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BURNER FOR METALLURGICAL FURNACES

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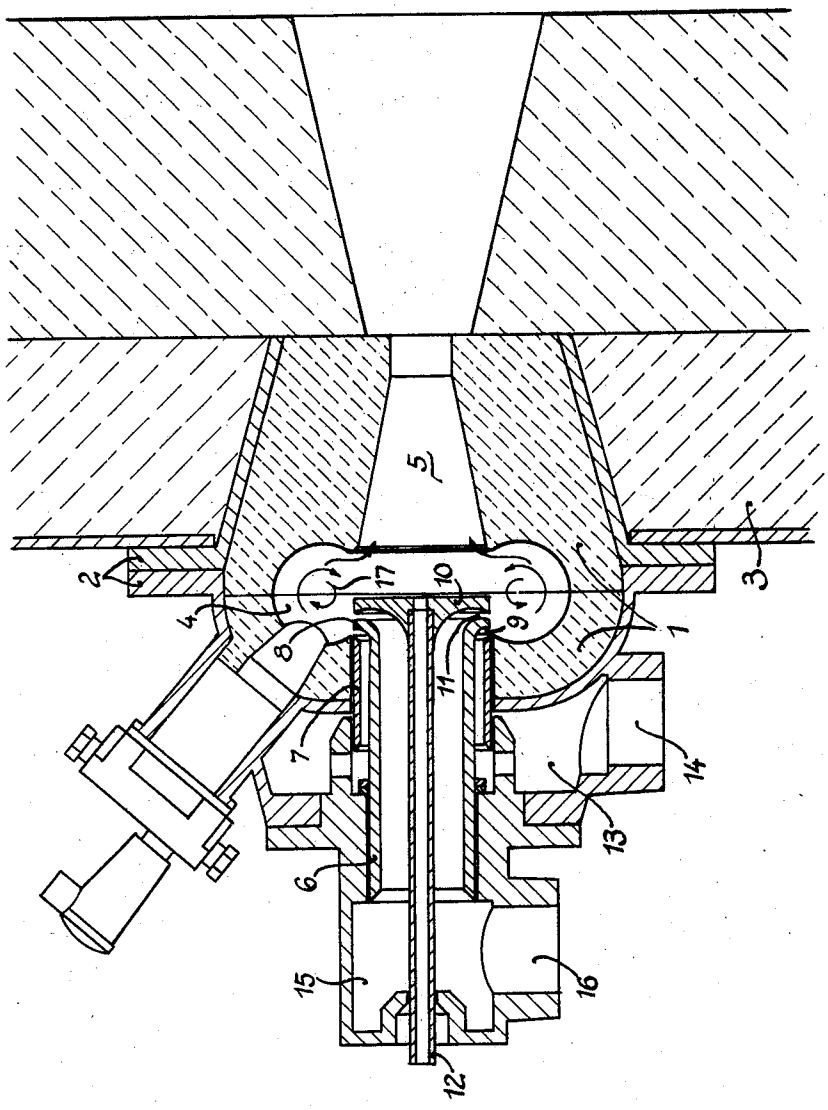

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BURNER FOR METALLURGICAL FURNACES

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ABSTRACT OF THE DISCLOSURE

A burner for heat-treating furnaces comprises a housing which defines a toroidal combustion chamber and a discharge opening of decreasing cross section for admission of combustion products from the chamber into the interior of a furnace. The chamber receives air and gaseous fuel by way of two annular orifices which are spaced from each other in the axial direction of the chamber and discharge gases radially outwardly whereby such gases flow along the internal surface of the housing and are mixed with each other and with burning gases to effect complete combustion of fuel prior to evacuation of resulting hot products by way of the discharge opening.

BACKGROUND OF THE INVENTION

The present invention relates to burners for heat-treating furnaces, and more particularly to improvements in burners which burn gaseous fuel.

It is already known to provide the combustion chamber of a burner for heat-treating metallurgical furnaces with a relatively small discharge opening which admits hot combustion products into the interior of a furnace. This insures almost complete combustion of fuel in the chamber and produces a rapidly flowing stream of combustion products. Such stream is intimately mixed with partially cooled gases in the interior of the furnace to thus insure uniformity of temperatures in all zones of the furnace without resorting to any mechanical agitating means. This is desirable in furnaces wherein the temperature is so high that mechanical agitating elements would be destroyed after a short period of use.

In the just described burners, the admission of gaseous fuel and oxygen-containing gas takes place in the axial direction of the combustion chamber. Such mode of admitting gases results in delayed mixing of oxygen with fuel and necessitates the provision of an elongated combustion chamber. This brings about several drawbacks, especially if the chamber must be long enough to insure substantially complete combustion of fuel. Thus, and in order to avoid that the housing of the burner would extend well beyond the furnace walls, the major part of the housing must be recessed into the furnace, i.e., the housing of a burner having an elongated combustion chamber must extend deep into or even through the refractory material of the furnace wall. Repeated heating and cooling of furnace walls produces stresses which act upon the housing of the burner and often cause damage or complete destruction of refractory material which surrounds the combustion chamber. Since the products of combustion in the chamber of the burner are maintained at an elevated pressure, they escape through the resulting cracks to penetrate into the furnace wall and to produce damage by overheating.

In order to avoid such damage to the burner housing and/or to the furnace walls, certain manufacturers prefer to mount the burner in such a way that its housing does not extend into the rear wall of the furnace. This reduces

the likelihood of damage but such burners occupy too much room.

SUMMARY OF THE INVENTION

It is an object of our invention to provide a novel and improved burner which occupies little room even though it insures substantially complete combustion of gaseous fuel and which need not extend well beyond a furnace even if its housing is not recessed into the furnace wall.

Another object of the invention is to provide novel means for admitting and circulating gases in the combustion chamber of the improved burner.

A further object of the invention is to provide a burner for heat-treating furnaces which is capable of effecting substantially complete combustion of fuel but is much shorter than conventional burners.

An additional object of the invention is to provide a novel arrangement for regulating the admission of oxygen and/or fuel into the improved burner.

The burner comprises a housing defining a substantially toroidal combustion chamber and having a discharge opening for evacuation of combustion products from the chamber into the interior of a metallurgical furnace along a path whose cross section diminishes in a direction away from the combustion chamber, gas-admitting means defining a pair of orifices spaced from each other in the axial direction of and communicating with the combustion chamber, a source of oxygen-containing gas connected with one of the orifices, and a source of gaseous fuel connected with the other orifice.

The orifices are preferably annular and are arranged to discharge gases substantially radially outwardly with reference to the axis of the combustion chamber.

In accordance with another feature of our invention, the internal surface of the housing provides a gradual transition between the combustion chamber and the discharge opening.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved burner itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single figure is an axial sectional view of a burner which embodies the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The improved burner comprises a housing which includes an inner portion **1** composed of two matching parts made of fireproof refractory material and an outer portion or shell which is provided with abutting flanges **2**. These flanges are affixed to a metallic liner provided on the rear wall **3** of a metallurgical heat-treating furnace of known design. The inner portion **1** of the housing defines a toroidal combustion chamber **4** which communicates with a discharge opening **5** of gradually decreasing cross section. The opening **5** serves to admit combustion products into the interior of the furnace.

The combustion chamber **4** accommodates the discharge end of a first tubular member **6** which forms part of a gas-admitting means and serves to admit air. This tubular member **6** is spacedly surrounded by a second tubular member or sleeve **7** defining therewith a relatively narrow annular gap for admission of gaseous fuel. The discharge end of the tubular member **6** is provided with an outwardly extending enlarged portion or flange **8** which defines with the discharge end of the sleeve **7** an annular orifice

9 for admission of gaseous fuel into the chamber 4. The orifice 9 is located in a plane which is normal to the axis of the chamber 4 and it discharges gaseous fuel substantially radially against the adjacent concave surface bounding the chamber 4. A plate-like deflector 10 of the gas-admitting means is located in front of the discharge end of the tubular member 6 and defines therewith a second annular orifice 11 for admission of air into the chamber 4. The deflector 10 is mounted on a tubular carrier 12 which extends with clearance through the tubular member 6 and is movable axially to thereby adjust the width of the orifice 11. The tubular member 6 and/or the sleeve 7 is also movable axially to regulate the cross-sectional area of the fuel-admitting orifice 9.

A median portion of the tubular member 6 is surrounded by an annular fuel compartment 13 which constitutes a source of gaseous fuel and receives fuel by way of an inlet 14. The compartment 13 communicates with the intake end of the sleeve 7 and hence with the aforementioned annular clearance between the sleeve and the tubular member 6. A second annular compartment 15 is located at the rear end of the tubular member 6 and is provided with an inlet 16 for air. This second compartment 15 constitutes a source of oxygen-containing gas and communicates with the intake end of the tubular member 6.

When the burner is in operation, the inlets 14, 16 respectively admit gaseous fuel and air into the compartments 13, 15 and the gases flow toward and issue from the orifices 9, 11 to be thoroughly intermixed in the chamber 4. Gases issuing from these orifices flow along the concave surface of the chamber 4 and are caused to circulate in directions which are indicated by arrows 17. The combustion products leave the chamber 4 by way of the discharge opening 5 and enter the interior of the heat-treating furnace. It will be noted that the internal surface of the burner housing provides a gradual transition between the surface surrounding the chamber 4 and the surface surrounding the discharge opening 5. The ratio of fuel and air entering the chamber 4 can be regulated by effecting axial adjustment of the sleeve 7, tubular member 6 and/or tubular carrier 12. It will be noted that the housing 1, 2 of the burner extends only into the rear wall 3 of the furnace but that the burner nevertheless extends only little beyond the outline of the furnace.

The surface surrounding the chamber 4 is of such configuration that the burning mixture of fuel and air returns into the zone adjacent to the orifices 9, 11 after travelling along a relatively short path. The injector-like action of orifices 9, 11 sucks the major part of burning gases into the streams of freshly admitted fuel and air to bring about rapid ignition of the resulting mixture. Such injector-like action also generates considerable turbulence which is another factor that insures rapid and substantially complete combustion of fuel which is admitted by way of the orifice 11. It was found that the improved burner can be operated with fuels which are not readily combustible and that the output on combustion products and heat energy is very high, for example, in the range of 60×60^6 kcal./m.^{3} per hour.

The toroidal configuration of the combustion chamber 4 renders it possible to reduce the overall length of the burner to but a fraction of conventional burners wherein the admission of fuel and oxygen takes place in the axial direction of an elongated combustion chamber. Furthermore, pressures at which the fuel and oxygen are admitted into the chamber 4 can be maintained at about half the pressure required for proper operation of conventional burners. Such reduction of pressures at the orifices 9 and 11 does not reduce the velocity at which the combustion products leave the chamber 4 by way of the discharge opening 5.

Since the air flows through the tubular member 6 which latter extends beyond the orifice 9, the inflowing air cools the parts which define the orifice 9 sufficiently to prevent damage to the burner, even after extensive periods of use. The inflowing air also cools the deflector 10.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A burner for admitting hot combustion products into heat-treating furnaces, comprising a housing defining a substantially toroidal combustion chamber and having a discharge opening for evacuation of combustion products from said chamber; gas-admitting means defining a pair of orifices spaced from each other in the axial direction of and communicating with said chamber, said orifices being arranged to discharge gases substantially radially outwardly with reference to the axis of said chamber; a source of oxygen-containing gas connected with one of said orifices; and a source of gaseous fuel connected with the other orifice, said gas-admitting means comprising a first tubular member having a discharge end in said chamber and an intake end connected with said first mentioned source, deflector means adjacent to and defining with said discharge end said one orifice, and a second tubular member spacedly surrounding said first tubular member and having a discharge end in said chamber and an intake end connected with said last mentioned source, said first tubular member having an enlarged portion adjacent to and defining with the discharge end of said second tubular member said other orifice.

2. A burner as defined in claim 1, wherein the cross-sectional area of said discharge opening diminishes in a direction away from said combustion chamber.

3. A burner as defined in claim 1, wherein said orifices are annular.

4. A burner as defined in claim 1, wherein said housing has an internal surface bounding said combustion chamber and being configurated to bring about circulation of gases issuing from said orifices.

5. A burner as defined in claim 1, wherein said housing has an internal surface providing a gradual transition between said chamber and said discharge opening and wherein the cross-sectional area of said discharge opening diminishes in a direction away from said chamber.

6. A burner as defined in claim 1, wherein said gas-admitting means comprises means for regulating the rate of gas admission by way of at least one of said orifices.

7. A burner as defined in claim 1, wherein at least one of said tubular members is adjustable axially with reference to the other tubular member and with reference to said reflector means.

8. A burner as defined in claim 1, wherein said deflector means is adjustable axially of said tubular members.

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EDWARD G. FAVORS, Primary Examiner

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