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(54) **CERAMIC BURNER FOR GASES AND REGENERATIVE HEAT GENERATOR PROVIDED WITH THE SAID BURNER**

KERAMISCHER GASBRENNER UND REGENERATIVE WÄRMEERZEUGUNGSANLAGE MIT EINEM SOLCHEN BRENNER

BRULEUR EN CERAMIQUE POUR GAZ ET GENERATEUR DE CHALEUR DE REGENERATION DOTE DUDIT BRULEUR

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(73) Proprietor: **Danieli Corus Europe BV**
1970 CA IJmuiden (NL)

(72) Inventors:
- **VAN DEN BEMT, Johannes, Cornelis, Antoine**
  NL-1741 VM Schagen (NL)
- **NOOIJ, Coert, Johannes**
  NL-1971 KX IJmuiden (NL)

(74) Representative: **Hansen, Willem Joseph Maria**
Corus Technology BV
Corus Intellectual Property Department
PO Box 10000
1970 CA IJmuiden (NL)

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Description

[0001] The invention relates to a ceramic burner for gases, especially for use in the combustion chamber of a regenerative heat generator, such as a hot-blast stove for a blast furnace, which ceramic burner is provided with a first feed duct for a first combustion component, such as a combustible gas, and with a second feed duct for a second combustion component, such as combustion air, the first feed duct opening out into a substantially elongate outlet opening and the second feed duct opening out into at least one second outlet opening, the latter opening(s) extending essentially parallel to and downstream of the first outlet opening, a partition, which continues until the two outlet openings, which outlet openings open directly into the combustion chamber, furthermore being situated between the first feed duct and the second feed duct. The invention also relates to a regenerative heat generator provided with a ceramic burner of this nature.

[0002] When operating a blast furnace, a plurality of hot-blast stoves are grouped together in the vicinity of this blast furnace, with the result. that switching from one hot-blast stove to another means that it is always possible to feed the blast furnace, via a discharge port of a heated hot-blast stove, with hot air as a reaction component. Whenever a hot-blast stove is disconnected from the blast furnace, it can be reheated by burning gas with the aid of the ceramic burner, whereupon hot flue gas flows through the combustion chamber and the heat-retention shaft, the heat-retention shaft absorbing the heat of the hot flue gas, so that this heat can then be given off again, in a subsequent operating phase, to air which is fed to the hot-blast stove via the supply port.

[0003] For the sake of efficiency of the installation, it is very important that the combustion components fed to the ceramic burner are burned as completely as possible before the hot flue gas flows through the heat-retention shaft. For this reason, various structures have been designed for the ceramic burner. In the burner of the known type mentioned, embodiments are known in which one single feed duct for the combustible gas and one single feed duct for the combustion air are provided. Designs are also known in which one duct for the combustible gas is situated centrally between two feed ducts for the combustion air.

[0004] Designs are also known in which the outlet opening of a feed duct for combustion air comprises a single opening, while it is also known to divide this outlet opening into a series of separate orifices. The latter design is described, for example, in European patent EP 0,090,096.

[0005] Although known designs have already allowed considerable improvements to the combustion efficiency to be achieved, it has been found that nevertheless further improvement is still possible. In particular, it has been found that it is very important to keep the ignition of the flame as close as possible above the burner all the time. This is because if this ignition takes place at a greater height, as a result of slow mixing of the combustion components, it is possible that the combustion location will begin to fluctuate considerably, leading to pulsation of the flame, which may cause vibration in the installation as a whole.

[0006] Therefore, the object of the invention is to provide features which will cause the combustion to take place virtually constantly, preferably very close to the outlet openings.

[0007] A solution has now been found which can be used both in designs with one and with two feed ducts for the second combustion component and also for designs in which the outlet opening of each feed duct is a single opening or is divided into separate orifices.

[0008] The invention consists in the fact that at least one of the first and second feed ducts is provided with means for imparting turbulence, during operation, to the combustion component while emerging through the duct(s) in question, which turbulence is such that a combustible mixture of the two combustion components is formed upstream of and adjacent to the end of the partition. This turbulence is brought about in a simple manner by said means comprising a step-widening, which is arranged in the vicinity of the outlet opening(s) of at least the first and/or the second feed duct, of the cross section of the duct in question, the step widening being provided by the shape of the partition and the step widening being followed, to as far as the end of the partition, by a gradual widening with the result that a turbulence chamber is formed. At the location of the abrupt widening, turbulence will be imparted to the combustion component flowing past this widening in the additional space created, which turbulence also entrains the other combustion component, with the result that a combustible mixture is formed in the turbulence, This combustible mixture can be ignited immediately at that very location, owing to the fact that there is a low velocity of flow in the turbulence in the longitudinal direction of the combustion chambe. As a result, a flame produced cannot easily be "blown away" from the burner head.

[0009] Naturally, the abrupt widening must be sufficiently wide to ensure sufficient turbulence. It has been found that good results are obtained if the step-widening amounts to 20 to 35 % of the original cross section of the duct in question.

[0010] The step widening is followed, to as far as the end of the partition, by a gradual widening, with the result that a turbulence chamber is formed. Owing to the gradual widening, the turbulence chamber formed acquires a sufficient volume to impart turbulence to a greater volume of gas and therefore to mix it into a combustible mixture. This ensures the stability of flame formation just above the end of the partition.

[0011] In DE 2700 786 a ceramic burner is disclosed with a mixing chamber for combustion gas and air which is situated upstream of the combustion chamber and separated therefrom by a channel with a restricted

cross-section. In the mixing chamber the combustion of the mixture is prevented by this channel with a restricted cross-section. Since in the present ceramic burner of the invention the outlet openings of gas and air open directly into the combust chamber and the means for imparting turbulence forms a combustible mixture upstream and adjacent to the end of the partition, the ignition of the combustible mixture starts from such means.

[0012] EP 0 090 096 describes a ceramic burner in which the outlet openings for gas and air have been shaped in order to create turbulences starting from these outlet opening into the combustion chamber. No separate means, such as a step-widening have been disclosed in order to create turbulences and a mixture of gas and air upstream of the openings and adjacent to the end of the partition.

In US 3,837,793 the prior art of ceramic burners has been disclosed over which the present invention constitutes an improvement.

[0013] In addition to the ceramic burner described, the invention also relates to a regenerative heat generator, such as a hot-blast stove for a biast furnace, which is provided with a supply port for supplying gas to be heated and a discharge port for discharging heated gas, comprising a combustion chamber and a heat-retention shaft, the combustion chamber, in order to heat the heat generator, being provided with a ceramic burner, this ceramic burner being of the type described above.

[0014] The invention will be explained in more detail below with reference to three figures, in which:

Fig. 1 shows, as an example of a regenerative heat generator, a hot-blast stove for a blast furnace;
Fig. 2 shows a detail II from Fig. 1 on an enlarged scale;
Fig. 3 shows another embodiment of this detail.

[0015] In Fig. 1, reference numeral 1 denotes a heat generator in the form of a hot-blast stove for a blast furnace. The hot-blast stove comprises a combustion chamber 2 and a heat-retention shaft 3, which are separated from one another by a wall 4. A ceramic burner 5 is located at the bottom of the combustion chamber. Combustion air for the ceramic burner is supplied through connection port 6, and fuel in the form of a combustible gas is supplied through connection port 7. The mixture of combustion air and combustible gas is burned in combustion chamber 2. The flue gases emanating from the combustion rise upwards in the combustion chamber 2, are diverted via the cupola 8, and then pass through the heat-retention shaft 3 which is filled with firebricks (not shown), where they give off sensible heat to the firebricks. The flue gases which have been cooled as a result of this action leave the hot-blast stove through the discharge ports 9, one of which is illustrated.

[0016] After the firebricks have been heated to a sufficient temperature, the supply of fuel and combustion air through the ports 6 and 7 is discontinued, after which cold air is supplied through the discharge port 9. This cold air then flows through the hot heat-retention area in heat-retention shaft 3, is heated therein, and then leaves the hot-blast stove via port 10. Port 10 is connected to a distribution system for hot air, the so-called "hot wind", in order for it to be fed to the blast furnace.

[0017] The combustible gas which is fed in via connection port 1 is diverted upwards into the first feed duct 13 for combustible gas, while connection port 6 merges into the second feed duct 12 for combustion air. Feed ducts 12 and 13 are separated from one another by partition 11.

[0018] The configuration around the top end of the partition 11 is indicated by II and illustrated in detail, on an enlarged scale, in Fig. 2. Corresponding reference numerals from Fig. 1 relate to corresponding elements in Fig. 2. In Fig. 2, it can be seen that the outlet opening 14 of feed duct 12 is located at a higher position than and is at an angle with respect to outlet opening 15 of duct 13 for the combustible gas. As a result, the air flow is able to penetrate the gas flow, with the result that they are mixed so as to form a combustible mixture.

[0019] Feed duct 13 is provided, just below the outlet opening 15, with a step-widening 16 which is obtained by a local narrowing of the partition 11. The step widening 16 is adjoined by a gradual widening 17 in the direction of the outlet opening 15. As a result, a turbulence chamber 18 is formed between the step widening 16, the gradual widening 17 and the outlet opening 15. In the turbulence chamber 18, an intensive turbulent movement, which extends to just above the outlet opening 15, is imparted to part of the gas flow, with the result that it entrains combustion air from duct 12. As a result, a rich combustible mixture which has a low velocity component in the main direction of flow through combustion chamber 2 is formed in the turbulence chamber 18. If this rich combustible mixture is ignited, the flame front will remain very stable in the vicinity of the free end of the partition 11. As a result, pulsation of the flame is avoided, and consequently vibration phenomena throughout the entire structure are also prevented. Moreover, the combustion efficiency is improved.

[0020] As has already been noted above, the invention is not limited to the design illustrated. In many cases, preference is given to a ceramic burner in which two feed ducts 12^a and 12^b for combustion air are disposed symmetrically with respect to feed duct 13 for the combustible gas. In this embodiment, as illustrated in Figure 3, two partitions 11^a and 11^b are provided instead of the single partition 11 and there are two outlet openings 14^a and 14^b for the feed ducts 12^a and 12^b.

[0021] An equally good effect is also obtained if the outlet opening(s) 14 (or 14^a and 14^b) for combustion air is/are divided into separate ports.

Claims

1. Ceramic burner for gases, especially for use in the combustion chamber (2) of a regenerative heat generator, such as a hot-blast stove (1) for a blast furnace (1), which ceramic burner is provided with a first feed duct (13) for a first combustion component, such as a combustible gas, and with a second feed duct (12) for a second combustion component, such as combustion air, the first feed duct (13) opening out into a substantially elongate outlet opening (15) and the second feed duct opening out into at least one second outlet opening (14), the latter opening(s) extending essentially parallel to and downstream of the first outlet opening, a partition (11), which continues until the two outlet openings (14, 15), which outlet openings (14, 15) open directly into the combustion chamber (2), furthermore being situated between the first feed duct (13) and the second feed duct (12), and in which at least one of the first and second feed ducts (12, 13) is provided with means for imparting turbulence, during operation, to the combustion component while emerging through the duct(s) in question, which turbulence is such that a combustible mixture of the two combustion components is formed upstream of and adjacent to the end of the partition (11), said means for imparting turbulence comprising step-widening (16), which is arranged in the vicinity of the outlet opening(s) (14, 15) of at least the first and/or the second feed duct, of the cross section of the duct in question, the step-widening (16) being provided by the shape of the partition (11), and the step-widening (16) being followed, to as far as the end of the partition (11), by a gradual widening (17), with the result that a turbulence chamber is formed.

2. Ceramic burner according to claim 1, **characterized in that** the step-widening (16) amounts to 20 to 35% of the original cross section of the duct in question.

3. Regenerative heat generator, such as a hot-blast stove for a blast furnace (1), which is provided with a supply port (9) for supplying gas to be heated and a discharge port (10) for discharging heated gas, comprising a combustion chamber (2) and a heat-retention shaft (3), the combustion chamber (2), in order to heat the heat generator, being provided with a ceramic burner (5), **characterized in that** the ceramic burner is of the type according to one of the preceding claims.

Patentansprüche

1. Keramikbrenner für Gase, insbesondere zur Verwendung in der Brennkammer (2) eines regenerativen Wärmegenerators, wie beispielsweise in einem Heißblase-Einbrennofen (1) für einen Hochofen (1), wobei der Keramikbrenner eine erste Zuführleitung (13) für eine erste Verbrennungskomponente, wie beispielsweise ein Verbrennungsgas, und eine zweite Zuführleitung (12) für eine zweite Verbrennungskomponente, wie beispielsweise Verbrennungsluft, wobei die erste Zuführleitung (13) in einer im wesentlichen länglichen Auslaßöffnung (15) und die zweite Zuführleitung in wenigstens einer zweiten Auslaßöffnung (14) mündet, wobei sich letztere Öffnung(en) im wesentlichen parallel zu und stromabwärts von der ersten Auslaßöffnung erstreckt, und ein Trennelement (11), das sich bis zu den zwei Auslaßöffnungen (14, 15) erstreckt, wobei die Auslaßöffnungen (14, 15) direkt in die Brennkammer (2) münden; und weiterhin zwischen der ersten Zuführleitung (13) und der zweiten Zuführleitung (12) angeordnet ist, aufweist, und worin wenigstens eine der ersten und zweiten Zuführleitungen (12, 13) Mittel aufweist, um während des Betriebs Verwirbelungen an die Verbrennungskomponente zu übertragen, während diese durch besagte Leitung(en) austritt, wobei die Verwirbelungen derart sind, daß ein Brennstoffgemisch der zwei Verbrennungskomponenten stromaufwärts von und nahe des Endes des Trennelementes (11) erzeugt wird, wobei das Mittel zur Übertragung von Turbulenzen eine stufenförmige Erweiterung (16), die in der Nähe der Auslaßöffnung(en) (14, 15) der wenigstens ersten und/oder zweiten Zuführleitung angeordnet ist, mit dem Querschnitt besagter Leitung aufweist, wobei die stufenförmige Erweiterung (16) durch die Form des Trennelementes (11) gebildet ist und auf die stufenförmige Erweiterung (16) bis zum Ende des Trennelementes (11) eine allmähliche Erweiterung (17) folgt mit dem Ergebnis, daß eine Wirbelstrombrennkammer gebildet wird.

2. Keramikbrenner nach Anspruch 1, **dadurch gekennzeichnet, daß** die stufenförmige Erweiterung (16) einen Querschnitt aufweist, der 20 bis 35% des ursprünglichen Querschnitts der besagten Leitung entspricht.

3. Regenerativer Wärmegenerator, wie beispielsweise ein Heißblase-Einbrennofen für einen Hochofen (1), der eine Zuführöffnung (9) zum Zuführen von zu erwärmendem Gas und eine Auslaßöffnung (10) zum Ablassen von erwärmtem Gas umfaßt, mit einer Brennkammer (2) und einem Wärmehaltungsschacht (3), wobei die Brennkammer (2) zum Erwärmen des Wärmegenerators einen Keramikbrenner (5) aufweist, **dadurch gekennzeichnet, daß** es sich bei dem Keramikbrenner um einen Keramikbrenner gemäß einem der vorhergehenden Ansprüche handelt.

Revendications

1. Brûleur en céramique pour gaz, destiné particulièrement à être utilisé dans la chambre de combustion (2) d'un générateur de chaleur de régénération, tel qu'un cowper (1) pour un haut fourneau (1), ledit brûleur en céramique étant doté d'une première conduite d'alimentation (13) pour un premier composant de combustion, tel qu'un gaz combustible, et d'une seconde conduite d'alimentation (12) pour un second composant de combustion, tel que de l'air de combustion, la première conduite d'alimentation (13) débouchant à l'intérieur d'une ouverture de sortie de forme sensiblement allongée (15) et la seconde conduite d'alimentation débouchant à l'intérieur d'au moins une seconde ouverture de sortie (14), cette(s) demière(s) s'étendant sensiblement parallèlement à la première ouverture de sortie et en aval de celle-ci, une cloison (11), qui s'étend jusqu'aux deux ouvertures de sortie (14, 15), les ouvertures de sortie (14, 15) débouchant directement dans la chambre de combustion (2), et étant en outre située entre la première conduite d'alimentation (13) et la seconde conduite d'alimentation (12), et dans lequel l'une au moins desdites première et seconde conduites d'alimentation (12, 13) est dotée de moyens pour conférer une turbulence, en fonctionnement, au composant de combustion lorsqu'il émerge par l'intermédiaire de la ou des conduite(s) en question, cette turbulence étant telle qu'un mélange combustible de deux composants de combustion se forme en amont de l'extrémité de la cloison (11) et de façon adjacente à cette extrémité, lesdits moyens conférant la turbulence comprenant un élargissement en gradin (16), qui est prévu au voisinage de ou des ouverture(s) de sortie (14, 15) d'au moins la première et/ou la seconde conduite (s) d'alimentation, de la section de la conduite en question, ledit élargissement en gradin (16) étant défini par la forme de la cloison (11), et ledit élargissement en gradin (16) étant suivi, jusqu'à l'extrémité de la cloison (11), par un élargissement progressif (17), une chambre de turbulence étant ainsi formée.

2. Brûleur en céramique selon la revendication 1, **caractérisé en ce que** l'élargissement en gradin (16) représente entre 20 et 35% de la section initiale de la conduite en question.

3. Générateur de chaleur de régénération, tel qu'un cowper pour un haut fourneau (1), qui est doté d'un orifice d'alimentation (9) pour fournir le gaz à chauffer et d'un orifice de décharge (10) pour décharger le gaz chauffé, comprenant une chambre de combustion (2) et un puits de conservation de chaleur (3), la chambre de combustion (2), afin de chauffer le générateur de chaleur, étant dotée d'un brûleur en céramique (5), **caractérisé en ce que** le brûleur en céramique est du type selon l'une quelconque des revendications précédentes.

Fig. 1

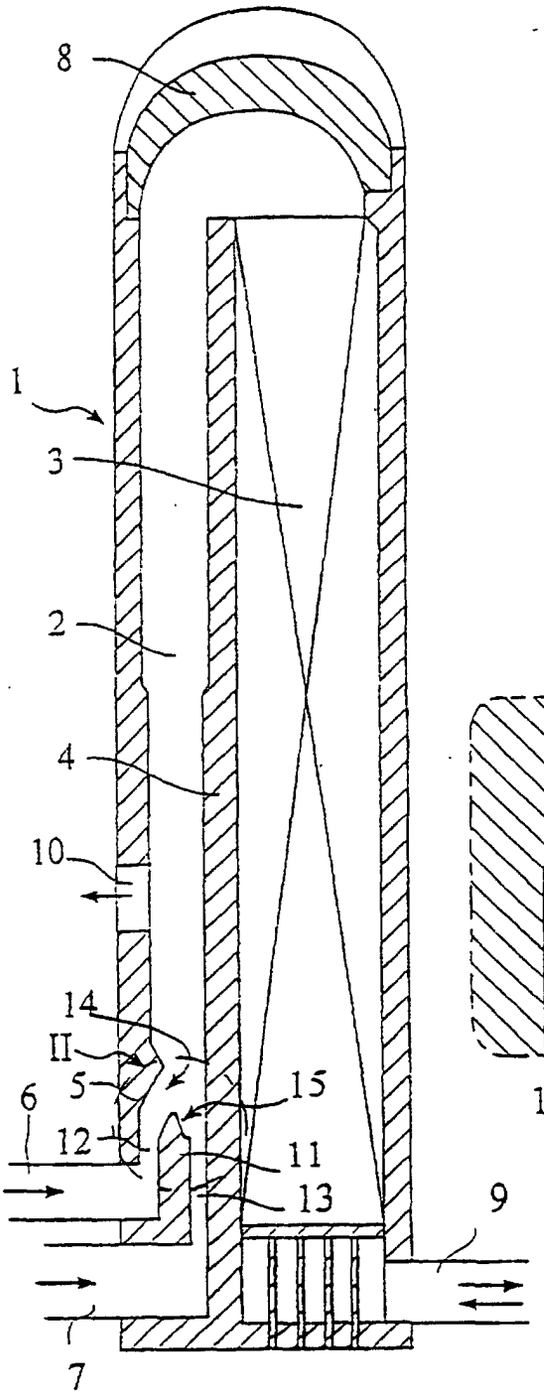

Fig. 2

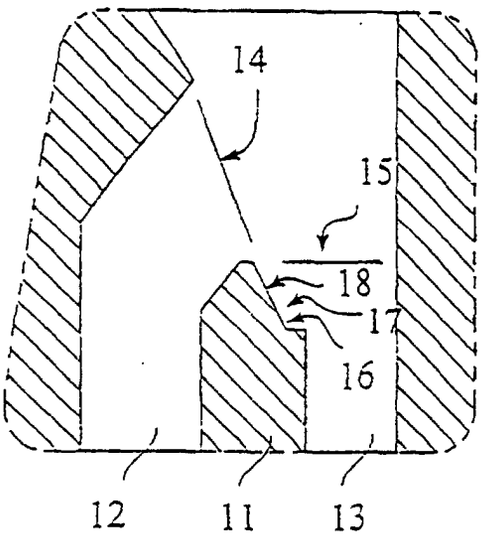

Fig. 3