May 20, 1969 K. KRIEGER 3,445,175

GAS BURNERS

Filed Feb. 28, 1967 Sheet 1 of 2

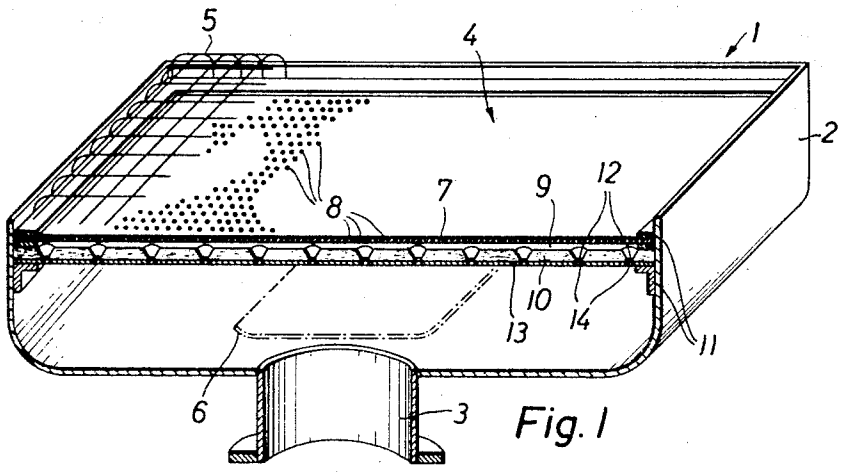


Fig. 1

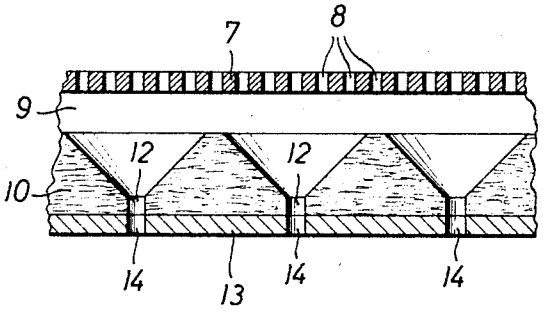


Fig. 2

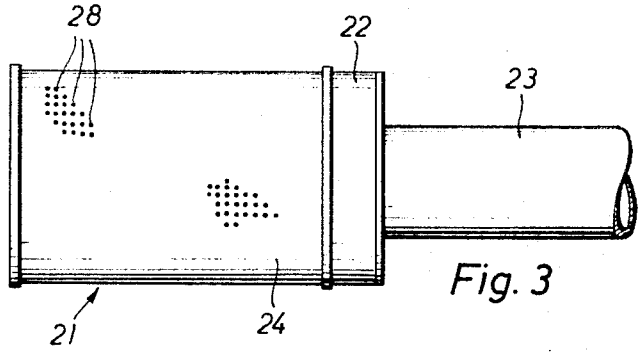


Fig. 3

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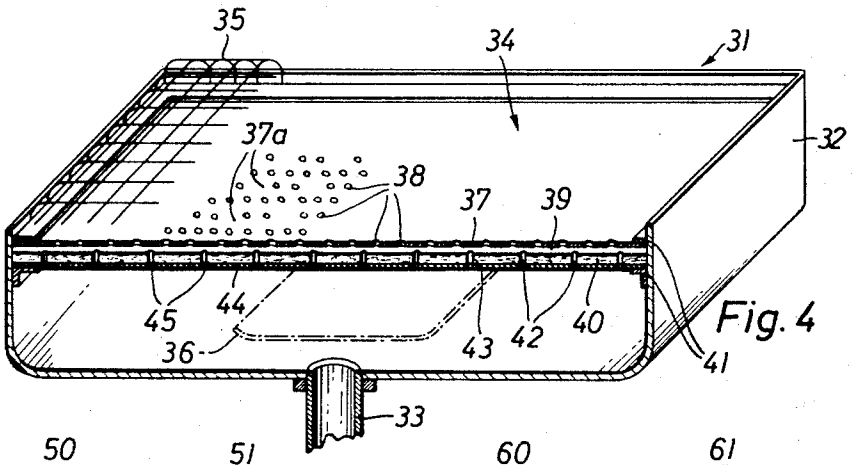


Fig. 4

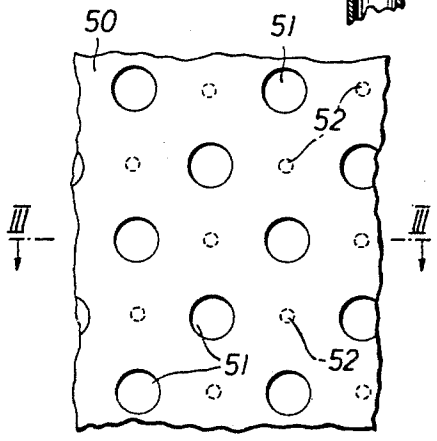


Fig. 5

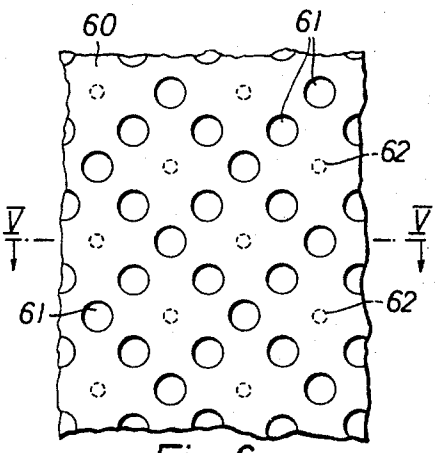


Fig. 6

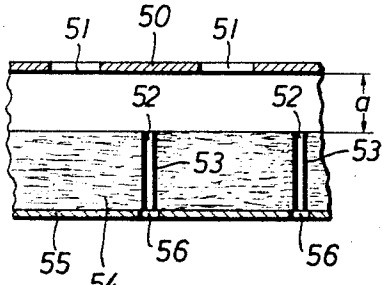


Fig. 7

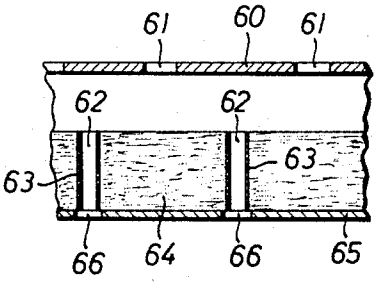


Fig. 8

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GAS BURNERS

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U.S. Cl. 431—328 10 Claims

ABSTRACT OF THE DISCLOSURE

A burner for mixtures of air and gas or fuel vapour has a burner head comprising an apertured plate of heat resisting metal, and an apertured layer, e.g., a fibrous fleece, of insulating material, which is arranged behind the metal plate and may be spaced therefrom. The total cross section of the apertures in the insulating layer may be less than that of the apertures in the metal plate and the apertures in the layer may be less numerous than those in the plate. The apertures in the layer may be enlarged towards the plate and may be formed by small metal tubes. The metal parts may be of chrome-nickel alloy or a high melting point heavy metal or alloy and the insulating material may be a fibrous material based on aluminum oxide.

This invention relates to a burner, more especially a radiation burner or incandescent radiator, in which a mixture of air and gas or fuel vapour is supplied through a combustion chamber to a permeable burner head consisting of elements arranged one behind another in the direction of flow.

It is known to use solid ceramic incandescent bodies which have a number of fine passages to which the gas-air mixture flows directly from a burner chamber. Such burner heads, usually made of several separate elements, are disadvantageous in various respects and are of limited utility.

The difficulties consist amongst others in that such elements are inclined to the formation of cracks, that the passages easily become blocked, that the danger of back-firing is comparatively great and so forth. Further, such elements involve a not inconsiderable expense. This applies, particularly as to repairs. Moreover the temperatures attainable with such burners are limited.

In order to avoid the drawbacks of burners constructed of such elements it has been proposed to use as an incandescent body a layer of quartz wool which is held between wire gauze. In this case only the outwardly directed part of such a layer is intended to form the actual incandescent body while in the rearward zone the mixture is intended simply to take up heat. Apart from the fact that even with such burner constructions the temperatures attainable are not very high, the danger of back-firing is in no way avoided. Even when two superposed layers are used it is not possible to avoid the incandescent combustion extending into the rear zone of the quartz wool layer and moving rearwards therein and progressively approaching the mixture chamber.

The invention has the object of producing a burner of the type mentioned above in which the drawbacks of known constructions, especially the above-mentioned drawbacks, are avoided. In addition the invention has the object of providing further constructions as described below such that particular advantages are achieved, especially the attainment of higher temperatures with greater reliability in operation.

According to the invention the burner head has a plate of heat resisting metal provided with apertures or perforations and an insulating layer of heat resisting or fireproof material, more particularly a fibrous fleece, arranged behind this plate and provided with defined apertures or performations.

Such a burner is simple in construction and allows of inexpensive manufacture. As a result of the particular features according to the invention it offers the possibility of reaching temperatures above 1000° C. and is protected against back-firing or the backward movement of the incandescent combustion.

Preferably a space is left between the metal plate and the insulating layer so that there is no direct contact between these two elements and consequently no direct heat transfer. If the insulating layer consists of a fleece or the like, this may if desired or necessary be covered with a fabric or grid.

According to a further feature of the invention, the apertures or perforations in the insulating layer are enlarged in the direction of the metal plate. This gives favourable conditions as regards the flow of the fuel mixture and the thermal conditions on and in the insulating layer. The enlargement of the apertures can, for example, be in the form of a funnel or there may be a stepwise enlargement of the cross-section.

The invention further provides that the through flow cross-section of the apertures in the insulating layer is smaller than in the metal plate. In this way it is possible to obtain in an advantageous manner a comparatively great flow velocity of the fuel mixture at the insulating layer which gives further security against back-firing.

More particularly the number of openings in the insulating layer may be smaller than in the metal plates. In an advantageous construction, for example the number of openings in the metal plate can be about five times the number of openings in the insulating layer.

A favourable construction consists in this that the total through flow cross-section of the openings in the insulating layer is about 0.5 to 5% of the surface area of the insulating layer. This total through flow cross section can be obtained by means of a large number of apertures of comparatively small diameter. For example in the case of an area of 4 cm.^{2} an aperture with a diameter of 1.7 mm. can be used.

The invention further provides that the total through flow cross-section of the apertures in the metal plates is about 15 to 30% of the surface area of the metal plate. It has been found that in this case the diameter of the apertures may be comparatively large and larger than that of the apertures in the insulating layer.

A particularly advantageous construction of the burner consists furthermore according to the invention in this, that the apertures in the insulating layer are formed by small tubes inserted or embedded therein. By this means the insulating layer has a particularly good mechanical stability as well as an improved resistance against distortions or displacements. Moreover, in this way, the flow conditions for the fuel mixture are made very favourable. The passages formed by the small tubes allow the fuel mixture to pass through as through nozzles which has been found very advantageous for the operating properties of the burner. This applies both for the flowing in and the combustion of the mixture and also as regards a satisfactory functioning of the insulating layer which is kept at a low temperature, which completely avoids the danger of backward travel of the combustion zone.

Any suitable material may be used for the small tubes. In particular the invention provides that the small tubes consist of metal. Although it is possible for example to use copper tubes, tubes of a heat-resisting metal principally a nickel-chromium alloy may also be used.

The invention further provides that the apertures in the metal plate and the apertures in the insulating layer are offset so as not to be in line with one another. This is of

particular advantage as regards the flow path of the fuel mixture and for the formation of the combustion zone.

As a further embodiment of the burner, the invention provides for the arrangement behind the insulating layer, that is to say at the side of the burner head facing the combustion chamber of a plate of heat-resisting metal which is likewise provided with apertures or perforations. In this way a stable and reliable construction is obtained which is adapted for a particularly high load. The number and arrangement of the apertures in this rearward burner head plate preferably corresponds with that in the insulating layer.

For the insulating layer, preferably a material consisting of or based upon aluminum oxide or a similar substance is provided especially in the form of a fibrous fleece. This enables very favourable results to be achieved. At the same time the use of another material of ceramic or other type which may be in solid form is not excluded.

As a material for the incandescent body plate or for a further plate provided on the combustion chamber side, in addition to heat resisting steels, chromium nickel alloys or high melting point heavy metals or heavy metal alloys, particularly tungsten, may be used.

The burner according to the invention can be used for domestic purposes and for industrial heating and drying purposes, in furnace constructions, for example in annealing furnaces and so forth, and can be made of optimum shape for the particular purpose of use. It may be made angular or circular and can also have a curved form, for example spherical or hemispherical or tubular. In this case it is also suitable as a burner for boiler heating or the like.

The invention is illustrated by way of example in the accompanying drawings in which

FIGURE 1 shows a burner according to the invention in a sectional perspective view,

FIGURE 2 is a vertical part section through a burner head construction on an enlarged scale,

FIGURE 3 shows a further burner construction in elevation,

FIGURE 4 shows another arrangement of a burner constructed according to the invention in a sectional perspective view,

FIGURE 5 shows a portion of the burner head in another construction in plan,

FIGURE 6 is a section on the line III—III of FIGURE 5,

FIGURE 7 shows a portion of the burner head in another construction in plan,

FIGURE 8 is a section on the line V—V of FIGURE 7.

The burner **1** shown in FIGURE 1 contains a burner casing **2** with supply tube **3** for a gas-air mixture and a burner head in the form of a rectangular surface indicated generally by the numeral **4**. At a distance above or in front of this a wire grid **5** a reflector or the like may be arranged. In the interior of the burner casing **2**, that is in the combustion chamber, a guide plate **6** or the like may be provided as indicated in broken lines.

The burner head **4** has an external incandescent body which is formed by a plate **7** of heat resisting metal, for example a chromium nickel alloy or tungsten, provided with through flow holes **8**. An insulating layer **10** is arranged behind the plate leaving an intermediate space **9**. This is a fleece of ceramic fibers, more particularly fibres based on aluminum oxide or a similar substance. The insulating layer **10** is provided with through flow openings **12** which are enlarged in the manner of funnels in the direction of the incandescent body plate **7**. The number of these passage openings **12** per unit area is substantially smaller than in the plate **7**. The arrangement is chosen such that the total through flow cross section provided by the apertures **8** of the plate **7** is about five to six times greater than the through flow area provided by the apertures **12** of the insulating layer **10** at their narrowest points.

Behind the insulating layer **10** lies a further plate **13** of heat resisting metal. In the construction illustrated this has through flow apertures **14** which correspond in number, arrangement and size to the apertures **12** in the insulating layer **10**. It is however possible if required to provide a larger number of apertures.

The above described layers forming the burner head are secured between holders **11** in the form of angular or flat profiles or the like which are secured or releasably or adjustably attached to the casing **2**. The burner head can also be constructed as a unit with a frame holding the individual layers together.

FIGURE 3 shows a burner **21** constructed according to the invention in cylindrical form such as can be used, for example for boiler heating. The supply tube **23** for the fuel mixture opens into a casing part **22** which adjoins the burner head **24**. The latter is constructed of several layers as in the burner according to FIGURE 1. The apertures in the incandescent body are indicated by the numeral **28**.

The burner **31** shown in FIGURE 4 has a burner casing **32** with a supply tube **33** for a gas-air mixture and a burner head in the form of a rectangular surface indicated generally by the numeral **34**. At a distance above or in front of this, a wire grid **35**, a reflector or the like may be arranged. In the interior of the burner casing **32** a guide plate **36** or the like may be provided as shown in broken lines.

The burner head **34** contains a plate **37** of heat resisting metal, for example an alloy of about 80% nickel and 20% chromium, provided with apertures **38**. Behind the plate **37** an insulating layer **40** is provided leaving an intermediate space **39**. This layer consists of a fibrous fleece more particularly a fleece of ceramic fibres or of fibres based on oxides. The insulating layer **40** has through-flow apertures **42** which are formed by small metal tubes **43**, for example tubes of copper or of an alloy of nickel and chromium or another metal. The arrangement of the apertures **42** in the insulating layer **40** and the apertures **38** in the plate **37** is made such that the streams of burning gas coming through the apertures **42** cannot pass in straight lines to apertures in the plate **37**, but that a distribution takes place. The axes of the apertures **42** thus do not coincide with those of the apertures **38**. The illustration in FIGURE 4 shows zones **37***a* of the plate **37** in which there are no apertures. At these points are the apertures **42** in the insulating layer **40** below.

Behind the insulating layer **40** is a further plate **44** of metal, for example of stainless steel, which has through flow apertures **45**. These apertures correspond in number and arrangement to those in the insulating layer and may be of the same size or may be larger than those in the insulating layer.

The above-mentioned layers forming the burner head are secured between holders **41** in the form of angular or flat profiles or the like secured or releasably or adjustably arranged on the casing **32**. The burner head may also be constructed as a unit with a frame holding the individual layers together.

FIGURES 5 and 6 and FIGURES 7 and 8 show different arrangements of apertures in the burner plate and in the insulating layer. In the construction according to FIGURES 5 and 6 apertures **51** provided in the burner plate **50** and through-flow apertures **52** formed by small metal tubes **53** in the insulating layer **54** are distributed in the same manner over the surface but are offset relative to one another by a half of the aperture spacing. The apertures **51** may, for example, have a diameter of 10 mm. and the apertures **52** a diameter of 1.5 to 2 mm. On a burner surface of 200 mm. x 140 mm. for examples 54 apertures **51** and 70 apertures **52**, may be provided. The total free flow area amounts to about 15% in the plate **50** and about 0.6 to 1% in the insulating layer. The number and size of the apertures, the thickness of the

insulating layer and the size of the distance *a* of the metal plate from the insulating layer may be varied according to requirements, the type of fuel gas, the desired temperature conditions and so forth.

In FIGURES 7 and 8 another arrangement of apertures **61** in the burner plate **60** and of apertures **62** formed by small metal tubes **63** in the insulating layer **64**, is illustrated. With this arrangement, for example a total flow cross section in the plate **60** of about 20% and in the insulating layer of about 1.5 to 2.5% or more may be provided.

In both constructions a further plate **55** or **65** with apertures **56** or **66** is placed beneath the insulating layer **54** or **64**.

The burner according to the invention allows of high operating temperatures and is characterised especially by the fact that a movement back of the incandescent combustion is completely prevented in addition to its simple construction and long life.

What is claimed is:

1. A burner comprising a casing defining a distribution chamber, means for supplying thereto a mixture of air and a member selected from the group consisting of gas and fuel vapour, and a permeable burner head which comprises a radiant plate of heat resistant metal provided with apertures and an insulating layer of heat resisting material, formed of a fibrous fleece, provided with discrete apertures and arranged behind the radiant metal plate, wherein an intermediate space is left between the radiant metal plate and the insulating layer; the said intermediate space forming a combustion chamber.

2. A burner as claimed in claim **1**, characterised by the feature that the apertures in the insulating layer are enlarged in the direction of the metal plate.

3. A burner as claimed in claim **1**, characterised by the feature that the total flow cross-section of the apertures in the insulating layer is smaller than in the metal plate.

4. A burner as claimed in claim **1**, characterised by the feature that the number of the apertures in the insulating layer is smaller than the number of the apertures in the metal plate.

5. A burner as claimed in claim **1**, characterised by the feature that the total flow cross section of the apertures in the insulating layer is about 0.5 to 5% of the area of the insulating layer, and the total flow cross section of the apertures in the metal plate is about 15 to 30% of the area of the metal plate.

6. A burner as claimed in claim **1**, characterised by the feature that the apertures in the insulating layer are formed by small metal tubes passing through the layer.

7. A burner as claimed in claim **1**, characterised by the feature that the apertures in the metal plate and the apertures in the insulating layer are displaced relative to one another so that they are not in line.

8. A burner as claimed in claim **1**, characterised by the feature that an apertured plate of heat-resisting metal is arranged behind the insulating layer.

9. A burner as claimed in claim **1**, characterised by the feature that a material based on aluminium oxide is used for the insulating layer.

10. A burner as claimed in claim **1**, characterised by the feature that the metal parts consist of a material selected from the group consisting of chrome-nickel alloy, high melting point heavy metals and alloys thereof.

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JAMES W. WESTHAVER, *Primary Examiner.*