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(54) A BURNER AND A PROCESS FOR THE GASIFICATION OF A SOLID FUEL

BRENNER UND VERFAHREN ZUR VERGASUNG EINES FESTEN BRENNSTOFFS

BRÛLEUR ET PROCÉDÉ POUR LA GAZÉIFICATION D'UN COMBUSTIBLE SOLIDE

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(73) Proprietor: **AIR PRODUCTS AND CHEMICALS, INC.**
Allentown, PA 18195-1501 (US)

(72) Inventor: **DISSELHORST, Johannes Hermanus Maria**
NL-1031 HW Amsterdam (NL)

(74) Representative: **SSM Sandmair**
Patentanwälte Rechtsanwalt Partnerschaft mbB
Joseph-Wild-Straße 20
81829 München (DE)

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Description

FIELD OF THE INVENTION

[0001] The invention is directed to a burner for the gasification of a solid fuel. The burner is particularly suitable for use in the gasification of carbonaceous fuels, such as finely divided solid fuel carried by a gas carrier, e.g., pulverized coal carried by a gas carrier such as nitrogen gas and/or carbon dioxide, using an oxygen-containing gas, e.g., for producing pressurized synthesis gas, fuel gas or reducing gas.

BACKGROUND OF THE INVENTION

[0002] Gasification of a solid carbonaceous fuel is obtained by the reaction of the fuel with oxygen. The fuel mainly contains carbon and hydrogen as combustible components. The gas-carried finely divided carbonaceous fuel and the oxygen- containing gas are passed via the separate channels in the burner into a reactor at relatively high velocity. In the reactor a flame is maintained in which the fuel reacts with the oxygen in the oxygen-containing gas at temperatures above 1300 °C to form mainly carbon monoxide and hydrogen.

[0003] Various burner designs have been proposed in the prior art. EP-A-328794 describes a burner wherein finely divided coal is supplied to a burner front via a central channel disposed along the longitudinal axis of the burner, and oxygen-containing gas is supplied via at least one annular channel surrounding said central channel. The oxygen is directed into the flow of coal at the burner front.

[0004] EP-A-130630 describes a burner wherein at the burner front, an oxygen containing gas is discharged from a central channel at high velocity and an oxygen containing gas is discharged from an annular outlet at a lower velocity. A solid fuel is discharged from a number of outflow openings located between said central and annular oxygen outlet openings. According to this publication, the outer low velocity oxygen stream serves to protect the burner against overheating due to suction of hot gasses. The publication discloses that if the burner is used for large throughputs, the outlet openings for the solid fuel are preferably not of an annular shape. It is stated that such a design would not result in a proper contact of all the solid fuel particles with oxygen.

[0005] The burner type according to EP-A-328794 has been used commercially with great success. However, at high throughputs the heat-flux to the burner front increases to such values that burner lifetimes may become too short.

[0006] EP-A-130630 addresses the issue of heat flux to the burner front by applying a low velocity oxygen shield around the flame. A disadvantage of the burner according to EP-A-130630 is that for high throughputs, the solid fuel is passed through separate channels to the burner front, which may cause erosion problems. Another problem is the complexity of the design due to the fact that one metal piece with multiple channels for solid fuel and oxygen containing gas needs to be manufactured. Moreover, the heat flux to the burner front can still be very high due to synthesis gas / oxygen flame.

[0007] EP-A-0108427 is directed to a Process and burner for the partial combustion of a finely divided solid fuel with oxygen. A core of oxygen or oxygen-containing gas and an annulus of finely divided solid fuel surrounding said core are introduced into a reactor space via a burner. The solid fuel is centrally introduced into the burner, whereas oxygen or oxygen-containing gas is separately introduced into the burner outside the central solid fuel. In the burner the solid fuel is caused to flow outwardly and the oxygen or oxygen-containing gas is caused to flow inwardly for supplying the solid fuel as an annulus around the oxygen or oxygen-containing gas into the reactor space.

SUMMARY OF THE INVENTION

[0008] The following burner aims at providing a burner which can be used for high throughputs and which does not have the disadvantages of the prior art burners:

a burner for the gasification of a solid fuel, comprising a burner front having an opening for discharging a solid fuel and one or more openings for discharging an oxygen containing gas, wherein the opening for discharging the solid fuel is fluidly connected to a central passage way and wherein the opening for discharging the oxygen containing gas is fluidly connected to an annular passage way for passage of oxygen; and

wherein the central passage way has a downstream part wherein the diameter of the passage way increases over a first length and subsequently decreases over a second length terminating at the burner front and wherein inside the downstream part of the central passage way, a hollow member is positioned that is closed at one end and has an opening at the burner front, the hollow member having an increasing diameter and decreasing diameter aligned with the increasing and decreasing diameter of the central passage way to form an annular passage for the solid fuel terminating at burner front in a inwardly directed annular opening for discharging the solid fuel; and

wherein the hollow member is fluidly connected with the annular passage way for the oxygen containing gas by means of one or more connecting conduits and wherein the opening of the hollow member forms at least a part of the opening for discharging the oxygen containing gas.

[0009] The invention is also directed to a process to prepare a mixture comprising hydrogen and carbon monoxide by means of gasification of a solid fuel using a burner as above, wherein an oxygen containing gas is

passed through the passageway for oxygen containing gas, a solid fuel and a carrier gas are passed through a central passage and gasification takes place at the burner front.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Applicants found that in contrast to the teachings of EP-A-130630, a burner can be provided for high throughput operation which has an annular opening for the solid fuel. By directing all the oxygen through the one or more openings for oxygen containing gas, a sufficient contact with the solid fuel is achieved. Detailed computer simulations predict that the flame will be somewhat lifted from the burner front. This greatly decreases the heat flux to the burner front and thereby extends the lifetime of said burner front and the lifetime of the rim separating the annular passage for the solid fuel and the one or more openings for discharging the oxygen containing gas.

[0011] The burner according to the invention does not have the outer annular outlet for discharging an oxygen containing gas at a lower velocity as in the burner according to EP-A-130630. Because of the alignment in dimensions of the hollow member and the central passageway a flow path for the solid fuel results, which limits erosion.

[0012] The term 'oxygen-containing gas' as used herein is intended to refer to gas containing free oxygen, O_2, and to include air, oxygen-enriched air (i.e., more than 21 mole % oxygen) and also substantially pure oxygen (i.e., more than about 95 mole % oxygen), with the remainder comprising gases normally found in air such as nitrogen, and/or rare gases.

[0013] The term 'solid carbonaceous fuel' as used herein is intended to include various, gas carried, combustible materials and mixtures thereof from the group of coal, coke from coal, coal liquefaction residues, petroleum coke, soot, biomass, and particulate solids derived from oil shale, tar sands and pitch. The coal may be of any type, including lignite, sub-bituminous, bituminous and anthracite. The solid carbonaceous fuels are preferably ground to a particle size so that at least about 90% by weight of the material is less than 90 microns and moisture content is less than about five per cent by weight. The solid fuel is supplied to the burner in admixture with a carrier gas, preferably nitrogen or carbon dioxide.

[0014] The term high capacity burner as used herein is intended to include a process wherein more than 3 kg/sec of solids is discharged from the annular opening. The width of the annular opening of such a high capacity burner is preferably more than 4 mm. The preferred velocity of solids as discharged from the annular opening is between 5 and 15 m/s.

[0015] The opening for oxygen containing gas is a central opening arranged at a distance upstream of the burner front as defined in claim 1. With non-vertical burners, in particular with horizontal burners, such a retracted opening reduces the risk of blockage by slag flowing down from the burner front.

[0016] In a further specific embodiment, the opening may comprise a plurality of openings, which can for instance be coaxial. Such an arrangement may for example include a central opening at the end of a low velocity conduit, and an annular opening at the end of a high velocity conduit, the annular opening being surrounded by the inwardly directed annular opening for discharging the solid fuel. In such an arrangement, mixing of oxygen and fuel is completed at a substantially shorter distance from the burner front. Optionally, the longitudinal axis of the central conduit can be offset from the longitudinal axis of the annular conduit, e.g., the central conduit may be offset downwardly relative to the center of the annular channel. With horizontal burners, this compensates for the effect of gravity on the uniformity of the solid fuel outflow. With such a burner arrangement the central opening may for example discharge oxygen containing gas with a velocity of between 10 and 30 m/s, while the annular opening around the central opening discharges oxygen containing gas with a velocity of between 30 and 100 m/s, and the fuel discharged from the annular opening is discharged at a velocity of between 5 and 15 m/s.

[0017] In a further specific embodiment, the opening for oxygen containing gas may comprise one or more openings with a longitudinal axis at a distance from the longitudinal axis of the fuel discharge opening. More particularly, the opening may be at a distance below the center point of the fuel discharge opening. With horizontal burners, this compensates for the effect of gravity on the uniformity of the fuel outflow.

[0018] The burner is particularly suitable for carrying out a process to prepare a mixture of hydrogen and carbon monoxide by means of gasification of a solid fuel, wherein an oxygen containing gas is passed through the passageway, a solid fuel and a carrier gas is passed through the central passage and gasification takes place at the burner front.

BRIEF DESCRIPTION OF THE FIGURES

[0019]

Figure 1 shows a longitudinal section of the front part of a first exemplary embodiment of a burner;
Figure 2 shows a cross-sectional section AA' of the burner of Figure 1;
Figure 3 shows a longitudinal section of the front part of a burner according to a comparative example;
Figure 4 shows a longitudinal section of the front part of a burner according to a comparative example.

DETAILED DESCRIPTION OF THE FIGURES

[0020] Figure 1 shows a longitudinal section of the front part of a burner (1). Burner (1) has a burner front (2) having an opening (13) for discharging a solid fuel and

a single central opening (11) for discharging an oxygen containing gas. The opening (13) for discharging the solid fuel is fluidly connected to a central passage way (5). A passageway (6) is positioned co-axially with the central passage way (5).

[0021] Central passage way (5) has a downstream part wherein the diameter of the passage way (5) increases over a first length (7) and subsequently decreases over a second length (8) terminating at the burner front (2). Inside the downstream part (6) of the central passage way a hollow member (9) is positioned which is closed at one end (10) and has an opening (11) at a distance upstream from the burner front (2). The hollow member (9) has an increasing diameter and decreasing diameter aligned with the increasing and decreasing diameter of the central passage way (5) to form an annular passage(12) for the solid fuel terminating near the burner front (2) in an inwardly directed annular opening 13 for discharging the solid fuel. The alignment in diameter can be chosen such that flow direction changes only gradually to limit erosion.

[0022] The hollow member (9) preferably has an internal increasing diameter (15) and internal decreasing diameter (16) aligned with the increasing and decreasing diameter of the hollow member (9). This defines a hollow space in the hollow member having a conical shaped part and a frusto-conical shaped part. The hollow member (9) is fluidly connected with the annular passage way (6) for the oxygen containing gas by means of one or more connecting conduits (14). The connecting conduits (14) are also the spacers which keep hollow member (9) positioned within the central passageway (5). The design of conduits (14) may be such that, when in use, a swirl is imparted to either the flow of solids or to the oxygen containing gas or to both. In the shown exemplary embodiment, the connecting conduits (14) have a discharge opening (17) positioned in the diverging part, said otherwise in the conical part, of the hollow member (9) having diameter (15). Discharge openings (17) suitably have an ellipsoidal form, wherein the longer dimension is aligned with the axis of the burner. In the shown embodiment the number of openings (14) is 3. Less or more openings (14) can also be used, if so desired.

[0023] Figure 1 also shows opening (11) of the hollow member at its frusto-conical shaped end, which opening is the opening for discharging the oxygen containing gas. The opening (11) for discharging the oxygen containing gas is thus fluidly connected to annular passage way (6) for passage of the oxygen containing gas via hollow member (9) and connecting conduits (14).

[0024] The downstream end of the hollow member (9) forms a rim (25). The rim (25) and the opening (11) are at a distance upstream of the burner front (2). This reduces the fraction of coal that is diluted with syngas before being mixed with oxygen, reduces the risk of blockage by liquid slag flowing down from the burner front (2), particularly in case the burner is not vertical, e.g., horizontal, and reduces heat flux towards the rim (25), e.g., after a burner shut-down.

[0025] The dimensions and shape of the hollow member (9) can be chosen such that the oxygen containing gas is discharged from its opening (11) in an evenly distributed flow. Preferably the velocity of the oxygen containing gas as it is discharged from this opening is between 30 and 90 m/s. The shape of the hollow member comprises a conical end and a frusto-conical end pointing towards the burner front (2), wherein both parts are directly connected or optionally via a tubular part. The angle made by the slopes of the top of the conical end (10) is preferably between 5 and 35 degrees. This angle should preferably not be too large in order to limit erosion at the point where the flow of solids is debouched from the central passage way (5) to the annular passage way (12). The shape of the frusto-conical part is preferably so chosen that the angle between the resulting outflow direction of the inwardly directed annular opening (13) for discharging the solid fuel and the axis of the burner (1) is between 5 and 35 degrees.

[0026] Preferably the width of rim (25) of the hollow member (9) separating the opening (13) for discharging a solid fuel from the opening (11) for discharging an oxygen containing gas is between 0.5 and 3 mm. The angle as formed by the outflow direction of the inwardly directed annular opening (13) for discharging the solid fuel and the axis of the burner (1) is preferably between 5 and 35 degrees. It has been found that within this range an optimal contact between the oxygen containing gas and fuel is achieved while also achieving sufficient lifting of the flame and thus reduction of the heat flux.

[0027] The burner of Figure 1 also has a preferred annular passage way (19) for coolant positioned around the annular passage way (6). Around passage way (19) an annular passage way (20) is present for return coolant. Suitably passageways (6), (19) and (20) terminate at a connection block (21) provided with a central opening for the central passage way (5), multiple openings (24) for passage of fresh coolant from passage way (19) to a cooling jacket (23) and multiple openings (22) for passage of used coolant from cooling jacket (23) to passageway (20). The presence of connecting block (21) is advantageous because it enables one to simply replace a possibly damaged hollow member (9). The frusto-conical part of the hollow member can be removed by cutting away the cooling jacket (23) and the frusto-conical wall part (26) of the central passage way (5) from connection block (21). The connection block (21) is suitably located at the point where the diameter of the central passage way (5) inverses from an increasing diameter to a decreasing diameter in order to allow simple removal as herein described.

[0028] Cooling jacket (23) is preferably a cooling jacket as described in the aforementioned EP-A-328794 or as described in CN-A-101363624. Such a cooling jacket (23) has double walls (28, 29) defining the exterior of the burner section starting at the connection block (21) and terminating at the burner front (2). The double walls (28,

29) are spaced by one or more baffles (30) defining a flow path for coolant encircling said burner section and part of the burner front (2). The coolant enters the burner front (2) via opening (32) from a coolant compartment (31) defined by wall (29) and wall (26) of the central passage way (5). Coolant compartment (31) is fluidly connected to passageway (19) via openings (24).

[0029] The end of burner (1) having the supply connections for oxygen containing gas, solid fuel, fresh and used coolant is not shown in Figure 1. A design as described in CN-A-101363622 may be suitably used for this purpose.

[0030] The references used in Figure 2 have the same meaning as described above. In addition Figure 2 shows the outer wall (27) of the annular passage way (20). Figure 2 shows an embodiment having three openings (17). In Figure 1 only one connecting conduit (14) and one opening (17) of the three openings is shown for clarity reasons.

[0031] Figure 3 shows a horizontally arranged burner (40) according to a comparative example. The buner (40) is to a large extent the same as the burner (1) of the Figure 1. The references used in Figure 3 have the same meaning as described above. The main difference with the burner (1) of Figure 1 is that the hollow member (9) has a longitudinal axis A at a distance X below the longitudinal axis B of the central passage way (5). As a result the radial width of the annular passage (12) is larger at the upper side than at the lower side, so the volumetric outflow will be larger at the top side of the annular fuel outlet opening (13). This compensates for the fact that coal density in the upper part of the fuel outlet (13) is lower than the coal density at the lower part of fuel outlet (13).

[0032] In the embodiment of Figure 3, the rim (25) and the opening (11) are at the burner front (2). In an alternative embodiment, the rim (25) and the opening (11) may be at a distance upstream of the burner front (2), similar to the embodiment of Figure 1.

[0033] Figure 4 shows a horizontal burner (50) according to a comparative example. The burner (50) is to a large extent the same as the burner (1) of the Figure 1 and the burner (40) of Figure 3. The references used in Figure 4 have the same meaning as described above. In the embodiment of Figure 4, the opening (11) comprises a plurality of coaxial openings, including a central opening (11) for discharging an oxygen containing gas, opening (11) comprising opening (60) at the downstream end of a low velocity conduit (51), and an inwardly directed annular opening (52) at the downstream end of a high velocity conduit (53). The annular opening (52) is surrounded by the inwardly directed annular opening (13) for discharging the solid fuel. A second vertical connecting block (54) divides the interior of the hollow member (9) into an upstream side (55) and a down stream side (56). A substantially frusto-conical wall (57) extends from the second connection block to the opening (11). The frusto-conical wall (57) runs substantially parallel to the wall of the hollow member (9).

[0034] The second connecting block (54) is provided with a central opening (58) providing an open connection between the interior of the frusto-conical wall (57) and the central passage way (5). This way the interior of the frusto-conical wall (57) defines the first oxygen supply conduit (51).

[0035] The second connecting block (54) is also provided with a circular array of openings (59) providing an open connection between the central passage way (5) and the downstream annular space between the frusto-conical wall (57) and the hollow member (9). This annular space defines the second oxygen supply conduit (52). The dimensions of the hollow member (9), the frusto-conical wall (57) and the openings (58, 59) in the second connecting block (54) are dimensioned to obtain a high velocity oxygen flow in the annular conduit (53) and a low velocity oxygen flow in the central conduit (51). This reduces the distance between the burner front (2) and the downstream point where mixing between oxygen and fuel is complete.

[0036] In the embodiment of Figure 4 the longitudinal axis of the frusto-conical wall substantially coincides with the longitudinal axis of the hollow member (9) and the burner (50). In an alternative embodiment, the longitudinal axis of the frusto-conical wall (57) may be offset from the longitudinal axis of the hollow member (9) and / or offset from the longitudinal axis of the burner (50). Particularly with non-vertical, e.g. horizontal burners, a downwardly offset arrangement of the frusto-conical wall (57) can contribute to compensating nonuniformity of the density distribution in the annular passageway (52).

Claims

1. A burner (1) for the gasification of a solid fuel, comprising:

   a burner front (2) having a fuel discharge opening (13) for discharging a solid fuel,
   the burner further comprising an opening (11) for discharging an oxygen containing gas,
   wherein the fuel discharge opening (13) is fluidly connected to a central passage way (5);
   wherein the opening (11) for discharging the oxygen containing gas is fluidly connected to an annular passage way (6) for passage of oxygen;
   wherein the central passage way (5) has a downstream part wherein the diameter of the passage way (5) increases over a first length (7) and subsequently decreases over a second length (8) terminating at the burner front (2);
   wherein inside the downstream part of the central passage way a hollow member (9) is positioned which is closed at one end (10), the hollow member (9) having an increasing diameter and decreasing diameter aligned with the increasing

and decreasing diameter of the central passage way (5) to form an annular passage (12) for the solid fuel terminating at the burner front (2) in an inwardly directed annular opening (13) for discharging the solid fuel; and
wherein the hollow member (9) is fluidly connected with the annular passage way (6) for the oxygen containing gas by means of one or more connecting conduits (14), the hollow member comprising said opening (11) at its frusto-conical shaped end, the opening (11) for discharging the oxygen containing gas is at a distance upstream of the burner front (2).

2. The burner according to claim 1 wherein the opening (11) for discharging an oxygen containing gas comprises a plurality of openings (52, 60).

3. The burner according to claim 2 wherein the plurality of openings of the opening (11) for discharging an oxygen containing gas are coaxial.

4. The burner according to claim 3 wherein the plurality of openings of the opening (11) for discharging an oxygen containing gas comprise a central opening (60) at the end of a low velocity conduit (51), and an annular opening (52) at the end of a high velocity conduit (53), the annular opening (52) being surrounded by the inwardly directed annular opening (13) for discharging the solid fuel.

5. The burner according to any one of the preceding claims wherein the hollow member (9) has a longitudinal axis at a distance below the longitudinal axis of the central passage way (5).

6. The burner according to any one of the preceding claims wherein the downstream end of the hollow member (9) forms a rim (25) and wherein the rim (25) and the opening (11) for discharging an oxygen containing gas are at a distance upstream of the burner front (2).

7. The burner according to claim 6 wherein the width of the rim (25) is between 0.5 and 3 mm.

8. The burner according to any of the preceding claims wherein the angle as formed by the outflow direction of the inwardly directed annular opening (13) for discharging the solid fuel and the axis of the burner (1) is between 5 and 35 degrees.

9. A process to prepare a mixture of hydrogen and carbon monoxide by means of gasification of a solid fuel using a burner according to any one of claims 1-8, wherein an oxygen containing gas is passed through passageway (6), a solid fuel and a carrier gas is passed through central passage (5) and gasification takes place downstream of the opening (11) for discharging an oxygen containing gas and the fuel discharge opening (13).

10. The process according to claim 9, wherein the opening (11) for discharging an oxygen containing gas comprises a central opening (60) discharging oxygen containing gas with a velocity of between 10 and 30 m/s, and an annular opening (52) around the central opening discharging oxygen containing gas as with a velocity of between 30 and 100 m/s, while the fuel discharged from the annular opening (13) is at a velocity of between 5 and 15 m/s, the annular fuel discharge opening (13) surrounding the annular oxygen discharge opening.

Patentansprüche

1. Brenner (1) für eine Vergasung eines festen Brennstoffs, umfassend:

einer Brennerfront (2) mit einer Brennstoffauslassöffnung (13), um einen festen Brennstoff abzugeben,
der Brenner umfassend ferner eine Öffnung (11) um ein sauerstoffhaltiges Gas abzugeben,
wobei die Brennstoffauslassöffnung (13) fluidisch mit einem zentralen Durchgangsweg (5) verbunden ist,
wobei die Öffnung (11) zur Abgabe des sauerstoffhaltigen Gases fluidisch mit einem ringförmigen Durchgangsweg (6) zum Durchleiten von Sauerstoff verbunden ist,
wobei der zentrale Durchgangsweg (5) einen stromabwärtigen Teil hat, in dem der Durchmesser des Durchgangswegs (5) sich über eine erste Länge (7) vergrößert und sich anschließend über eine zweite Länge (8), die an der Brennervorderseite endet, verkleinert,
wobei in dem stromabwärtigen Teil des zentralen Durchgangswegs eine hohleres Teil (9) angeordnet ist, das an einem Ende (10) geschlossen ist, wobei das hohle Teil (9) einen zunehmenden Durchmesser und eine abnehmenden Durchmesser hat, die zu dem zunehmenden und abnehmenden Durchmesser des zentralen Durchgangswegs (5) ausgerichtet sind, um einen ringförmigen Durchgang (12) für den festen Brennstoff zu bilden, der an der Brennerfront (2) in eine nach innen gerichteten ringförmigen Öffnung (13) übergeht, um den festen Brennstoff abzugeben; und wobei das hohle Teil (9) fluidisch mit dem ringförmigen Durchgangsweg (6) für das sauerstoffhaltige Gas durch eine oder mehrere Verbindungsleitungen (14) verbunden ist, und das hohle Teil die Öffnung (11) an seinem kegelstumpfförmig geformten Ende um-

fasst, wobei die Öffnung (11) zur Abgabe des sauerstoffhaltigen Gases in einem Abstand stromaufwärts von der Brennerfront (2) ist.

2. Brenner nach Anspruch 1, wobei die Öffnung (11) zur Abgabe eines sauerstoffhaltigen Gases eine Vielzahl von Öffnungen (52, 60) umfasst.

3. Brenner nach Anspruch 2, wobei die Vielzahl von Öffnungen der Öffnung (11) zur Abgabe eines sauerstoffhaltigen Gases koaxial angeordnet sind.

4. Brenner nach Anspruch 3, wobei die Vielzahl von Öffnungen der Öffnung (11) zur Abgabe eines sauerstoffhaltigen Gases eine zentrale Öffnung (60) am Ende einer Niedergeschwindigkeitsleitung (51) umfassen, und eine ringförmige Öffnung (52) am Ende einer Hochgeschwindigkeitsleitung (53), wobei die ringförmige Öffnung (52) durch die nach innen gerichtete ringförmige Öffnung (13) zur Abgabe des festen Brennstoffes umgeben ist.

5. Brenner nach einem der vorhergehenden Ansprüche, wobei das hohle Teil (9) eine Längsachse in einem Abstand unterhalb der Längsachse des zentralen Durchgangswegs (5) hat.

6. Brenner nach einem der vorhergehenden Ansprüche, wobei das stromabwärtige Ende des hohlen Teiles (9) einen Rand (25) bildet, und wobei der Rand (25) und die Öffnung (11) zur Abgabe des sauerstoffhaltigen Gases in einem Abstand stromaufwärts von der Brennerfront (2) sind.

7. Brenner nach Anspruch 6, wobei die Breite des Rands (25) zwischen 0,5 und 3 mm liegt.

8. Brenner nach einem der vorhergehenden Ansprüche, wobei der Winkel, der durch die Ausflussrichtung der nach innen gerichteten ringförmigen (13) zur Abgabe des festen Brennstoffs und die Achse des Brenners zwischen 5 und 35 Grad beträgt.

9. Verfahren zum Bereiten einer Mischung aus Wasserstoff und Kohlenmonoxid durch eine Vergasung eines festen Brennstoffs mit einem Brenner nach einem der Ansprüche 1 bis 8,
wobei ein sauerstoffhaltiges Gas durch einen Durchgangsweg (6) geleitet wird, ein fester Brennstoff und ein Transportgas durch den zentralen Durchgang (5) gleitet wird, und die Vergasung zur Abgabe eines sauerstoffhaltigen Gases und der Brennstoffabgabeöffnung (13) stromabwärts der Öffnung (11) erfolgt.

10. Verfahren nach Anspruch 9, wobei die Öffnung (11) zur Abgabe des sauerstoffhaltigen Gases eine zentrale Öffnung (60) umfasst, aus der das sauerstoffhaltiges Gas mit einer Geschwindigkeit zwischen 19 und 30 m/s abgegeben wird, und eine ringförmige Öffnung (52), die die zentrale Öffnung umgibt, und das sauerstoffhaltige Gas mit einer Geschwindigkeit zwischen 30 und 100 m/s abgibt, während der Brennstoff, der von der ringförmigen Öffnung (13bei einer Geschwindigkeit von 5 und 15 m/s) abgeben wird, wobei die ringförmige Brennstoffabgabeöffnung (13) die ringförmige Sauerstoffabgabeöffnung umgibt.

Revendications

1. Brûleur (1) pour la gazéification d'un combustible solide, comprenant :

une partie avant de brûleur (2) ayant une ouverture de décharge de combustible (13) pour décharger un combustible solide,
le brûleur comprenant en outre une ouverture (11) pour décharger un gaz contenant de l'oxygène,
dans lequel l'ouverture de décharge de combustible (13) est raccordée, de manière fluidique, à une voie de passage centrale (5) ;
dans lequel l'ouverture (11) pour décharger le gaz contenant de l'oxygène est raccordée de manière fluidique à une voie de passage annulaire (6) pour le passage de l'oxygène ;
dans lequel la voie de passage centrale (5) a une partie en aval, dans laquelle le diamètre de la voie de passage (5) augmente sur une première longueur (7) et diminue sensiblement sur une seconde longueur (8) se terminant par la partie avant de brûleur (2) ;
dans lequel à l'intérieur de la partie en aval de la voie de passage centrale, on positionne un élément creux (9) qui est fermé au niveau d'une extrémité (10), l'élément creux (9) ayant un diamètre croissant et un diamètre décroissant alignés avec le diamètre croissant et décroissant de la voie de passage centrale (5) afin de former un passage annulaire (12) pour le combustible solide se terminant au niveau de la partie avant de brûleur (2) dans une ouverture annulaire (13) dirigée vers l'intérieur pour décharger le combustible solide ; et
dans lequel l'élément creux (9) est raccordé, de manière fluidique, avec la voie de passage annulaire (6) pour le gaz contenant de l'oxygène au moyen d'un ou de plusieurs conduits de raccordement (14), l'élément creux comprenant ladite ouverture (11) au niveau de son extrémité de forme tronconique, l'ouverture (11) pour décharger le gaz contenant de l'oxygène est à une distance en amont de la partie avant de brûleur (2).

2. Brûleur selon la revendication 1, dans lequel l'ouverture (11) pour décharger un gaz contenant de l'oxygène comprend une pluralité d'ouvertures (52, 60).

3. Brûleur selon la revendication 2, dans lequel la pluralité d'ouvertures de l'ouverture (11) pour décharger un gaz contenant de l'oxygène, sont coaxiales.

4. Brûleur selon la revendication 3, dans lequel la pluralité d'ouvertures de l'ouverture (11) pour décharger un gaz contenant de l'oxygène comprend une ouverture centrale (60) à l'extrémité d'un conduit à faible vitesse (51), et une ouverture annulaire (52) à l'extrémité d'un conduit à vitesse élevée (53), l'ouverture annulaire (52) étant entourée par l'ouverture annulaire (13) dirigée vers l'intérieur pour décharger le combustible solide.

5. Brûleur selon l'une quelconque des revendications précédentes, dans lequel l'élément creux (9) a un axe longitudinal à une distance au-dessous de l'axe longitudinal de la voie de passage centrale (5).

6. Brûleur selon l'une quelconque des revendications précédentes, dans lequel l'extrémité en aval de l'élément creux (9) forme un bord (25) et dans lequel le bord (25) et l'ouverture (11) pour décharger un gaz contenant de l'oxygène sont à une distance en amont de la partie avant de brûleur (2).

7. Brûleur selon la revendication 6, dans lequel la largeur du bord (25) est comprise entre 0,5 et 3 mm.

8. Brûleur selon l'une quelconque des revendications précédentes, dans lequel l'angle, tel que formé par la direction de sortie de l'ouverture annulaire (13) dirigée vers l'intérieur pour décharger le combustible solide et l'axe du brûleur (1) est compris entre 5 et 35 degrés.

9. Procédé pour préparer un mélange d'hydrogène et de monoxyde de carbone au moyen de la gazéification d'un combustible solide à l'aide d'un brûleur selon l'une quelconque des revendications 1 à 8, un gaz contenant un oxygène passe par la voie de passage (6), un combustible solide et un gaz porteur passent par le passage central (5) et la gazéification a lieu en aval de l'ouverture (11) pour décharger un gaz contenant de l'oxygène et l'ouverture de décharge de combustible (13).

10. Procédé selon la revendication 9, dans lequel l'ouverture (11) pour décharge un gaz contenant de l'oxygène comprend une ouverture centrale (60) déchargeant le gaz contenant de l'oxygène avec une vitesse comprise entre 10 et 30 m/s, et une ouverture annulaire (52) autour de l'ouverture centrale déchargeant le gaz contenant de l'oxygène tel qu'avec une vitesse comprise entre 30 et 100 m/s, alors que le combustible déchargé par l'ouverture annulaire (13) est à une vitesse comprise entre 5 et 15 m/s, l'ouverture de décharge de combustible annulaire (13) entourant l'ouverture de décharge d'oxygène annulaire.

Fig.1

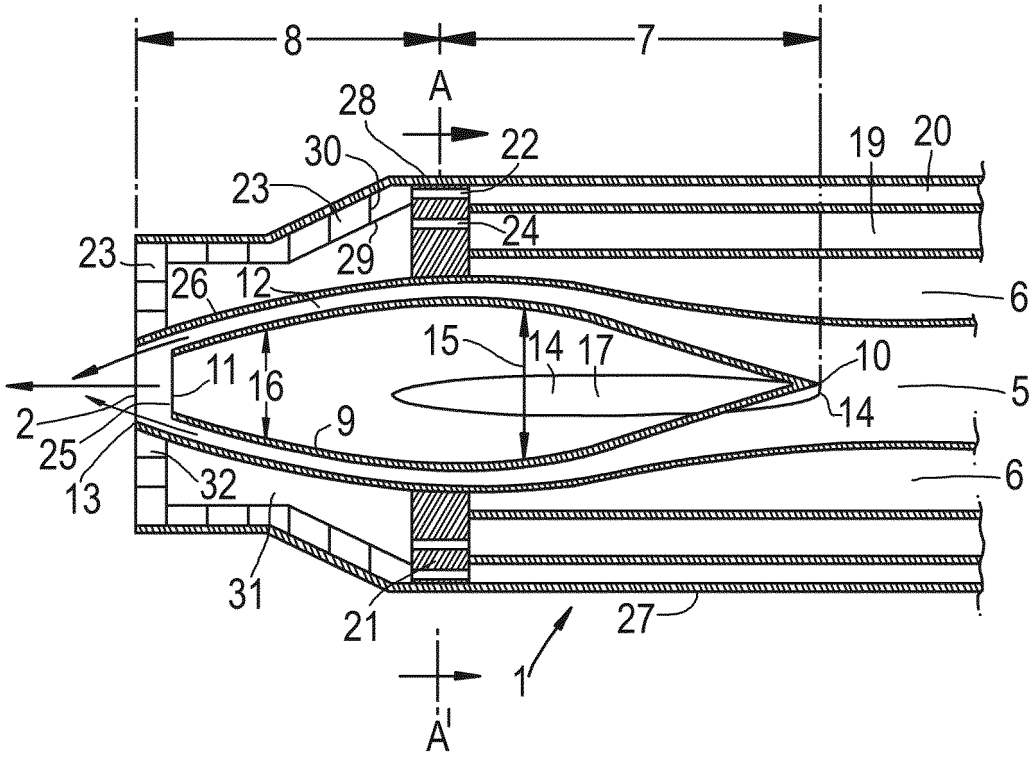
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Fig.2

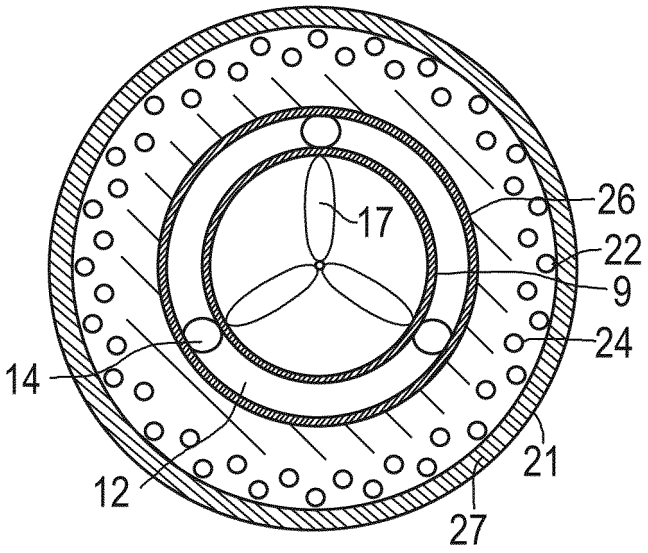
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Fig.3

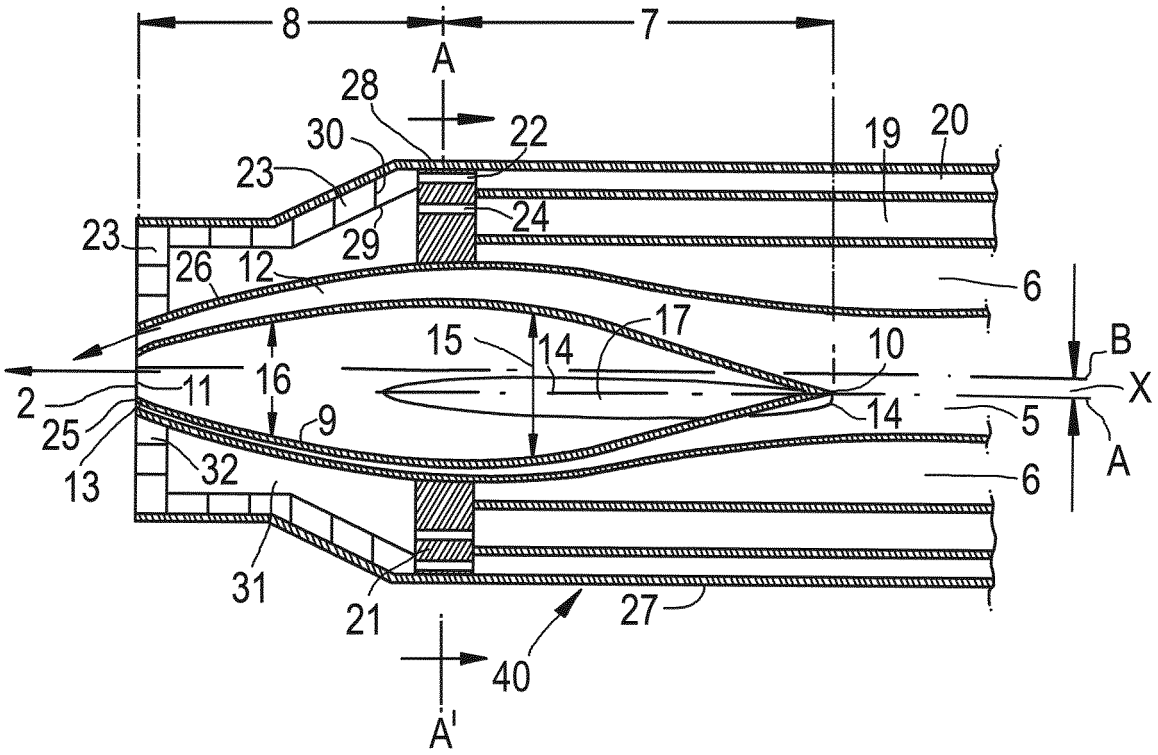
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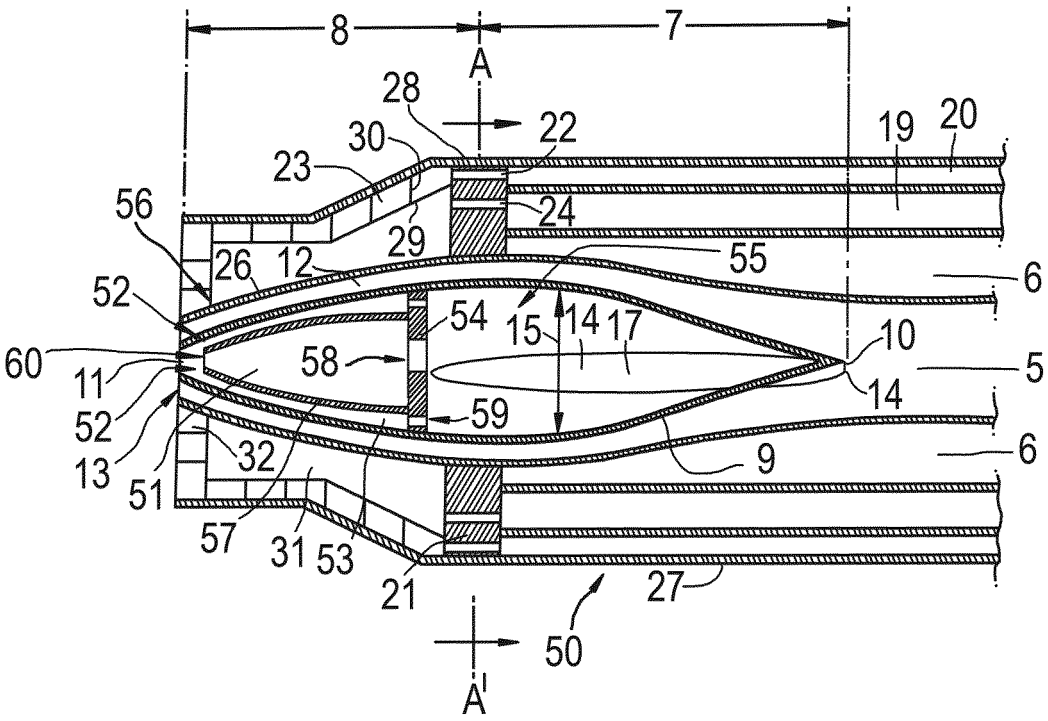
Fig.4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REFERENCES CITED IN THE DESCRIPTION

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