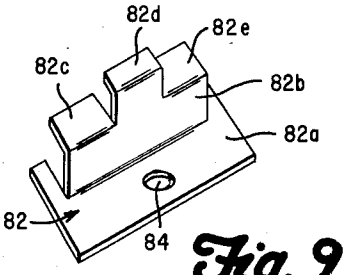

Fig. 9

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3,200,874

PREMIXED GAS INFRARED BURNER

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Filed Oct. 1, 1962, Ser. No. 227,280
6 Claims. (Cl. 158—114)

This invention relates to infrared burners, more particularly to infrared burners using gaseous fuels which have industrial application, wherein the size of the burner unit can be tailored to fit the conditions under which it is to be used.

Infrared burners using gaseous fuels have become very efficient devices for use in industrial applications, wherein the heating and/or drying characteristics of far infrared rays are utilized. Infrared burners which are used in this type of application may vary widely in size and in their method of mounting in the apparatus where the heating and/or drying occurs, and it is highly advantageous to have available infrared burner units which are of modular design to allow the fabrication of burner units having widely varying size, being built up of modules including all the necessary equipment to be used therewith which will result in an infrared burner which is exactly suited for the use or purpose intended. At the same time, the fitting together of the modules of the infrared burner require flexible connecting and mounting means, so that the modules can be mounted together to make up the complete infrared burner in a convenient and inexpensive manner.

In the design of an infrared burner of this type, which is suitable for use with the various industrial gases, such as natural gas, artificial gas, butane, propane, and others, the means to distribute the gas after it has been mixed with a suitable quantity of air, requires special arrangements in order to make the modular design practicable and easily applied in the field where the infrared rays are to be used. The present invention contemplates the provision of a distribution system for the explosive mixture of fuel gas and air, so that it will be burned in the various infrared burners at equal rates, to assure that the infrared rays will be disseminated in uniform pattern from the infrared burner without giving rise to hot spots or to spots which are operating at temperatures below the optimum.

It is, therefore, a principal object of this invention to provide an infrared burner which is of modular design, whereby burners for use with fuels consisting of explosive gases for the production of far infrared rays can be modified and tailored to suit the specific conditions under which the infrared burners are to be used in commercial applications.

It is a further object of this invention to provide a distribution system for an explosive gas-fuel mixture to infrared burners, wherein the fuel pressure on each unit of the infrared burner will be equal and the units will be supplied with equal amounts of fuel, so that a substantially uniform temperature will be had at each portion of the burners to give uniform dissemination of infrared rays.

It is a further object of this invention to provide an infrared burner of modular design which can be made cheaply and can be readily assembled in the field by workmen of ordinary mechanical skill.

Other objects and advantages of this invention relating to the arrangement, operation and function of the related elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference

characters designate corresponding parts in the several views.

Referring to the drawings:

FIG. 1 is an elevational view, partly in section, of an infrared burner incorporating the invention;

FIG. 2 is a plan view, partly in section, of the burner shown in FIG. 1;

FIG. 3 is an end view of the burner housing;

FIG. 4 is an end view taken along the line 4—4 of FIG. 2;

FIG. 5 is an elevational view of a single unit burner;

FIG. 6 is a plan view showing a recticulated screen attached to the face of the burner;

FIG. 7 is an end view taken along the lines 7—7 of FIG. 5;

FIG. 8 is an end view, partly in section, taken along the line 8—8 of FIG. 6; and

FIG. 9 is a perspective view of a detail of construction.

Referring to the drawings, particularly to FIGS. 1 and 3, an open-ended, trough-like member 10 is shown which has upper terminating edges 12 and 14 which are in parallel longitudinal relation as is best seen in FIG. 3. Each of the terminating edges of the open-ended, trough-like member is provided with flat mounting faces 12*a* and 14*a*, the purpose of which will be described hereinafter. Each end of the trough-like construction terminates in a flat end face 16 and 18 which are pierced by threaded apertures 20, suitable embossments 22 being provided adjacent some of the apertures in order to materially improve physical strength of the structure. Each of the end faces is provided with a flat closure plate 24 and 26 which are adapted to fit against the end faces 16 and 18 respectively, being held in position by suitable screws 28 which fit into threaded apertures 20 as is best seen in FIG. 1.

At the inlet end of the trough-like member, the plate 26 is provided with a central aperture 30, into which is threaded a supply pipe 32, being locked in position by welding if desired. The inlet pipe 32 is in communication with a source of combustible fuel, preferably in the form of an explosive mixture such as a mixture of natural gas, artificial gas, butane, or propane and air in an amount to give sufficient oxygen for complete combustion of the explosive mixture at the face of a burner plate 36, shown in FIG. 4, which will be described in further detail hereinafter. The pipe 32 conveys the explosive fuel mixture into a chamber 38 formed between the burner mat 36 and the housing 10 where special diffusing and distributing devices are provided to supply the combustible fuel mixture to the rear side of the burner mat 36 at a uniform pressure, so that each unit area of the burner mat is provided with a substantially equal quantity of the combustible mixture, whereby, when it is burned at the front face of the burner mat 36, by issuing through apertures 36*f*, it will heat the face where the burning occurs to a uniform high temperature which makes it glow with incandescence at a temperature of approximately 1600–2200 degrees F.

The distal end of the open-ended, trough-like member 10, which is closed by the plate 24, is also attached to a second similar member 10*a* by means of bolts 40 which thread through apertures to aline with the apertures 20 described in connection with FIG. 3. The plate 24 is provided with suitable aligning apertures, so that the bolts 40 may thread into the threaded apertures in the end face to the next adjacent box-like member 10*a* to pull the three portions together into a gas-tight relation, whereby no leakage of the combustible mixture occurs at the end faces of the two adjoining trough-like members in end-to-end relation.

This arrangement allows the building up of an infra-

red burner which consists of a number of units or modules, such as **10** and **10***a*, in longitudinal concatenation until the desired longitudinal dimension is obtained to suit the dimensions of the device in which the infrared burner is to be used. This modular system of building up infrared burners has many advantages in the commercial adaptation of infrared burners for various purposes such as heating, drying, or the like. The modular system has great flexibility and allows burners of varying sizes to be easily fabricated and mounted in commercial heating or drying devices. The means for distributing explosive gas which forms the combustible fuel will be described further hereinafter.

The burner mat **36**, described in connection with FIG. 4, has a transverse dimension to extend across the open-ended, trough-like member **10**, as is seen in FIG. 4, and is made up for convenient production in several units which extend longitudinally of the open-ended, trough-like member **10** as is seen in both FIGS. 1 and 5. The mat **36** itself may be made of ceramic material, as described in copending application Serial No. 184,978, filed April 4, 1962, or it may be made of metallic fibers and described in application Serial No. 153,110, filed November 17, 1961. A burner mat made of ceramic material with transverse apertures **36***f* for fuel flow is illustrated in FIG. 4 where the longitudinal edges of the burner mat are provided with flanges **36***a* and **36***b* which fit into grooves **12***a* and **14***a* of the terminating edges of the trough-like member **10**, as is best seen in FIGS. 3 and 4. The transverse faces **36***c* of the burner mat **36** may be either placed in flat abutting relation, as shown at **36***d* in FIGS. 1 and 5, or they can be fitted together in overlapping relation as shown at **36***e* by grinding suitable cooperating flanges on the adjacent members, as is clearly shown. It is generally more desirable to utilize the construction shown at **36***e* with the over-lapping of the transverse edges of the burner mat rather than the abutting relation as shown at **36***d*, inasmuch as the overlapping relation allows for thermal expansion and contraction during temperature variations without serious leakage occurring at the joints. The burner mats **36**, where they fit against the transverse plates **24** and **26**, are provided with flat terminating edges, as shown.

In order to hold the burner plates **36** in position in the longitudinal grooves **12***a* and **14***a*, metallic plates **50** and **50***a* are provided which are held in position on the terminating edges **12** and **14** of the trough-like member **10** by screws **52** threading into threaded apertures **54** in the faces **12** and **14** (FIG. 8). Gaskets **56** of suitable material, such as asbestos, are placed between the plates **50** and **50***a* and the faces **12** and **14**. The dimensions of the parts are such that the over-hanging portion of the plates **50** and **50***a*, which contact the longitudinal flanges **36***a* and **36***b* of the burner plate, are distorted and placed in stress when the screws **52** are driven home to resiliently hold the burner plates in position in the grooves **12***a* and **14***a*.

In the event a single open-ended, trough-like member **10** is to be utilized as an infrared burner, the distal end of the member remote from the outlet pipe **32** is closed by an imperforate plate **24***a*, as seen in FIGS. 5 and 7. The distribution of the fuel gas equally to the rear side of the burner plates **36** is provided by an open-ended cone **60** of screen material which is positioned by welding on the inner surface of the closure plate **26** over aperture **30***a*, into which the inlet pipe **32** is fitted on the opposite side by welding, or other suitable means, so that the explosive gas issuing from the inlet pipe **32** enters the base portion **60***a* of the cone **60** and flows outwardly through the screen openings as well as longitudinally of the cone to issue from its open end **60***b* to create substantially a uniform pressure in the explosive fuel mixture behind the ceramic mat **36** to flow through the openings **36***f* therein to burn uniformly on the outer face thereof to create an incandescence which is the source of the far infrared rays.

In the event the burners are to be built up of several units or modules **10** and **10***a*, as shown in FIG. 1, a distribution pipe **70** (FIG. 1) for the gaseous fuel is provided which fits into the open end of the fuel inlet pipe **32** by a threaded relation at the closure plate **26** to extend the entire longitudinal dimension of the open-ended housing **10** to pass through an aperture **74** in the closure plate **24** positioned between the trough-like channel members **10** and **10***a* as already described. The distribution pipe **70** for the fuel is given a longitudinal dimension to terminate at the last closure plate between the last two open-ended, trough-like members similar to **10** to cooperate with a cone of screened material similar to the one described with reference to FIG. 5 in the last open-ended, trough-like member of the series. To distribute the gas equally, and at substantially uniform pressure to the chambers **38** in the trough-like members behind the burner mats **36**, a series of spaced apertures **76** is provided in the lower side of the distribution pipe **70** away from the burner plates **36**, as is best seen in FIGS. 1 and 4. In order to more uniformly distribute the explosive fuel mixture, the pipe **70** is surrounded in a concentric relation by a tubular screen member **78** which is fitted into the apertures **30** and **74** in the closure plates **26** and **24** respectively by welding or the like, each of the open-ended, trough-like members **10**, **10***a*, and the like being provided with a similar screen tube with the exception of the last, which has a screen cone similar to the cone **60** described in connection with FIG. 5.

If desired, the outer surface of the burner mats **36** may be covered by a reticulated screen member **80** (FIGS. 6 and 8), upon which the flame issuing from the burner mat impinges during the operation of the infrared burner unit. The screens **80** are held in spaced parallel relation with the front face of the burner mat **36** by means of brackets **82** which cooperate with the longitudinal edges of the screens **80** as is shown in FIG. 6. The brackets are constructed as shown in perspective in FIG. 9, having a base member **82***a* which is pierced by an aperture **84** which cooperates with screws **52** holding the longitudinal metallic strips **50** in position on the terminating faces of the open-ended, trough like member **10**, as is most clearly seen in FIG. 8. The upstanding web **82***b* is provided with three cooperating flanges **82***c*, **82***d*, and **82***e*, which cooperate in spaced planes to hold the screen **80** between them. The flanges **82***c* and **82***e* are in one lower plane, while the flange **82***d* is positioned in an upper plane in spaced relation to hold the screen as is shown in FIG. 8.

The explosive fuel mixture issuing from the apertures **36**—in the burner plate **36** heats the reticulated screen **80** to a temperature approximating 1600–2000 degrees F., which, in combination with the incandescent front face of the burner mat **36**, gives rise to the infrared rays which issue from the burner.

For mounting the members **10**, either as a single unit or as a modular construction fabricated from several units or modules onto an extraneous supporting structure (not shown) such as a drying oven, bosses **12***b* and **14***b* are provided which extend laterally having threaded apertures therein to cooperate with suitable attaching bolts (not shown). When the units or modules are to be mounted on a flat surface, the plates **24**, **26** and **24***a* are provided with square corners as shown in FIG. 7 which conveniently may rest on the supporting surface.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the

invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed:

1. In an infrared burner, a first open-ended trough-shaped member having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat faces positioned in the same plane one on each terminating edge, said member also having flat end faces at its terminal ends in parallel relation to each other, closure plates adapted to be attached to the faces on the terminal ends, one of said plates being pierced with an aperture for communication with an inlet pipe for gaseous fuel on the outer side of the plate, a fuel distributor positioned within said trough-shaped member and communicating with said aperture on its inner side, said other closure plate having an aperture in communication with the fuel distributor, a reticulated member concentrically mounted around said fuel distributor and substantially coextensive with the fuel distributor in an axial direction, a second open-ended trough-shaped member similar to the first fitted to the outside of said other plate, a third imperforate closure plate for the open end of the second trough-shaped member, infrared burner plates fitted in abutting relation on the mounting faces of the terminal edges of the sides of the trough-shaped members to form a substantially continuous flat burner surface, and means to hold the burner plates in operative position on said faces.

2. In an infrared burner, a first open-ended trough-shaped member having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat faces positioned in the same plane one on each terminating edge, said member also having flat end faces at its terminal ends in parallel relation to each other, closure plates adapted to be attached to the faces on the terminal ends, one of said plates being pierced with an aperture for communication with an inlet pipe for gaseous fuel on the outer side of the plate, a tubular fuel distributor positioned within said trough-shaped member and communicating with said aperture on its inner side, said other closure plate having an aperture in communication with the fuel distributor, a reticulated tubular member positioned about the fuel distributor and substantially coextensive with the fuel distributor in an axial direction, a second open-ended trough-shaped member similar to the first fitted to the outside of said other closure plate, a conical reticulated member in communication with the fuel distributor and positioned in the second trough-shaped member, a third imperforate closure plate for the open end of the second trough-shaped member, infrared burner plates fitted on the mounting faces of the terminal edges of the sides of the trough-shaped members, and means to hold the burner plates in operative position on said faces.

3. In an infrared burner, a first open-ended trough-shaped member having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat faces positioned in the same plane one on each terminating edge, said member also having flat end faces at its terminal ends in parallel relation to each other, closure plates adapted to be attached to the faces on the terminal ends, one of said plates being pierced with an aperture for communication with an inlet pipe for gaseous fuel on the outer side of the plate, a tubular fuel distributor positioned within said trough-shaped member and communicating with said aperture having outlet apertures on its side facing the bottom of the trough-shaped member, said other closure plate having an aperture in communication with the fuel distributor, a reticulated tubular member positioned outside the fuel distributor and substantially coextensive with the fuel distributor in an axial direction, a second open-ended trough-shaped member similar to the first fitted to the outside of said other closure plate, a third imperforate closure plate for the open end of the second trough-shaped member, infrared burner plates fitted in abutting relation on the mounting faces of the terminal edges of the sides of the trough-shaped members to form a substantially continuous flat burner surface, and means to hold the burner plates in operative position on said faces.

4. In an infrared burner, open-ended trough-shaped members having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat mounting faces positioned in the same plane one on each terminating edge said members also having flat end faces at their terminal ends in parallel relation to each other, said flat end faces being adapted to be placed in end-to-end relation to form a continuous burner of desired controllable length, a closure plate adapted to be attached to a first face on a terminal end, said plate being pierced with an aperture for mounting an inlet pipe for gaseous fuel on the outer side of the plate, a perforated closure plate positioned between and abutting the end faces of each adjacent pair of trough-shaped members and means securing the members and closure plates together in said abutting relationship, a fuel distributor positioned within said trough-shaped members and supported in said aperture and extending to the last perforated closure plate, a plurality of infrared burner plates fitted on the mounting faces of the terminal edges of the trough-shaped member to form a substantially continuous flat burner surface, each burner plate having a plurality of gas escapement perforations and comprising a means providing combustion of said fuel to produce radiant heat at the outer surface of said plates, an imperforate closure plate for the free end of the last trough-shaped member, and means to hold the burner plates in operative position on said faces.

5. In an infrared burner, open-ended trough-shaped members having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat mounting faces positioned in the same plane one on each terminating edge said members also having flat end faces at their terminal ends in parallel relation to each other, said flat end faces being adapted to be placed in end-to-end relation to form a continuous burner of desired controllable length, a closure plate adapted to be attached to a first face on a terminal end, said plate being pierced with an aperture for mounting an inlet pipe for gaseous fuel on the outer side of the plate, a tubular fuel distributor including a screen member mounted in said aperture on the inner side, said fuel distributor extending to the last perforated closure plate, said screen member being substantially coextensive with the fuel distributor in an axial direction, other perforated closure plates positioned between the trough-shaped members to connect the members, infrared burner plates fitted on the mounting faces of the terminal edges of the trough-shaped member, an imperforate closure plate for the free end of the last trough-shaped member, and means to hold the burner plates in operative position on said faces.

6. In an infrared burner, open-ended trough-shaped members having a terminating edge on either side in parallel longitudinal relation to the said member and provided with a pair of flat mounting faces positioned in the same plane one on each terminating edge said members also having flat end faces at their terminal ends in parallel relation to each other, said flat end faces being adapted to be placed in end-to-end relation to form a continuous burner of desired controllable length, a closure plate adapted to be attached to a first face on a terminal end, said plate being pierced with an aperture for mounting an inlet pipe for gaseous fuel on the outer side of the plate, a tubular fuel distributor having spaced apertures mounted

in said aperture on the inner side, said fuel distributor extending to the last perforated closure plate, a tubular screen mounted concentrically about the fuel distributor in each of the trough-shaped members and substantially coextensive with the fuel distributor in an axial direction, other perforated closure plates positioned between the trough-shaped members to connect the members, infrared burner plates fitted on the mounting faces of the terminal edges of the trough-shaped member, an imperforate closure plate for the free end of the last trough-shaped member, and means to hold the burner plates in operative position on said faces.

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