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BURNER WITH HIGH FLAME STABILITY, PARTICULARLY FOR THE THERMAL TREATMENT OF CERAMIC ARTICLES

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BURNER WITH HIGH FLAME STABILITY, PARTICULARLY FOR THE THERMAL TREATMENT OF CERAMIC ARTICLES

Technical field

The present invention refers to a burner with high flame stability, particularly for the thermal treatment of ceramic articles.

Background Art

With particular, but not exclusive, reference to the ceramic sector, it is known that the apparatuses for the thermal treatment of articles, such as kilns and dryers, generally use blown-air gas burners for heating the chamber for processing such articles.

Such burners are generally constituted by a supporting body that defines an intake chamber which communicates with a combustion chamber by means of a combustion head. The intake chamber is provided with a port connected to the air supply and runs around a conduit for supplying the combustible gas that ends at the combustion head, which is provided with a plurality of nozzles for the outflow of the combustible gas. The air itself flows freely around the conduit for supplying the gas toward the above-mentioned combustion head, which comprises a diffuser that is provided with a plurality of through openings for orienting the flow of air flowing into the combustion chamber to obtain the mixing with the combustible gas flowing out of the nozzles of the combustion head.

The diffuser of the combustion head is generally constituted by an annular plate that is arranged on a plane perpendicular to the conduit for supplying the combustible gas. A first face of the plate therefore faces the intake chamber, whereas the second face, on the side opposite to the first face, faces the combustion chamber. The above-mentioned openings penetrate the entire thickness of the diffuser, running from the first to the second faces.

At the centre of the diffuser, the combustion head has a tubular element one end of which is joined to the gas supply conduit and the other end of which, facing the combustion chamber, is closed and provided with a plurality of nozzles for the gas to flow out. This tubular element can be integral with the diffuser itself or it can be removably connected to it so as to allow the mounting of alternative connecting elements of different shape according to the type of combustible gas used.

The diffuser is generally provided with a plurality of circular through holes, arranged along at least one circumference proximately to the centre, the respective axes of which

are inclined so as to converge at the extension of the longitudinal axis of the gas supply conduit along the combustion chamber, which permit a linear flow of the air in the combustion chamber.
The diffuser also has a plurality of notches formed on its peripheral region according to planes that are inclined with respect to the longitudinal axis, to give the amount of air that passes through them a helicoidal motion along the combustion chamber.
These burners can be provided with an end conduit that is open at one end, associated with the supporting body and inside which the combustion head is accommodated, and which forms the combustion chamber. There may also be provided, inside the supporting body, a tubular element for conveying the air toward the combustion head.
These burners of the known type are not without drawbacks, among which is the fact that they do not make it possible to obtain an optimal mixing of the air and the combustible gas, particularly with reduced gas flows, thus causing the formation of unburned substances with consequent inefficient yield of the combustion, and they do not ensure stability of the flame in situations where the combustion system operates with gas flows that are near the minimum level. Also, the holes formed proximate to the centre of the diffuser tend to get dirty and become obstructed over time owing to the use of recovered and unfiltered air, thus necessitating periodic maintenance activities and/or replacement and thus exhibiting a rapid decline of performance levels between one intervention and the next. Disclosure of the Invention
The aim of the present invention is to eliminate the above-mentioned drawbacks of the known art, by providing a burner with high flame stability, particularly for the thermal treatment of ceramic articles which makes it possible to obtain an optimal mixing of the air and the combustible gas, independently of the ratio of the supplied flows, and which ensures flame stability even under conditions of operation with minimal gas flows.
Within this aim, an object of the present invention is to be efficient and long-lasting even with the use of recovered hot air.
A further object of the present invention is to provide a simple structure, that is relatively easy and practical to implement, safe to use and effective in operation, and has relatively low costs.
This aim and these and other objects which will become better apparent hereinafter are achieved by the present burner with high flame stability, particularly for the thermal treatment of ceramic articles, comprising a supporting body provided with at least one first port for the inflow of an oxidizing fluid and with at least one second port for the inflow of a combustible fluid, and a combustion head which is associated with said supporting body and is provided, in its central region, with nozzle means which are associated with said second port, for the outflow of the combustible fluid in a combustion region and, in its peripheral region, with an annular diffuser provided with a plurality of through openings for orienting the flow of the oxidizing fluid toward the combustion region, characterized in that at least one of said openings comprises a slot, which is provided inside said diffuser and has an extension along a first transverse dimension that is substantially larger than the extension along a second direction transverse to the first direction.
Brief description of the drawings
Further characteristics and advantages of the present invention will become better apparent from the following detailed description of a preferred, but not exclusive, embodiment of a burner with high flame stability, particularly for the thermal treatment of ceramic articles, illustrated by way of non-limiting example in the accompanying drawings, wherein:
Figure 1 is a schematic perspective projection view of a burner according to the invention;
Figure 2 is a schematic longitudinal cross-section view of the burner of Figure 1 ;
Figure 3 is a schematic perspective projection view of the combustion head of the burner according to the invention;

Figure 4 is a schematic front view of the diffuser of the combustion head of the burner according to the invention;
Figure 5 is a schematic plan view of the diffuser of Figure 4.
Ways of carrying out the Invention
With reference to the figures, the reference numeral 1 generally designates a burner with high flame stability, particularly for the thermal treatment of ceramic articles.
Indeed, the burner 1 is specifically designed for application in apparatuses for the thermal treatment of ceramic articles, such as kilns and dryers.
The burner 1 comprises a supporting body 2 that is internally hollow so as to form an intake chamber 3.
The supporting body 2 is provided with at least one first port 4 for the inflow of an oxidizing fluid and with at least one second port 5 for the inflow of a combustible fluid.
The first port 4 can be connected to a ventilation system for blowing the oxidising fluid, generally constituted by air, possibly recycled by the same apparatus in which the burner 1 is applied.
The combustible fluid is preferably in the gaseous state such as methane and the like.
The supporting body 2 is fixed to a flange 6 for fixing to the structure of the apparatus to which the burner 1 is applied.
The burner 1 also comprises a combustion head 7 which is provided, in its central region, with nozzle means 8 which are associated with the second port 5, for the outflow of the combustible fluid in a combustion region 9 by way of means 10 for supplying such fluid.
The supply means 10 are substantially constituted by a conduit 11 which is inserted passing through the inside of the supporting body 2 and around which the intake chamber 3 runs.
The conduit 11 has a first end joined to the second port 5 and a second end, opposite to the first, connected to the nozzle means 8. In the present description the longitudinal axis A of the burner 1 is intended to be the axis along which the conduit 11 runs.
The nozzle means 8 comprise a terminal element 12 that is substantially cylindrical, one end of which is open and connected to the second end of the conduit 11 and the other end of which is closed. Proximate to the closed end, on the side wall of the terminal element 12, a plurality of holes 13 are formed which are radially oriented and distributed along a circumference, for the outflow of the combustible fluid.
The combustion head 7 also comprises, at its peripheral region, an annular diffuser 14 which is provided with a plurality of through openings 15 for orienting the flow of oxidizing fluid which, from the intake chamber 3, arrives in the combustion area 9 by passing through the openings.
The plane of the diffuser 14 is perpendicular with respect to the longitudinal axis A.
At least one of the openings 15 comprises a slot 15a which has a closed perimeter and is formed inside the diffuser 14, which has an extension along a first direction that is substantially larger than the extension along a second dimension that is transverse to the first.
Advantageously, the elongated shape of the slot 15a makes it possible to reduce the losses of head by the oxidizing fluid, with respect to traditional combustion heads, ensuring an adequate capacity and flow speed of the fluid. Also, the width of the slot 15a reduces the phenomena of its pollution and its obstruction, thus making it possible to supply the burner 1 with recovered and unfiltered air without necessitating frequent interventions to clean and/or replace the combustion head 7.
The closed end of the terminal element 12 protrudes axially toward the combustion area 9 with respect to the diffuser 14, so that the holes 13 are positioned forward with respect to the diffuser 14 . to ward the combustion area.
More precisely, the diffuser 14 is provided with a first group of openings 15 arranged proximate to the nozzle means 8 which comprise the above-mentioned slot 15a which is shaped so as to define an arc of circumference centred on the longitudinal axis A.
This slot 15a has an angular extension of between 90[deg.] and 150[deg.] and preferably

120[deg.].
Also, the slot 15a is formed according to a conical wall that converges on the longitudinal axis A, at the combustion area 9, with an angle comprised between 2[deg.] and 5[deg.], so as to orient the flow of oxidizing fluid toward this axis.
Preferably, two of the above-mentioned slots 15a of this first group of openings 15 are arranged on diametrically opposite sides of the nozzle means 8 and a plurality of through holes 15b are interposed between them and are distributed along the circumference traced by the slots.
The through holes 15b are also formed according to axes that are inclined with respect to the longitudinal axis A, with the above-mentioned angle comprised between 2[deg.] and 5[deg.] and converging on the combustion area 9.
The passage through the slots 15a and the through holes 15b gives the flow of oxidising fluid a linear progression.
Advantageously, the diffuser 14 is also provided with a second group of openings 15 which are formed at its peripheral region and each of which is constituted by a notch 15c that is formed according to a plane which is inclined with respect to the plane of the diffuser at an angle comprised between 30[deg.] and 60[deg.] and preferably 45[deg.].
These notches 15c orient the flow of the oxidizing fluid that passes through them with a helicoid motion, thus optimising the mixing in the combustion area 9.
It should be noted that the burners 1 are designed to be mainly used in apparatuses that are provided with systems for fixed-flow ventilation of the oxidizing fluid (air) and systems for variable-flow distribution of the combustible fluid. What must therefore be obtained is a flow of oxidizing fluid in the combustion area 9 that is adapted to ensure a supply of oxygen sufficient to achieve a complete combustion for any flow of combustible fluid. Moreover, if recovered hot air is used as the oxidizing fluid, flows of greater volumes must be supplied than in the case where clean air is used, so as to obtain the same supply of oxygen in the combustion area 9.
In this regard the geometry of the diffuser 14 has been optimised and, preferably, the set of notches 15c affects a portion that is equal to 20%-30% (preferably 25%) of the annular surface of the diffuser.
It should be noted that, given the inclination of the notches 15c, the maximum circumferential width must be determined in relation to the thickness of the diffuser 14 to prevent the direct passage of the flow of oxidizing fluid in the axial direction.
The burner 1 , in this embodiment, allows a combined mixing, axial and centrifugal, in the combustion area 9.
The possibility is not excluded, however, that the diffuser 14 is provided with openings 15 which are exclusively of the slot 15a type, thus obtaining a mixing that is purely axial.
The burner 1 is also provided with an ignition electrode 16 and with a sensor 17 for monitoring the combustion, both traditional in type and, therefore, not described in detail.
The ignition electrode 16 and the monitoring sensor 17 are arranged in alignment with the longitudinal axis A and are inserted through the diffuser 14 in respective through seats 18, terminating at the combustion area 9.
In one of the holes 15b a metal rung, which is not shown, can be inserted, which protrudes toward the combustion area 9, and cooperates with the ignition electrode 16 for the maintenance of the flame.
The burner 1, preferably, has a tubular element 19 for confining the combustion area 9, which is associated with the supporting body 2 and along which the combustion head 7 is arranged.
The tubular element 19 extends along the longitudinal axis A and its open end 20 is designed to be arranged inside the heated chamber of the apparatus in which the burner 1 is mounted.
The longitudinal positioning of the combustion head 7 along the tubular element 19 can be different, i.e. nearer to or farther from the open end 20, according to the needs of the specific application. Also, means can be provided for adjusting the longitudinal position of

the combustion head 7 along the tubular element 19, which are not shown in the figures.
The burner 1 can also have a conveyance element 21 which is associated inside the supporting body 2 so as to direct the flow of the oxidizing fluid toward the diffuser 14.
This conveyance element 21 can be constituted by a tubular jacket which is arranged inside the intake chamber 3 along the longitudinal axis A and extends inside the tubular element 19, with one end connected to the bottom 2a of the supporting body 2 and the other end fitted over the diffuser 14.
At the first port 4 the side wall of the conveyance element 21 has a plurality of slits 22 that are distributed annularly to allow the passage of the flow of oxidizing fluid from the first port 4 toward the diffuser 14 by passing, successively, through the intake chamber 3, the slits 22, the inside of the conveyance element 21. In an alternative embodiment, which is not shown, the conveyance element 21 can be fixed to the supporting body 2 at the flange 6, leaving the intake chamber 3 free, and have a plurality of slits 22 which are annularly distributed so as to allow the passage of the flow of oxidizing fluid from the intake chamber 3 to the gap formed between the outside wall of the conveyance element and the inside wall of the tubular element 19. In this way it is possible to obtain the venting of any excess oxidizing fluid, according to the losses of head that have occurred in the passage through the openings 15, thus avoiding flame detachment phenomena which could occur if the flow of oxidizing fluid reaches the combustion area 9 with an excessive speed, and the tubular element 19 is cooled.
In practice it has been found that the burner according to the invention as described achieves the intended aim and objects and, in particular, attention is drawn to the fact that the burner according to the invention ensures flame stability under any condition of operation and enables an optimal mixing of air and combustible gas and, therefore, a combustion process that is efficient.
Also, the burner is particularly adapted to be used in systems for ceramics that execute drying or firing processes and which supply fixed-flow recovered air.
The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.
In addition, all the details can be replaced by other technically equivalent elements.
In practice the materials employed, as well as the contingent dimensions and shapes, may be any according to requirements, but without for this reason leaving the scope of protection of the appended claims.
The disclosures in Italian Patent Application No. MO2010A000087 from which this application claims priority are incorporated herein by reference. Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.