GAS BURNER FOR FURNACES, KILNS, AND THE LIKE

Abstract

A gas burner for use with kilns, furnaces, and the like, having a tubular body with a venturi throat. A ceramic burner head of high-heat resistant material is mounted on one end of the body. A regulated volume of air, and gas are admitted at the opposite end. A gas supply orifice is adjustable relative to the venturi throat. The burner head is cup-shaped and provides a mixing chamber for the air and gas. The mixture discharges through a series of passageways in the head to form separate high-heat flames. The burner head is aligned and carried by a coupling that is detachable from the body. A refractory seal is formed between the coupling and the adjacent end of the burner head.
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GAS BURNER FOR FURNACES, KILNS, AND THE LIKE

FIELD OF THE INVENTION

The present invention relates to a gas burner construction for use with furnaces, kilns, and the like, and more particularly to a burner including a ceramic head or tip made from material that will insure clean flame and long burner life.

DESCRIPTION OF THE PRIOR ART

Various types of gas burners have heretofore been proposed including burners having steel or ceramic heads or tips, but the principal disadvantage of these is that the materials used in making the burner tips cannot withstand for any substantial period the high temperatures required to be maintained in kilns and furnaces. In an effort to overcome these shortcomings, burners have been frequently mounted outside of the furnace walls so as to be remote from the center of heat, and arranged to project the burner flame into the furnace or kiln. Such arrangements have been unsatisfactory in many instances because of inefficiency and excess or secondary air being drawn into the furnace, resulting in a lowering of the temperature within the furnace. Even with such arrangements, the metal burner heads oxidize or deteriorate rapidly so that they have a short service life requiring frequent replacement. Prior ceramic heads have been subject to cracking and crazing, resulting in rapid deterioration. In addition, many of such prior heads have been relatively inefficient in operation, producing poor flames and resulting in a great waste of fuel.

SUMMARY OF THE INVENTION

The present invention overcomes the foregoing objections, in that the gas burner construction is such that the burner head is highly resistant to heat and its design is otherwise such that it provides for a large number of clean and efficient jets of flame. More specifically, the present burner includes a ceramic burner head resembling a cup and having three circular rows of openings formed in the bottom or end thereof through which the mixture of gas and air is discharged into a combustion space in a glass working furnace, kiln, or the like. The burner head is preferably cast from tabular alumina but may be made from any other material having the same heat resistant properties.

The burner head is detachably mounted upon a tubular body member having a venturi throat and being closed at one end except for a series of openings for admitting air into the burner. This end of the tubular body member has a threaded tube axially mounted therein, with a plug in its inner end provided with an orifice or passage of predetermined size to control the rate of flow of fuel into the burner. A disk is adjustably mounted on the tube and can be moved toward and away from the air inlet openings to vary the rate at which air can flow into the burner. The other end of the tubular body member is open and exteriorly threaded, and has a conventional pipe coupling mounted thereon. The ceramic burner head of the present invention is cup-shaped and has a flanged rim that abuts one end of the coupling, and is held in place on the coupling by a ring that surrounds the coupling. The ring is mounted concentric with the coupling by four fingers one end of each of which is welded to a side edge of the ring and its other end welded to the coupling. Four tabs are welded to the other edge of the ring and engage the flange on the burner head to hold it in place against the outer end of the pipe coupling. The space between the ring and the flange is filled with refractory material, which may be of the same character as the material from which the burner head is made.

In conformity with the above, the principal object of the invention is to provide a gas burner construction that is long-lived, and which provides maximum heat with a minimum of fuel.

Another object is to provide a gas burner wherein the burner head can be readily mounted or demounted from the main body of the burner.

Another object is to provide a gas burner construction having a venturi throat in association with means for adjusting a gas supply orifice relative to the throat of the venturi; and which also includes means for adjusting the supply of air to the venturi.

A further object is to provide a gas burner that can be mounted in a furnace wall without resulting in cracking or breaking of the burner head as a result of exposure to intense heat.

A still further object is to provide a burner head having a mixing chamber for air and gas and which has a large number of openings through which the mixture can flow and then burn as a clean flame.

Other and further objects of the invention will be apparent from the following description and accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal cross-sectional view through the burner construction of the present invention, the burner being shown mounted in a furnace wall indicated in dot-and-dash lines; FIG. 2 is a right end elevational view of the burner shown in FIG. 1; FIG. 3 is a vertical sectional view, taken on the line 3—3 of FIG. 1; and FIG. 4 is a vertical sectional view taken on the staggered section line 4—4 of FIG. 1 and particularly showing the shape of the air inlet ports.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the complete burner assembly is generally identified by the numeral 2 and includes a tubular body member 4 having an end 5 closed by a wall 6, and having external pipe threads 8 at the opposite end 9 thereof. The end wall 6 has three arcuate air inlet openings 10, as is best shown in FIG. 4. The end wall 6 also has a central threaded opening 12 in which one end of a threaded gas supply tube 14 is adjustably mounted. Gas is supplied to the tube 14 through a pipe and shut-off valve, not shown. The tube 14 also has internal threads 16 to receive a plug 18 having a metered passage or orifice 20. A disk 22 of about the same diameter as the tubular body end 5 is threadedly mounted on the tube 14 and, by rotation thereof, can be adjusted toward and away from the air inlet openings 10 in the end wall 6, to control the amount of air drawn into the tubular body member 4.
The tubular body member 4 tapers inwardly from the end wall 6 on an angle of about 20° to the horizontal and also tapers inwardly and away from the open end 9 on a more gradual angle of about 7° to form a venturi throat 24, located about one fourth the distance between the inner face of the end wall 6 and the open end 9. The gas supply tube 14 is longitudinally adjustable in the end wall 6 to position the gas discharge orifice 20 at any desired location relative to the venturi throat 24, to thus vary the amount of air induced to enter the burner assembly by venturi action. It will be understood that the volume of air "drawn-in" will vary with the pressure of the gas. By virtue of the adjustments described, adequate air to support complete combustion of the gas is assured at all times.

A pipe coupling 26 is mounted upon the threads 8 of the tubular body member 4 and projects therefrom beyond for a substantial distance. The coupling 26 forms part of a burner head assembly that can be readily mounted or demounted from the tubular body member 4. Four radial fenders 28, spaced 90° apart, are welded at their inner end to the coupling 26, as indicated at 30 in FIG. 3. A side edge of a retaining ring 32 is welded to the outer end of the fingers 28 so as to be concentric with and to extend axially beyond the coupling 26. Four inwardly extending tabs 34 are welded to the opposite edge of the ring 32 for a purpose described later.

A generally cup-shaped burner head or tip 36 has a cylindrical side wall 38, an end wall 40 at one extremity of said side wall, and a flange 42 that extends laterally outwardly at the opposite extremity. The side wall 38 and the end wall 40 form a mixing chamber for the gas and air delivered thereto through the venturi throat 24. The tabs 34 engage the end flange 42 of the burner head 36 and retain it within the ring 32 in centered relation to the coupling 26. The ring 32 forms an annular space 44 surrounding the coupling 26, with one side of the space being formed by the adjacent face 46 of the flange 42. This space is filled with suitable refractory material 48, which forms a seal between the coupling 26 and the flange 42 of the burner head 36.

The end or bottom wall 40 of the burner head 36 has three concentric rows of openings 50, as is best shown in FIG. 2. The openings 50 in the innermost and outermost rows are arranged on a common radius; whereas, the openings 50 in the intermediate row are staggered with respect to the radially arranged openings. Twenty-four openings 50 are shown, eight in each row, but it will be understood that the number will vary with the size of the burner head. However, the arrangement of the openings 50, as shown, provides for good flame distribution and efficient combustion.

The burner assembly 2 is conveniently inserted into a passageway 52 in a furnace wall 54. The axial length of the burner head 36 can be varied, of course, to suit furnace walls of different thicknesses. An important feature is that the burner head need not be disposed externally of the furnace, since it can withstand extremely high temperatures without suffering heat damage. To this end, the burner head 36 is preferably made from tabular alumina, which is a form of aluminum oxide, $\text{Al}_2\text{O}_3$. The burner head may be made by casting the same to shape, or may be formed in a pressure mold. The sealing material 48 may also consist of tabular alumina and any suitable binder prepared as a thick paste and positioned in the annular space 44 to harden and seal the burner head 36 to the end of the coupling 26.

The present burner construction is designed to burn either natural or propane gas, and has a general BTU rate of 25,000 to 350,000 BTU per hour. The supply of air is limited only by the size of the air inlet openings 10 and can be regulated by adjustment of the disk 22. Larger sized burners would, of course, have a higher BTU rating.

In the operation of the device, each of the openings 50 in the burner head 36 provides a flame which receives the proper mixture of gas and fuel for complete combustion. The openings 50 in the burner head 36 are designed so as to assure a continuous flow of the gas and air for proper combustion without any "blow off" or any "pop back" of the flame. The substantial number of openings 50 in the burner face creates a condition which supports large combustion activity. They also provide a great deal of surface area for facilitating combustion. In the present instance, and by way of example and not limitation, each of the burner openings 50 will support a flame approximately three eighths of an inch in diameter and about 8 inches long. This enables the burner head 36 to support a large volume of combustion in a relatively small space.

The burner will also operate with natural draft, or with a mixing box in which air and gas are mixed prior to delivery to the burner, or in an environment where both air and gas are supplied under pressure. The referred system is the one described herein employing the venturi, wherein pressurized gas draws in a corresponding amount of air, depending upon the kind of flame desired.

The air adjustment is such that air is supplied in proper proportion to the amount of fuel so that the fuel is burned at the same rate at which it is introduced, to establish ideal combustion conditions.

The burner head 46 is characterized by lack of cracking or crazing, so that it is impervious to the corrosive, oxidizing effect of the high temperatures in the combustion chamber.

The preferred material is commercially available as "Green Cast 97", a well known tabular alumina that is castable and which consists of almost 100 percent $\text{Al}_2\text{O}_3$. Another material useful for present purpose is a mullite mix, wherein mullite ($3\text{Al}_2\text{O}_3\cdot2\text{SiO}_2$) is converted from Kyanite ($3\text{Al}_2\text{O}_3\cdot3\text{SiO}_2$) by sintering kyanite, a natural mineral, at a temperature above 700° F. The foregoing materials are quite satisfactory and, in fact, any high alumina content ceramic material, (over 60 percent) would be useful, including calcined alumina. Other materials which could be used include silicon carbide, zircon, and fused silica. All of these materials have a low coefficient of thermal expansion and exhibit the quality of high refractory strength.

The ceramic burner head 36 is much longer-lived than present steel burner heads whose life span is very limited as a result of rapid oxidation and expansion and contraction under high furnace and kiln temperatures. Oxidation causes partial obstruction of the burner openings and frequently causes the quality of the flame to be so poor that effective operation is unattainable. Experience has shown that the extreme heat requirement in furnaces and kilns attacks the metal burner heads and soon turns them into black iron ox-
A gas burner, comprising: a tubular body member having inlet means for air and gas; a generally cup-shaped ceramic burner head having an open end and a radial flange at said open end; and means mounting said burner head in axial alignment with said member with its open end adjacent said member, said mounting means including fastening elements carried by said tubular body member and engaging said flange, said burner head having a side wall, and an end wall remote from said member, the interior of said burner head communicating with said member and forming a mixing chamber for said air and gas, said end wall having a series of openings extending therethrough for the passage of mixed air and gas from said mixing chamber.

2. A gas burner as recited in claim 1, wherein the burner head is made of tabular alumina.

3. A gas burner as recited in claim 1, wherein the tubular body member is elongated and contains a restricted throat forming a venturi.

4. A gas burner as recited in claim 3, wherein the mounting means includes a coupling secured to said tubular body member and a ring attached to said coupling, and sealing means within said ring disposed between said burner head and said coupling.

5. A gas burner as recited in claim 4, wherein the ring surrounds the flange on the burner head; and means carried by said ring engaging the flange on said burner head.

6. A gas burner as recited in claim 4, wherein the ring is mounted concentrically upon the coupling, and the coupling is threaded on the tubular body member.

7. A gas burner as recited in claim 3, wherein the tubular body member is provided with air and gas inlet means in advance of the venturi throat.

8. A gas burner as recited in claim 7, wherein the tubular body member has an end wall and the air inlet means comprises openings in said end wall, and wherein the gas inlet means comprises a tube having one end mounted in said end wall and orifice means in said one end of said tube for metering gas flow.

9. A gas burner as recited in claim 8, wherein a draft control member is adjustably mounted on the tube in confronting relation to the air inlet means for regulating the amount of air that can enter said tubular body.

10. The burner device as recited in claim 7, wherein the orifice means is axially adjustable relative to the venturi throat.