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(54) **Gas burner, particularly for metallurgic furnaces**

Gasbrenner, insbesondere für metallurgische Öfen

Brûleur à gaz, en particulier pour des fours métallurgiques

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DE-A- 1 529 163 **DE-A- 2 033 117**
FR-E- 79 283 **GB-A- 1 420 047**

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Description

[0001] The present invention is related to gas burners, particularly but not exclusively intended to be applied to metallurgic furnaces for continuous heating of metal pieces, for instance billets or bars. These burners traditionally comprise a tubular body provided with passages for the supply of a combustible gas and air and forming a combustion head including an outflow nozzle of the combustible mixture towards a flame outlet. Such a burner is disclosed in DE-A-1 529 163.

[0002] The object of the present invention is to provide a gas burner of the above-referenced type having enhanced performance in terms of a more efficient development of the flame under high temperature, greater flame stability and low combustion noise.

[0003] According to the invention, this object is achieved essentially by the fact that the outflow nozzle of the combustion head is formed by a hollow member having an at least in part conical outer surface, converging towards the flame outlet, on which a circumferential series of axial grooves is formed which are outwardly closed by the inner wall having a complementary conical surface of the tubular body so as to define outflow channels progressively tapered towards said flame outlet, said channels communicating with respective oblique passages formed through said tubular member and opening into a crown of front holes arranged, coaxially with the cavity of said hollow member, on the outer end thereof facing towards said flame outlet.

[0004] Subordinatedly, the invention contemplates further geometrical and shape features of the above outflow nozzle.

[0005] According to a further development of the invention, the tubular body of the burner defines, upstream of said combustion head, a combustible gas and air mixing section, containing a circular mixer member having a radially outer coaxial crown of larger diameter through holes communicating with said air supply passage, and a radially inner coaxial crown of smaller diameter through holes communicating, through a central tubular connector element of said mixer member, with said combustible gas supply passage.

[0006] The invention further provides peculiar arrangements of said through holes of the outer crown and of the inner crown of the mixer member.

[0007] By virtue of the above features, the gas burner according to the invention enables achieving, as compared with the traditional gas burners, a series of important advantages which are summarized herebelow:

- high range of thermal load,
- enhanced flame development at high temperature,
- high heating speed,
- optimum flame stability,
- wide rate-of-flow ratio between the minimum and maximum values,
- wide air/gas combustion ratio,

- low combustion noise.

[0008] The invention will now be disclosed in detail with reference to the accompanying drawings, purely provided by way of non limiting example, in which:

- figure 1 is a diagrammatic perspective and partially sectioned view of a gas burner according to the invention, applied to a metallurgic furnace,
- figure 2 is a longitudinally sectioned and enlarged view of a part of the gas burner of figure 1,
- figure 3 is a diagrammatic perspective view of a component of the gas burner,
- figure 4 is a perspective view of a second component of the gas burner,
- figure 5 is a front elevational view of figure 4,
- figure 6 is an axially sectioned view along line VI-VI of figure 5,
- figure 7 shows a variant of figure 5, and
- figure 8 is an axially sectioned view along line VIII-VIII of figure 7.

[0009] Referring initially to figure 1, reference numeral 1 generally designates a gas burner according to the invention, applied to a wall P, made of a refractory material, delimiting a longitudinal heating chamber of a metallurgic furnace, for instance designed for continuous heating of steel bars. The burner 1 is fitted in correspondence of a transverse passage H of the wall P, communicating with the heating chamber of the furnace and having a substantially cylindrical outer portion H1 followed by a conical surface inner portion H2, diverging towards the heating chamber.

[0010] The burner 1 is fitted in correspondence of the inner cylindrical portion H1 and is adapted to produce and direct the flame, through the conical surface portion H2, towards the heating chamber of the furnace.

[0011] Naturally the furnace shall be provided with a plurality of these gas burners 1, for instance arranged along each lateral wall of the heating chamber over two superimposed rows, with the burners of one row offset with respect to the burners of the other row, according to what is disclosed and illustrated in Italian patent application IT-A-TO95A001049.

[0012] The gas burner 1 essentially comprises a tubular body 2 defining an initial supply section 3, an intermediate combustible gas/air mixing section 4 and a final section defining a combustion head 5 housed within the portion H1 of the passage H.

[0013] The initial supply section 3 comprises a radial tubular connector 6 connected, through a duct 7, with a manifold not shown in the drawings for the supply of air, and an axial-radial tubular connector 8 connected, through a duct 9, with a manifold not shown in the drawings for the supply of the combustible gas. The connector 8 is not directly communicating with the initial section 3, but is connected to an inner axial tube 10 whose end facing towards the combustion head 5 is secured to a

mixing member 11, which shall be disclosed in detail in the following with reference to figures 4 through 8.

[0014] The terminal portion of the tubular body 2 defining the combustion head 5 has an inner wall with an initial section having a cylindrical surface 12, of a shorter length, followed by a surface having a conical surface 13, converging towards the passage H, of a greater length.

[0015] Within the cavity of the portion 5, whose free end defines a flame outlet 15, an outflow nozzle 16 of the combustible mixture is axially fitted and locked in a releasable fashion by means of radial screws 14.

[0016] As it can be better seen in figures 2 and 3, this outflow nozzle 16 is formed by a hollow member having an initial portion 17 with an outer cylindrical surface of a lower diameter than the initial cylindrical section 12 of the portion 5, and a portion with a conical outer surface 18 complementary to the section 13 of the portion 5. Its inner cavity has an initial section with a conical inner surface 19, converging towards the flame outlet 15, followed by a cylindrical section 20.

[0017] The conical outer surface 18 is formed with a circumferential series of axial grooves 21, which are outwardly closed by the conical inner surface of the section 13 of the portion 5, so as to define outflow channels progressively tapering towards the flame outlet 15. These channels are evidently communicating, in correspondence of the larger ends thereof, with the interior of the cylindrical wall section 12, and thus with the mixing section 4 of the tubular body 2, while at the opposite ends these channels are communicating with respective oblique passages 22 formed through the wall of the hollow member 16 and converging towards the flame outlet 15. The oblique passages 22 open into a crown of front holes 23 provided, coaxially with the cavity of the hollow member 16, on the outer end 24 of the latter facing towards the flame outlet 15. This outer end 24 has a slightly recessed design, namely is provided with a conical surface diverging towards the flame outlet 15.

[0018] Referring now in more detail to figures 4 through 6, the mixer member 11 has a generally circular design and is coaxially fitted within the outer end of the portion 4 of the tubular body 2. The mixer member 11 is provided with a radially outer coaxial crown of through holes 25 having a larger diameter, communicating with the air supply connector 6, and with a radially inner coaxial crown of through holes 26 having a smaller diameter, communicating with a central tubular connecting element 27 in turn connected, for instance by means of a threaded coupling, to the combustible gas supply duct 10. The holes 26, which open into a frusto-conical central portion 28 of the mixer member 11, are diverging with respect to the axis thereof, in the direction of the flame outlet 15. As clearly depicted in figure 5, the through holes 25 of the outer crown and the through holes 26 of the inner crown are alternatively offset relative to one another. Moreover the holes 25 of the outer crown may be directed parallelly to the axis of the mixer

member 11, and thus of the tubular body 2 as in the case shown in figures 1, 2, 4, 5 and 6, or they can be inclined, namely obliquely diverted in clockwise direction (or counterclockwise direction) with respect to the axis of the mixer member 11, as in the case of the variant shown in figures 7 and 8. In the latter case, also the holes 26 of the inner crown may be inclined, namely diverted obliquely with respect to the axis of the mixer member 11 in the opposite direction, i.e. in a counterclockwise (or, respectively, clockwise) direction.

[0019] When the above disclosed burner 1 is operating, air supplied through the duct 7 and the connector 6 passes through the holes 25 of the mixer member 11, while the gas fed through the duct 9, the connector 8 and the tube 10 passes through the holes 26 of the mixer member 11. Gas and air are thus mixed together within the section 4 of the tubular body 2, along either axial or helical or rotating flows, depending on whether these holes 25 and 26 are directed axially or, respectively, are inclined. The combustible mixture then reaches the combustion head 5, splitting into a central flow going axially through the conical section 19 and the cylindrical section 20 of the cavity of the outflow nozzle 16, and a crown of peripheral flows which travel along the channels 21 and reach the oblique passages 22. The central flow and the peripheral flows are progressively accelerated and conveyed towards the flame outlet 15, where the combustible mixture reaches the maximum speed. Accordingly the flame produced in correspondence of the flame outlet 15 is particularly stable, with a very high thermal load range and a remarkably reduced combustion noise.

[0020] Naturally the details of construction and the embodiments may be widely varied with respect to what has been disclosed and illustrated, without thereby departing from the scope of the present invention, such as defined in the appended claims. Thus, for instance, the combustion head 5 and the related outflow nozzle 16 may be provided with a swinging construction, for instance according to what is disclosed and illustrated in Italian patent application IT-A-TO95A001048, so as to enable adjusting the orientation of the flame outlet 15 at least in a plane passing through the axis of the tubular body 2.

Claims

1. Gas burner (1), particularly for metallurgic furnaces, comprising a tubular body (2) provided with combustible gas and air supply passages (10, 3) and forming a combustion head (5) including an outflow nozzle (16) of the combustible mixture towards a flame outlet (15), wherein the outflow nozzle (16) is formed by a hollow member having an at least in part conical outer surface (18), converging towards the flame outlet (5), on which outer surface (18) a circumferential series of axial grooves (21) is

formed which are outerly closed by the inner wall having a complementary conical surface (13) of said tubular body (2) so as to define outflow channels (21) progressively tapered towards said flame outlet (15), said channels (21) communicating with

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2. Gas burner according to claim 1, characterized in that the cavity of said hollow member (16) has an initial portion (19) with a conical inner surface converging towards the flame outlet (15), followed by a

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3. Gas burner according to claim 1 or claim 2, characterized in that the outer surface of said hollow member (16) has an initial cylindrical portion (17) of a reduced diameter.

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4. Gas burner according to any of claims 1 to 3, characterized in that said outer end (24) of the hollow member (16) onto which said front holes (23) are opening has a conical surface diverging towards

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5. Gas burner according to any of claims 1 through 4, characterized in that said hollow member (16) is releasably secured within said combustion head (5).

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6. Gas burner according to one or more of claims 1 through 5, characterized in that the tubular body (2) of the burner (1) defines, upstream of said combustion head (5), a combustible gas and air mixing section (5) containing a circular mixing member (11) having a radially outer coaxial crown of larger diameter through holes (25) communicating with said air supply passage (6, 7), and a radially inner coaxial crown of smaller diameter holes (26) communicating, through a central tubular connector element (27) of said mixing member (11), with said combustible gas supply passage (8, 9, 10).

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7. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) are oriented parallelly to the axis of the mixing member (11).

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8. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) are inclined with respect to the axis of the mixing member (11).

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9. Gas burner according to claim 6, characterized in that said through holes of the inner crown (26) are converging towards said combustion head (5).

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10. Gas burner according to claim 6, characterized in that said through holes of the inner crown (26) are inclined with respect to the axis of the mixer member (11).

11. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) and said through holes of the inner crown (26) are alternatively offset relative to one another.

Patentansprüche

1. Gasbrenner (1), besonders für metallurgische Öfen, der einen röhrenförmigen Körper (2), bereitgestellt mit Brenngas- und Luftversorgungsdurchgängen (10, 3) umfasst und einen Brennerkopf (5) bildet, welcher eine Ausflußdüse (16) des brennbaren Gemisches in Richtung eines Flammenabzugs (15) einschließt, wobei die Ausflußdüse (16) durch ein Hohlelement mit wenigstens teilweise konischer Außenfläche (18), welche in Richtung des Flammenabzugs (15) zusammenläuft, auf dessen Außenfläche (18) eine umlaufende Reihe von axialen Rillen (21) gebildet ist, die von außen durch die innere Wand mit einer komplementären, konischen Oberfläche (13) des röhrenförmigen Körpers (2) abgeschlossen sind, um so die in Richtung Flammenabzug (15) zunehmend verjüngten Ausflußkanäle (21) zu begrenzen, wobei die Kanäle (21) mit den durch das Hohlelement gebildeten, entsprechenden, schrägen Durchgängen (22) in Verbindung stehen und sich in einen Kranz von Vorderlöchern (23) öffnen, die, coaxial zu dem Hohlraum des Hohlelements (16), auf dem äußeren Ende (24) angeordnet sind und damit in Richtung des Flammenabzugs (15) zeigen.

2. Gasbrenner gemäß Anspruch 1, dadurch gekennzeichnet, dass der Hohlraum des Hohlelements (16) einen Anfangsbereich (19) mit einer konischen Innenfläche hat, der in Richtung Flammenabzug (15) zusammenläuft und dem sich ein zylindrischen Bereich (20) anschließt.

3. Gasbrenner gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Außenfläche des Hohlelements (16) einen zylindrischen Anfangsbereich (17) mit einem reduzierten Durchmesser hat.

4. Gasbrenner nach irgendeinem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass das äußere Ende (24) des Hohlelements (16), auf dem sich die vorderen Löcher (23) öffnen, eine konische, in Richtung Flammenabzug (15) auseinanderlaufende Oberfläche hat.

5. Gasbrenner gemäß irgendeinem der Ansprüche 1

bis 4, dadurch gekennzeichnet, dass das Hohlelement (16) innerhalb des Brennerkopfes (5) lösbar gesichert ist.

6. Gasbrenner gemäß irgendeinem der Ansprüche 1 bis 5, dadurch gekennzeichnet, dass der röhrenförmige Körper (2) des Brenners (1), stromaufwärts des Brennerkopfes (5), einen Brenngas- und Luftmischbereich (5) begrenzt, enthaltend ein rundes Mischelement (11) mit einem radialen äußeren, koaxialen Kranz von Durchgangslöchern mit größerem Durchmesser (25), welche mit dem Luftversorgungsdurchgang (6, 7) in Verbindung stehen, und einem radialen inneren koaxialen Kranz von Durchgangslöchern mit kleinerem Durchmesser (26), welche durch ein zentrales, röhrenförmiges Verbindungselement (27) des Mischelements (11) mit dem Brenngasversorgungsdurchgang (8, 9, 10) in Verbindung stehen. 5
7. Gasbrenner gemäß Anspruch 6, dadurch gekennzeichnet, dass die Durchgangslöcher des äußeren Kranzes (25) parallel zu der Achse des Mischelements orientiert sind. 10
8. Gasbrenner gemäß Anspruch 6, dadurch gekennzeichnet, dass die Durchgangslöcher des äußeren Kranzes (25) in Bezug auf die Achse des Mischelements (11) geneigt sind. 15
9. Gasbrenner gemäß Anspruch 6, dadurch gekennzeichnet, dass die Durchgangslöcher des inneren Kranzes (26) in Richtung des Brennerkopfes (5) zusammenlaufen. 20
10. Gasbrenner gemäß Anspruch 6, dadurch gekennzeichnet, dass die Durchgangslöcher des inneren Kranzes (26) in Bezug auf die Achse des Mischelements (11) geneigt sind. 25
11. Gasbrenner gemäß Anspruch 6, dadurch gekennzeichnet, dass die Durchgangslöcher des äußeren Kranzes (25) und die Durchgangslöcher des inneren Kranzes (26) abwechselnd zu einander versetzt sind. 30

Revendications

1. Brûleur à gaz (1), destiné notamment à des fours métallurgiques, comprenant un corps tubulaire (2) ayant des passages (10, 3) d'alimentation en gaz combustible et en air et formant une tête de combustion (5) qui comprend une buse (16) de circulation de sortie du mélange combustible vers une sortie de flamme (15), dans lequel la buse (16) de circulation de sortie est formée par un organe creux ayant au moins une surface externe partiellement 50

conique (18) qui converge vers la sortie de flamme (5), une série circonférentielle de gorges axiales (21) étant formées sur la surface externe (18) et étant fermées vers l'extérieur par la paroi interne qui a une surface conique complémentaire (13) de celle du corps tubulaire (2) afin que des canaux (21) de circulation de sortie soient délimités et aient une dimension qui varie progressivement vers la sortie de flamme (15), les canaux (21) communiquant avec des passages obliques respectifs (22) formés dans l'organe creux (16) et débouchant par une couronne de trous avant (23) disposés coaxialement à la cavité de l'organe creux (16) à son extrémité externe (24) tournée vers la sortie de flamme (15). 15

2. Brûleur à gaz selon la revendication 1, caractérisé en ce que la cavité de l'organe creux (16) possède une partie initiale (19) ayant une surface interne conique qui converge vers la sortie de flamme (15), suivie d'une partie cylindrique (20). 20
3. Brûleur à gaz selon la revendication 1 ou 2, caractérisé en ce que la surface externe de l'organe creux (16) a une partie cylindrique initiale (17) de diamètre réduit. 25
4. Brûleur à gaz selon l'une quelconque des revendications 1 à 3, caractérisé en ce que l'extrémité externe (24) de l'organe creux (16) sur laquelle débouchent les trous avant (23) a une surface conique qui diverge vers la sortie de flamme (15). 30
5. Brûleur à gaz selon l'une quelconque des revendications 1 à 4, caractérisé en ce que l'organe creux (16) est fixé de façon amovible dans la tête de combustion (5). 35
6. Brûleur à gaz selon une ou plusieurs des revendications 1 à 5, caractérisé en ce que le corps tubulaire (2) du brûleur (1) délimite, en amont de la tête de combustion (5), une section (5) de mélange de gaz combustible et d'air qui contient un organe circulaire de mélange (11) ayant une couronne externe coaxiale radialement de trous débouchants (25) de diamètre relativement grand communiquant avec le passage d'alimentation en air (6, 7), et une couronne interne coaxiale radialement de trous (26) de diamètre relativement petit communiquant par un élément tubulaire central de connecteur (27) de l'organe de mélange (11) avec le passage d'alimentation en gaz combustible (8, 9, 10). 40
7. Brûleur à gaz selon la revendication 6, caractérisé en ce que les trous débouchants de la couronne externe (25) sont orientés parallèlement à l'axe de l'organe de mélange (11). 45

8. Brûleur à gaz selon la revendication 6, caractérisé en ce que les trous débouchants de la couronne externe (25) sont inclinés par rapport à l'axe de l'organe de mélange (11).

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9. Brûleur à gaz selon la revendication 6, caractérisé en ce que les trous débouchants de la couronne interne (26) convergent vers la tête de combustion (5).

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10. Brûleur à gaz selon la revendication 6, caractérisé en ce que les trous débouchants de la couronne interne (26) sont inclinés par rapport à l'axe de l'organe mélangeur (11).

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11. Brûleur à gaz selon la revendication 6, caractérisé en ce que les trous débouchants de la couronne externe (25) et les trous débouchants de la couronne interne (26) sont décalés en alternance les uns par rapport aux autres.

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