Nov. 15, 1966 F. W. KEINONEN ETAL 3,285,318

FURNACE AND BURNER UNIT

Filed Dec. 30, 1963 2 Sheets-Sheet 1

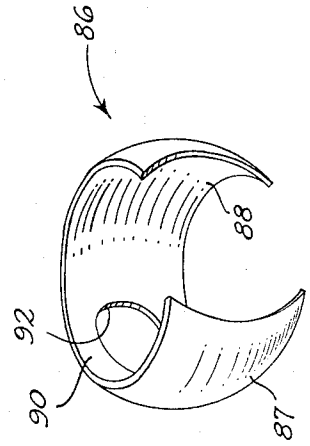


Fig. 7.

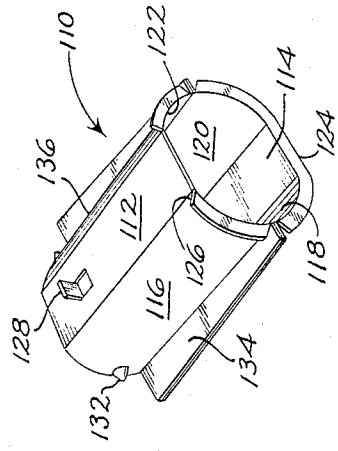


Fig. 8.

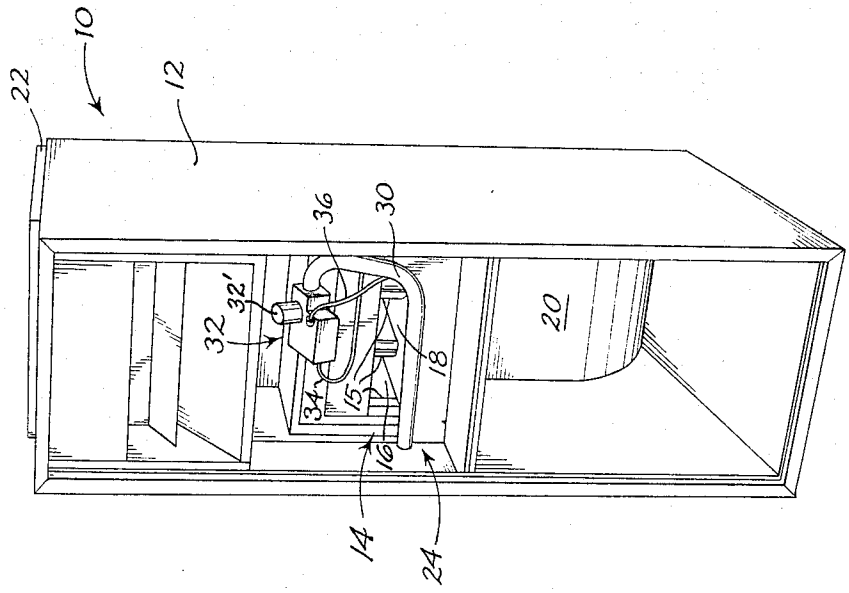


Fig. 1.

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FURNACE AND BURNER UNIT

Filed Dec. 30, 1963 2 Sheets-Sheet 2

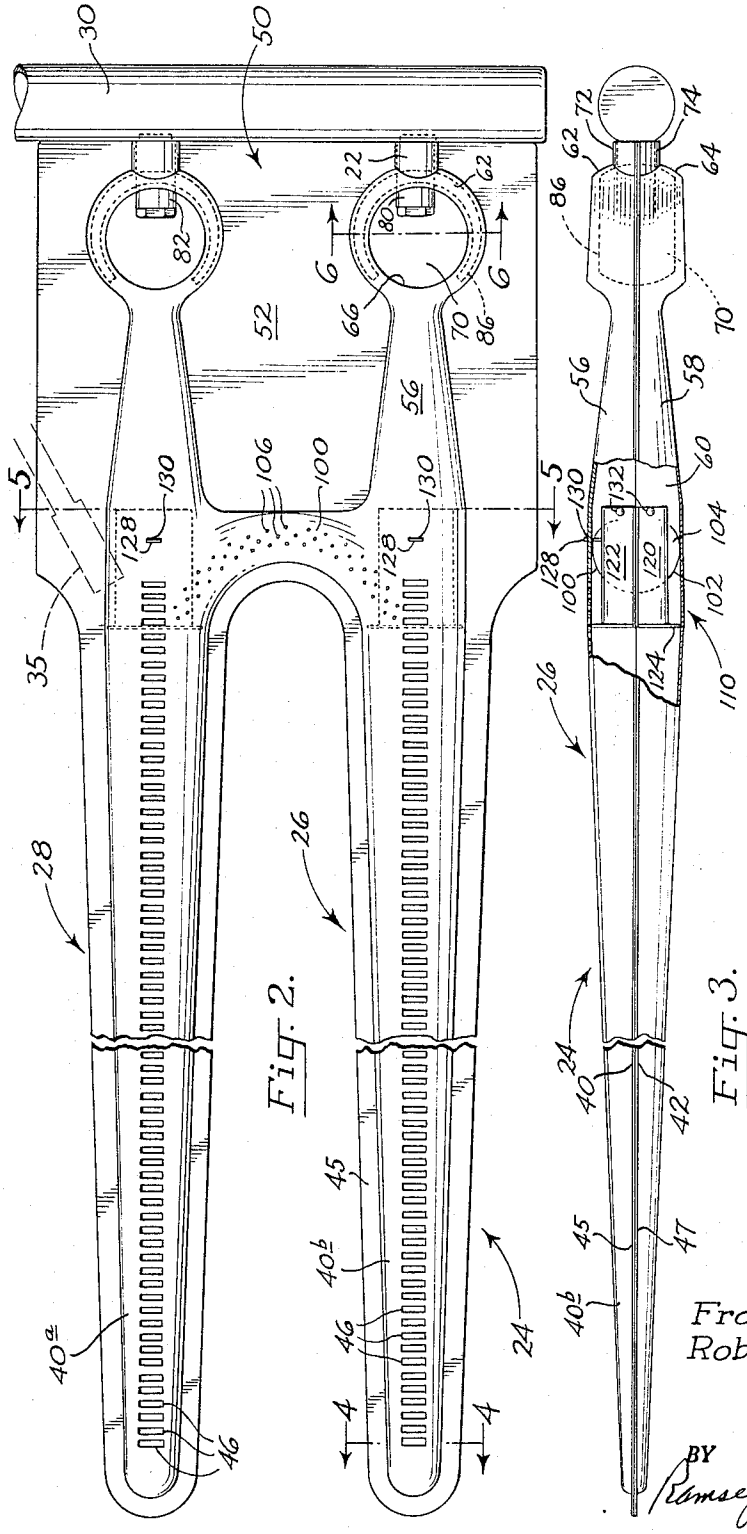


Fig. 2.

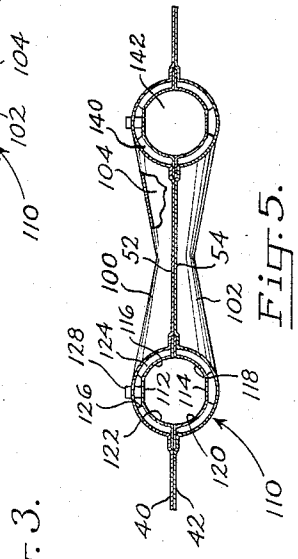


Fig. 5.

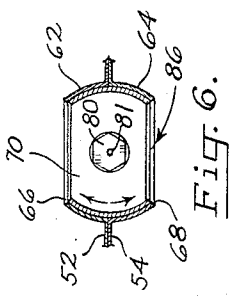


Fig. 6.

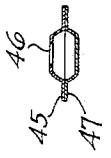


Fig. 4.

Fig. 3.

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FURNACE AND BURNER UNIT

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Filed Dec. 30, 1963, Ser. No. 334,456
4 Claims. (Cl. 158—114)

This invention relates to furnaces and like appliances, and a construction for burner units therein.

More specifically, the invention relates to a burner unit for gas furnaces, featuring novel improvements whereby the same is an efficient and reliably operating unit, the unit at the same time being simply constructed and produceable at relatively low cost.

One form of gas furnace known today comprises a heat exchanger, with elongated furnace chambers therein where fuel combustion takes place. Means is provided for circulating air through passages in the exchanger, and such air is warmed in the exchanger, whence it is blown into the space to be heated. Elongated burners, sometimes referred to as "pipe-type" burners, are included in the furnace, and these extend into the furnace chambers mentioned, and supply the fuel which is ignited during operation of the furnace.

With gas furnaces, particularly those including pipe-type burners of the type described, problems are involved in obtaining a proper fuel mixture for burning, and in properly circulating the fuel mixture to the burners prior to combustion actually taking place. Most furnaces are operated intermittently, and there are also problems involved in providing for quick-acting and reliable start-up in the furnace after a nonoperating period.

A general object of this invention is to provide a novel burner unit for gas furnaces, and related heating appliances, which takes care of the above mentioned difficulties in a highly satisfactory and practical manner.

More specifically, an object is to provide a burner unit, which includes multiple, elongated burners for injecting a fuel mixture in the zones where combustion actually takes place and a novel flame carry-over means interconnecting these burners whereby all may be ignited quickly and surely from a pilot burner located adjacent the burner unit.

Another object is to provide a burner unit, including multiple burners and novel flame carry-over means for igniting the burners, which includes means effective to produce a positive gas pressure in the carry-over means during start-up periods.

A further specific object is to provide a novel burner unit, with multiple pipe-type burners, which includes multiple fuel mixing cavities for mixing gas and air for burning, one for each burner, and novel means accommodating a change in amount of air mixed with the gas, whereby a proper consistency in the fuel mixture may be produced.

Other and related features of the invention include the provision of a novel burner unit which is adapted to be manufactured from stamped metal parts. Considerable economies may thus be realized in the production of the burner units.

The burner unit of the invention is particularly advantageously incorporated in a furnace of the type which has a series of adjacent furnace chambers or compartments defined in a heat exchanger, since the construction of the unit is such as to readily accommodate an increase or decrease in the heating capacity of the furnace, by increasing or decreasing the number of burners included in the burner unit.

While the invention is described hereinbelow in connection with a gas fired, hot-air furnace, it is not intended

thereby to limit the invention solely to such apparatus, as certain features of the invention have applicability to other end related heating appliances.

The invention is described hereinbelow and in conjunction with accompanying drawings, wherein:

FIG. 1 is a perspective view, illustrating a furnace constructed according to one embodiment of this invention;

FIG. 2 is a plan view, on a slightly enlarged scale, showing a burner unit as contemplated herein including a pair of pipe-type burners;

FIG. 3 is a side elevation of the burner unit in FIG. 2 with portions thereof broken away;

FIG. 4 is a cross sectional view taken along the line 4—4 in FIG. 2;

FIG. 5 is a cross sectional view along the line 5—5 in FIG. 2;

FIG. 6 is a cross sectional view along the line 6—6 in FIG. 2;

FIG. 7 is a perspective view on a still larger scale, showing a damper element present in the furnace unit; and

FIG. 8 is another perspective view, on approximately the same scale as FIG. 7, showing a baffle element present in the burner unit.

Referring now to the drawings, and first of all more particularly to FIG. 1, here a furnace is indicated generally at **10**, including a substantially rectangular cabinet **12** which houses the operating parts of the furnace.

Mounted within cabinet **12**, substantially midway between the top and bottom ends thereof, is a heat exchanger **14**. Heat exchanger **14** includes walls **15** defining a pair of elongated furnace chambers **16** and **18** which extend to the rear of the heat exchanger. Air to be heated passes upwardly into the heat exchanger through a duct **20**. Such air circulates through passages in the heat exchanger (not shown) where it is heated. The air leaves the heat exchanger and the furnace through a duct **22**.

Heat exchanger **14** including its walls **15** are heated by means of a burner unit, shown generally at **24**. As best seen in FIG. 2, burner unit **24** includes a pair of elongated, pipe-type burners designated at **26** and **28**. Each burner extends rearwardly in the heat exchanger in one of the furnace chambers **16**, **18**, shown in FIG. 1. A fuel mixture is supplied to burner elements **26**, **28** through a manifold **30**. In FIG. 1 the manifold is illustrated, but details of the burners have been omitted since the scale of the drawing does not permit the showing of such details.

Still referring to FIG. 1, valve mechanism **32** including valve casing **32'** is illustrated, which is suitably connected to a fuel gas supply line (not shown). Valve mechanism **32** controls the supply of fuel, through a conduit **32**, to manifold **30**. At **34** is indicated a line which is connected to a thermo-sensitive device (not illustrated) operable to adjust valve mechanism **32** so as to close off the supply of gas to manifold **30** should a pilot burner for the furnace happen inadvertently to become extinguished. Such a pilot burner, shown at **35** in FIG. 2, is supplied fuel through line **36**.

In the furnace illustrated, as already indicated, there are a pair of burners **26**, **28**, and these extend into a heat exchanger having a pair of furnace chambers **16** and **18**. Thus the furnace illustrated has a relatively low heat capacity, and would be used for heating a relatively small space. Where a larger heat output is desired, a larger heat exchanger may be provided, including a greater number of furnace chambers. With such a heat exchanger, a burner unit is used which includes a correspondingly greater number of burners. A feature of the invention is that the construction of burner unit **24** is such as to permit readily modification by changing the number of

burners therein to make the same adaptable for furnaces of varying capacities.

Burner unit **24** is illustrated in more detail, and on a slightly enlarged scale, in FIGS. 2 through 6.

Referring now to FIGS. 2 and 3, it will be noted that the burner unit illustrated comprises a body formed of a pair of shaped plates, which may be metal stampings, and which are indicated at **40, 42**. Plates **40, 42** are mounted in face-to-face relationship. Each of the plates includes a pair of elongated projections, indicated for upper plate **40** at **40***a* and **40***b*. The projections of the upper plate, i.e., projections **40***a* and **40***b*, are opposite similar projections provided in the lower plate. The two projections of a plate are shaped with a transverse concavity, and this concavity faces a similar transverse concavity shaped in the projections of the other plate. Along the margins of the concavity in the various projections are marginal flanges, indicated for top plate **40** at **45**, and for the bottom plate **42** at **47**. In the burner unit, these margins are joined together in a suitable manner. The projections, with their concavities, form elongated, hollow, substantially parallel finger elements, and these finger elements are the burners **26, 28** in the unit.

Each of the burners has a row of jet apertures **46** provided along the length thereof. The apertures, which accommodate the flow of streams of fuel for ignition purposes from the burners, comprise cut outs made in top plate **40**.

The body of the burner unit, in addition to the burners described, includes what is referred to herein as a base portion **50**. The burners or finger elements project to one side of base portion **50**. Base portion **50** is formed by expanse **52** of plate **40**, and expanse **54** of plate **42**.

Expanses **52, 54** of plates **40, 42** are each provided with shaped portions that define a fuel transfer passage connecting with the interior of each burner. Thus, and considering burner **26**, an elongated concavely curved portion **56** is provided in plate **40**, and a similar concavely curved portion **58** is provided in plate **42**. These two curved portions together define a fuel transfer passage **6Q** which flares progressing from left to right in FIG. 3. This passage **60** communicates with the hollow interior of burner **26**. Similar curved portions define a similar fuel transfer passage for burner **28**.

Expanses **52, 54** of upper and lower plates **40, 42** are also formed with circular skirt portions defining a fuel mixing cavity communicating with each transfer passage. This is illustrated for transfer passage **60**, (connecting with burner **26**) by skirt portions **62, 64** shown adjacent the right edge of base portion **50**. Skirt portions **62, 64** are bounded by circular edges **66, 68** which define openings on the top and bottom of the burner unit. The mixing cavity defined by skirt portions **62, 64** is indicated at **70** and it will be noted that the cavity has a generally spherical over-all outline truncated by cut-off planes disposed on opposite sides of the cavity, which cut-off planes generally parallel the longitudinally axes of burners **26, 28** and the plane in which these burners extend. The mixing cavity communicates with the small diameter end of passage **60**. As illustrated in the drawings, similar skirt portions define a similar fuel mixing cavity for the passage corresponding to passage **60** which communicates with burner **28**.

Plate expanses **52, 54** further include semicylindrically formed portions, illustrated by portions **72, 74** for mixing cavity **70**, which together define a cylindrical tube section projecting out from one side of each cavity.

A combustible fuel mixture is supplied each burner from the fuel mixing cavity associated with the burner. Each mixing cavity has a separate means for introducing a supply of gas thereto. Thus, and considering burner **26**, a nozzle is illustrated at **80**, containing the usual aperture **81** accommodating the flow of gas from the nozzle. The nozzle is mounted on manifold **30**, with the inside of the nozzle communicating with the inside of the manifold. Nozzle **80** extends from the manifold and through the tube section defined by portions **72, 74** into mixing cavity **70**. A similar nozzle **82** is provided for introducing gas to the mixing cavity associated with burner **28**.

During operating periods of the burner unit, the air which is mixed with the fuel supplied by a nozzle enters the mixing cavity which surrounds the nozzle through the circular openings defined on the top and bottom of the unit by edges **66, 68** of a set of skirt portions **62, 64**. According to this invention, a damper element **86** is provided in each mixing cavity, illustrated in perspective in FIG. 7, for the purpose of regulating the amount of air mixed with the gas.

Each damper element is hollow and has a substantially spherical outline, as most clearly seen in FIG. 7 which matches the outline of the mixing cavity within which the damper element is mounted. The spherical outline of each damper element is truncated along opposite sides in parallel planes in a manner which resembles the truncation of the mixing cavities earlier described. The damper element includes arced-arms **87, 88**, which with the element properly mounted in a mixing cavity, are positioned snugly beside the walls of the cavity. A curved web portion **90** joins the arced-arms, and this web portion contains a circular hole **92**.

With a damper element mounted in place, within a mixing cavity, hole **92** accommodates the nozzle for the cavity, said nozzle extending from the manifold and past the damper element into the mixing cavity. As best seen in FIG. 6, because the damper element has a spherical overall outline, it has circular outline in a plane extending transversely of the nozzle which extends through it. The mixing cavity surrounding the damper element has a matching circular outline in this transverse plane. This means that the damper element may be rotated about an axis extending normal to this transverse plane, or about an axis which substantially corresponds to the longitudinal axis of the nozzle. By rotating the damper element in the directions indicated by the double pointed arrow shown in FIG. 6, the openings at the top and bottom of a mixing cavity may be closed to a varying extent by the arms of the damper element. It is in this way that a proper consistency is produceable in the fuel fed to the burners, whereby complete and economical combustion may be obtained.

As noted earlier, in FIG. 2 a pilot burner is shown at **35**, which is utilized to ignite gas emanating from the burner unit on start-up after a nonoperating period. The pilot burner is conventional, and includes the usual orifice through which a small stream of gas is continuously ejected. This gas stream burns continuously, whereby a small flame is always present over the series of ports **46** present in burner **28** illustrated at the top of FIG. 2. A feature of this invention is the provision of novel carry-over means, whereby a flame is carried from one to other burners in the burner unit, in a reliable and speed manner, upon fuel being supplied simultaneously to all the burners. In this way the unit is made quickly operative, after a nonoperating period.

Referring now to FIGS. 2, 3, and 5, it will be noted that top and bottom plates **40, 42** include oppositely disposed concave portions, indicated at **100** and **102**, respectively. These concave portions define a carry-over passage **104**, also referred to herein as a bleed passage, which extends between and interconnects interiors of the burners, at points adjacent the butt ends of these burners. As best seen in FIG. 5, by the outer contour shown for portions **100, 102**, passage **104**, progressing from one burner to the other, gradually decreases in size and has its smallest cross section at a point approximately midway between the two burners.

Upper plate **40** contains a series of small apertures or orifices **106**, constituting aperture means herein, disposed in a row along the top of concave portion **100**, said row thus extending transversely of the burners in the space

between the burners. These orifices accommodate the flow of gas in streams from inside the carry-over passage to the exterior of the burner unit, with such gas streams ejecting into the atmosphere at points distributed between the burners.

When gas is fed to the burner unit from manifold **30**, through nozzles **80**, **82**, such gas flow through the fuel transfer passages, and a portion of the gas supplied by each nozzle flows into one end of the carry-over passage, when it flows out orifices **106** as described. With the pilot burner operating, this gas is ignited, to produce a carry-over flame extending between adjacent burners.

In the burner unit, particularly if the nozzles are not exactly properly positioned, so as to direct gas directly forwardly into the burners in front thereof, with the construction so far described, a subatmospheric pressure may result in carry-over passage **104**. Further explaining, a fuel mixture in flowing into the burners and out through ports **46** may produce a suction in opposite ends of passage **104**, whereby air is drawn into the passage through orifices **106**. Any such tendency, of course, is undesirable, as it prevents the carry-over passage described from operating properly. Thus baffle elements are included in the burner unit, one for each burner, which function positively channel a small amount of gas into opposite ends of interconnecting passage **104**, whereby such a subatmospheric condition is prevented.

Referring to FIGS. 3, 5, and 8, a baffle element is shown at **110**. The baffle element is hollow, with open ends, and approximately cylindrical in shape. The baffle element for a burner is mounted inside the burner adjacent its butt end, at the location where interconnecting passage **104** has an end connecting with the interior of the burner.

As seen in FIG. 8, each baffle element includes a top and a bottom **112**, **114**, respectively, and arcuately curved sides **116**, **118**, **120** and **122**. With the baffle element properly in place within a burner, these sides are spaced somewhat inwardly from those portions of plates **40**, **42** which define the burner and the passage **60** extending into the burner. The forward end of a baffle element, i.e., the end nearest the viewer in FIG. 8, includes flange means **124**, which extends substantially entirely around the end of the element, save for a cut-out portion **126**. This flange means, as can be seen in FIG. 3, rests snugly against top and bottom plates **40**, **42** in the completed burner unit.

Each baffle element is operable to define two channels **140**, **142** extending forwardly from the passage **60** behind it. One of these channels extends along the interior of the baffle element, and leads to the hollow burner in front of the baffle element. This channel accommodates the flow of the major portion of the fuel mixture flowing in passage **60**. The other channel comprises the annular channel extending about the baffle element. This channel is blocked at its forward end by flange means **124**, and connects with an end of interconnecting passage **104**.

The baffle element includes a flap **128** which seats within a slot **130** cut in plate **40**. This flap serves to position the baffle element properly in the unit. Dimples **132** adjacent an end of element opposite flange **124** function to position this end of the baffle element in the assembly. Oppositely disposed flanges **134**, **136** extending along the length of the element also function to position the element. These flanges may be joined, if desired, as by welding, to one of the plates **40**, **42**, to anchor the element in place.

Each baffle element, by defining a pair of channels extending longitudinally of passage **60**, operates to divert a small portion of the gas flowing through passage **60**, and channel this gas into interconnecting passage **104**.

During operating periods, a combustible mixture, i.e., gas and a certain amount of air, is supplied each burner from a separate nozzle located to the rear thereof. Combustion of this mixture takes places substantially along the entire length of each burner. When starting up after a period of nonoperattion, there is a substantially immediate and positively produced discharge of gas through orifices **106**. This gas is quickly ignited to produce a carry-over flame from one burner to the next.

A proper fuel mixture is readily produceable by suitable adjustment of damper elements **86** provided for the respective burners.

The construction may be readily modified to adapt it for larger capacity. This is done by increasing the number of burners formed by plates **40**, **42**.

The unitized construction contemplated makes the burner unit easy to install, and easy to remove if replacement is necessary. The plate construction of the unit enables the unit to be manufactured at low cost.

While there has been described an embodiment of the invention, variations and modifications are possible. It is not intended to be limited in all respects to the specific embodiment disclosed, as it is desired to cover all variations and modifications as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a burner unit,

a body with an elongated burner passage defined therein and a jet opening in said body connecting with said burner passage accommodating the flow for ignition purposes of a fuel mixture from said burner passage,

a fuel mixing cavity defined in said body where fuel is mixed with air, said cavity being spaced from one end of said burner passage,

a fuel transfer passage defined within said body extending from said fuel mixing cavity to said one end of said burner passage,

a bleed passage defined in said body extending laterally of said fuel transfer passage, communicating at one end with said fuel transfer passage,

an aperture in said body connecting said bleed passage with the atmosphere and accommodating the flow of a fuel mixture from said bleed passage to the atmosphere, and

a substantially cylindrically shaped hollow baffle element mounted within said fuel transfer passage, with the axis thereof substantially paralleling the longitudinal axis of said burner passage and with the inside thereof forming a path between said fuel mixing cavity and said burner passage, said baffle element being mounted in said fuel transfer passage adjacent where the bleed passage connects with the transfer passage and including means on the outside thereof blocking the flow of the fuel mixture whereby such is directed on flowing over the outside of the baffle element into said bleed passage.

2. In a burner unit,

a body with an elongated burner passage defined therein, and a jet opening in said body connecting with said burner passage accommodating the flow for ignition purposes of a fuel mixture from said burner passage,

a fuel mixing cavity defined in said body where fuel is mixed with air, said cavity being spaced from one end of said burner passage,

an elongated fuel transfer passage defined within said body extending from said fuel mixing cavity to said one end of said burner passage, said fuel mixing cavity having a spherical outline truncated by a cut-off plane along at least one side thereof which plane substantially parallels the longitudinal axis of said fuel transfer passage,

an opening for the fuel mixing cavity defined where the same is truncated by said cut-off plane which faces laterally to one side of the fuel transfer passage, and

a hollow damper element mounted within the fuel mixing cavity, having a spherical outline which matches

the spherical outline of the mixing cavity, said damper element being rotatable about an axis generally paralleling the longitudinal axis of the transfer passage and having means defining an opening thereinto accommodating the flow of air into said mixing cavity which is registrable with said opening of the fuel mixing cavity to varying degrees depending upon the position that the damper element occupies relative to said opening of said fuel mixing cavity.

3. In a burner unit,

a body with an elongated burner having a passage defined therein, and a jet opening in said body connecting with said burner passage accommodating the flow for ignition purposes of a stream of fuel from said burner passage,

a fuel mixing cavity defined in said body where fuel is mixed with air, said cavity being spaced from one end of said burner passage,

a fuel transfer passage defined within said body extending from said fuel mixing cavity to said one end of said burner passage,

a baffle within said fuel transfer passage, said baffle defining a side channel which has a forward end blocked off from the burner,

a bleed passage defined in said body which extends laterally of said burner passage adjacent its said one end, said bleed passage connecting with said side channel, and

an aperture in said body connecting with said bleed passage, said aperture being at a point disposed to one side of said burner passage, said aperture accommodating the flow of a fuel mixture from said bleed passage to the atmosphere.

4. A burner unit comprising a pair of shaped plates of substantially matching outline joined together with the plates in face to face relationship,

each of said plates including at least a pair of elongated projections, disposed opposite similar projections in the other plate, each of the projections of one plate having a transverse concavity that faces a similar transverse concavity in the projection of the other plate which is opposite it,

said projections of the two plates cooperating to form elongated hollow fingers in the unit which taper progressing from a set of adjacent butt ends,

each of said plates further including an expanse joining the projections of the plate which is opposite and facing a similar expanse in the other plate, said expanses of the two plates having formed portions defining a pair of fuel transfer passages, one connecting with each hollow finger, and

a baffle element for each hollow finger, mounted between said expanses of the two plates, in the transfer passage for the finger, adjacent the butt end of the finger, said baffle element defining two channels with one of the two channels connecting with the interior of the finger, and the other channel blocked off from the interior of the finger,

said two plates also having concavely curved portions in said expanses of the two plates defining a carry-over passage which communicates at opposite ends with said other channels defined by the baffle elements for the two fingers.

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