(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 090 096**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **82200389.3**

(22) Date of filing: **30.03.82**

(51) Int. Cl.³: **F 23 D 15/00**, C 21 B 9/10

(43) Date of publication of application: **05.10.83**
Bulletin 83/40

(84) Designated Contracting States: **BE DE FR GB IT NL**

(71) Applicant: **HOOGOVENS GROEP B.V., P.O. Box 10.000, NL-1970 CA IJmuiden (NL)**

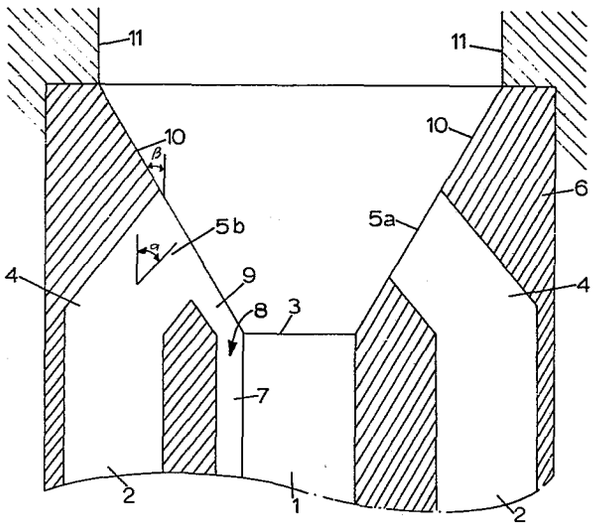
(72) Inventor: **Van Den Bemt, Johannes Cornelis Antoin, Essenlaan 10, Schagen (NL)**

(74) Representative: **Zuidema, Bert, Ir. et al, p/a HOOGOVENS GROEP B.V. P.O. Box 10.000, NL-1970 CA IJmuiden (NL)**

(54) A ceramic burner for gas, particularly for a hot-blast stove for a blast furnace.

(57) Burner has parallel vertical supply ducts (1, 2) for the two combustion components (gas and air). A first one (1) of said ducts opens upwardly at a first outlet (3) which is substantially oblong in plan view and the second (2) of said ducts opens at a plurality of second outlets (5a, 5b) which are located on either side of and above the first outlet (3), the general discharge directions of the second outlets, (5a, 5b) being oblique to that of the first outlet (3).

The first outlet (3) has, as seen in plan view, a slot shape and has, in its long sides, a plurality of recesses (8) which extend outwardly towards the second outlets (5a, 5b). The second outlets (5a, 5b) are arranged alongside the said long sides of the first outlet (3) with the second outlets (5a, 5b) on one side opposite those on the other side. The recesses (8) are, along the length of the first outlet (3), located alternately in said long sides and, on each said long side, directed towards alternate ones (5b) of said second outlets (5a, 5b).



EP 0 090 096 A1

"A ceramic burner for gas, particularly for a hot-blast stove for a blast furnace"

This invention relates to a ceramic burner, particularly such a burner for a hot-blast stove of a blast furnace. The invention also relates to a hot-blast stove having such a ceramic burner.

A ceramic burner of a hot blast stove is located in the combustion shaft of the stove. German patent specification no. 1,803,984 illustrates a ceramic burner having parallel vertical supply ducts for the two components of combustion, namely combustion gas and combustion air, wherein a first supply duct opens upwardly at a substantially oblong first outlet and the second supply duct opens at second outlets arranged in two sets above and on either side of the first outlet, the discharge directions of the second outlets being oblique to that of the first outlet.

In burners for hot blast stoves, it is of major importance that scarcely any combustible components of the combustion gas should be left unburned. To avoid nuisance to the environment, strict limitations are imposed in this respect by the authorities in various countries. On the other hand, it is also important that the surplus of air for combustion should be kept as low

as possible, in order to achieve the highest possible temperature of the gaseous combustion products. To achieve both these aims, it is necessary for the combustion components to be thoroughly and uniformly mixed together as they leave the openings of the burner.

The above-mentioned German specification describes a burner in which the first outlet has a wholly rectangular shape, and the first set of second outlets are located at a distance from those of the second set. This causes the combustion ingredients discharged from the various outlets to flow through and alongside one another, as a result of which they become mixed together. It now appears that this mixing can be further improved.

It is the object of the present invention to provide a burner which improves this mixing action and the homogenisation of the gas/air mixture, so as to achieve a more complete combustion of the combustion gas.

According to the invention, the first outlet has a slot shape and has, in its long sides recesses located opposite alternate ones of said second outlets on each side, the second outlets on one side being respectively opposite those on the other side. This arrangement produces an entirely different flow pattern from that of the design shown in German specification 1,803,984. The flow-streams of the combustion component from the two

sets of second outlets are no longer directed alongside one another, causing them to penetrate the flow-stream of combustion component being discharged from the first outlet; instead combustion component from the second outlets is now directed towards and along the flow-stream of the combustion component from the first outlet. This is because the outlets of the two sets are not located at a distance from one another. Thorough mixing and homogenisation is achieved through the presence of the recesses in the slot shape of the first outlet. These recesses cause intensive turbulence around the long sides of the first outlet, resulting in a rapid and effective mixing and homogenisation of the various currents of gas. The mixing action in this instance is therefore achieved not so much by spraying various gas jets across one another, but by directing thin strata of gas towards one another instead and causing them to diffuse at an accelerated rate on account of increased turbulence.

This appears to produce a more settled flame pattern with more complete combustion of the combustion gas than has so far been possible using burners known hitherto.

A further improvement in the formation of mixing turbulence may be achieved if the second outlets located between the above-mentioned alternate ones of said second

outlets lie in planes extending outwards and upwards obliquely away from the first outlet, the recesses in the first outlet being formed by rectangular-section grooves which extend upwardly to the first outlet in the side walls of the first duct, said grooves extending obliquely parallel to said planes from said first outlet so as to intersect the respective said alternate ones of said second outlets. In many cases, the known ceramic burners are constructed of several separate refractory elements. In order to keep down the costs of the apparatus, it is generally attempted to construct the burner where possible from refractory elements which differ as little as possible in shape. It has been found that this may be achieved very effectively when the recesses are provided by grooves in this manner.

The shape of the flame, its stability, and the completeness of combustion of the combustion gas are influenced among other things by the location of these oblique planes and the directions in which the combustion components are discharged in relation to one another. Good results may be achieved if the oblique planes are inclined at an angle β of 15 to 45° relative to the vertical and wherein the discharge directions of the second outlets are inclined at an angle α of 30 to 70° to this vertical direction. Preferred values are 35 to 40°

for angle α, and 25 to 30o for angle β.

It has appeared that a relatively simple and effective construction may be achieved if the recesses are square in shape as seen in plan view with a side length equal to 25 to 40% of the width of the slot-shape of the first outlet.

The preferred embodiment of the invention will now be described by way of non-limitative example with reference to the accompanying drawings, in which:-

Fig. 1 illustrates, in plan view, the tip of a ceramic burner in accordance with the invention,

Fig. 2 is a cross section along the line II-II in Fig. 1 on an enlarged scale,

Fig. 3 shows one side of the burner viewed in perspective along the line III-III in Fig. 1.

The installation and use of the illustrated ceramic burner of the invention in the combustion shaft of a hot-blast stove are completely in accordance with the state of the art, as described for example in German patent specification 1,803,984. Further description and explanation about this is therefore superfluous.

Combustion gas is supplied through a central duct 1 in the burner tip 6 and discharged at a first outlet 3 into a combustion shaft of a hot-blast stove. The outlet 3 has an elongate slot-shape, as seen in plan view. Two

boundary surfaces 10 (see Fig. 2) of the burner tip extend outwards and upwards at an angle from the outlet 3 to connect with the wall 11 of a combustion shaft which is partly shown in Fig. 2 but not in Fig. 1. The surfaces 10 are inclined at an angle β of 30° to the vertical.

On each side of the supply duct 1, there is an air supply duct 2 which discharges via an obliquely extending duct-section 4 into second outlets 5a and 5b. These second outlets are in two sets, one on each side of the first outlet 3. Each set has outlets 5a alternating with outlets 5b as explained further below. The discharge angle of these duct sections 4 through the outlets 5a and 5b is indicated in Fig. 2 as α, wherein α is 36°. The outlets 5a are at the level of the planes 10.

The long side walls of the supply duct 1 has grooves 7 of a square cross section which continue as similarly shaped grooves 9 on reaching the surface of the burner tip 6. The grooves 9 open into the duct sections 4 at the outlets 5b. This effectively results in the outlets 5b being set back from the outlets 5a by an amount equal to the depth of the grooves. Outlets 5a and 5b alternate with each other within each set of outlets and furthermore occupy alternate positions in one set of outlets relative to the other. The grooves 7 form a

square recess, as seen in Fig. 1, in the outlet 3 at the point where this outlet 3 discharges from suply duct 1. As Fig. 1 shows, these recesses alternate from one side of the outlet 3 to the other, in the longitudinal direction of the outlet 3.

Fig. 3 illustrates the side of the burner in perspective, from which the course of the grooves 7 and 9 and the recessed position of outlets 5b relative to outlets 5a are clearly visible.

Fig. 1 illustrates how outlets 5a and 5b of one set on one side of outlet 3 are each arranged in the same plane (i.e. directly opposite) as an outlet 5a or 5b from the other set on the other side of outlet 3. Air for combustion discharged from these sets of outlets 5a and 5b does not therefore flow through the central gas current but towards and along it. The particular design of the recesses 8 and the effectively recessed position of outlets 5b, as indicated in the drawings, give rise to an exceptionally turbulent transition layer between the currents of gas and air, as a result of which more or less ideal homogenisation of gas and air is achieved over a very short distance. This results in a stable flame shape and highly uniform and complete combustion of the combustion gas without too large an excess of combustion air.

CLAIMS:

1. A ceramic burner for gas, for a combustion chamber of a hot-blast stove of a blast furnace, having parallel vertical supply ducts (1,2) for the two combustion components (gas and air), a first one (1) of said ducts opening upwardly at a first outlet (3) which is substantially oblong in plan view and the second (2) of said ducts opening at a plurality of second outlets (5a,5b) which are located on either side of and above the first outlet (3), the general discharge directions of the second outlets being oblique to that of the first outlet,

characterised in that:

as seen in plan view, the first outlet (3) has a slot shape and has, in its long sides, a plurality of recesses (8) which extend outwardly towards the second outlets (5a,5b) which are arranged alongside the said long sides of the first outlet (3) with the second outlets on one side opposite those on the other side, the recesses (8) being, along the length of the first outlet, located alternately in said long sides and, on each said long side, directed towards alternate ones (5b) of said second outlets.

2. A burner according to claim 1 wherein the second outlets (5a) located between said alternate ones (5b) of said second outlets lie in planes (10) which extend obliquely upwardly away from the first outlet (3) on the two sides thereof, and the said recesses (8) are formed by rectangular-section

grooves (7) which extend upwardly to the first outlet (3) in the side walls of the first duct (1), said grooves (7) extending obliquely parallel to said planes (10) (at 9) from said first outlet (3) so as to intersect the respective said alternate ones (5b) of said second outlets.

3. A burner according to claim 2 wherein said oblique planes (10) are each at an angle (β) in the range 15° to 45° to the vertical and the discharge directions of said second outlets (5a,5b) are each at an angle (α) in the range 30° to 70° to the vertical.

4. A burner according to claim 3 wherein $35° < \alpha < 40°$ and $25° < \beta < 30°$.

5. A burner according to any one of claims 1 to 4 wherein said recesses (8) are square in shape as seen in plan view and have a depth which is equal to 20 to 30% of the width of the said first outlet (3).

0090096

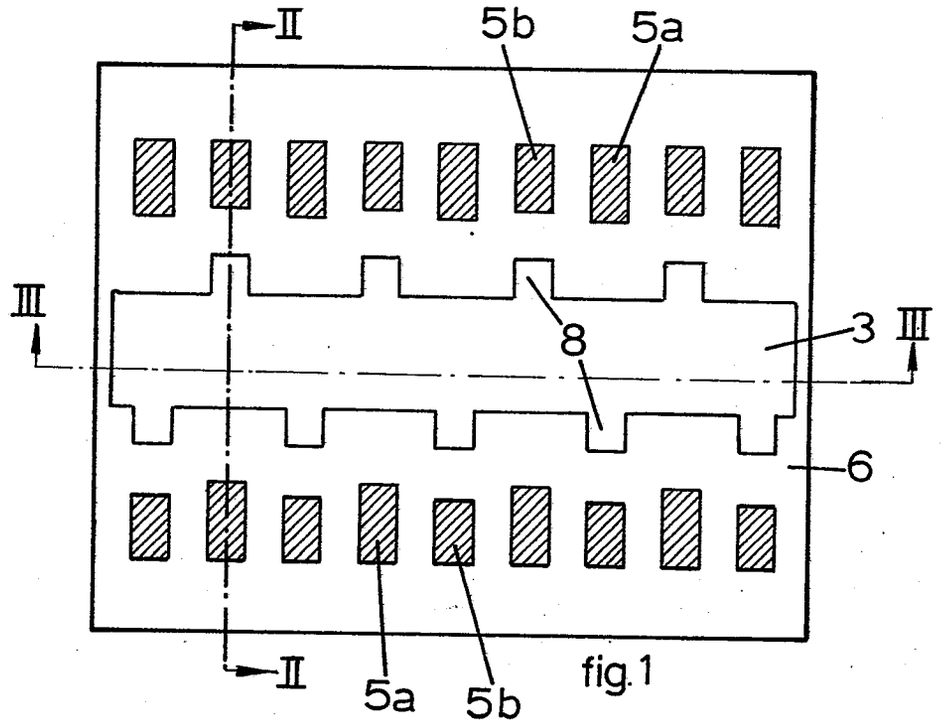


fig.1

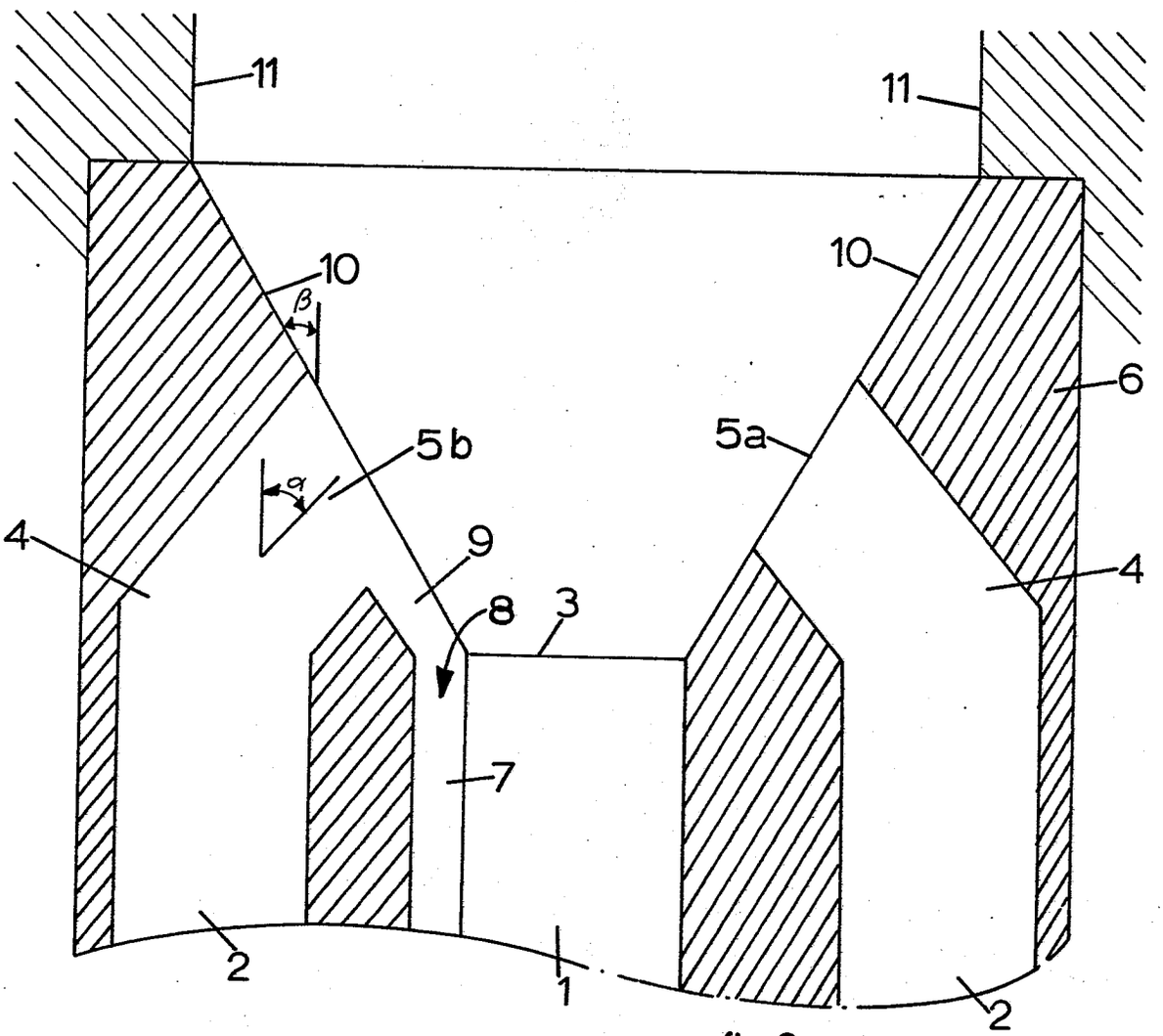


fig.2

0090096

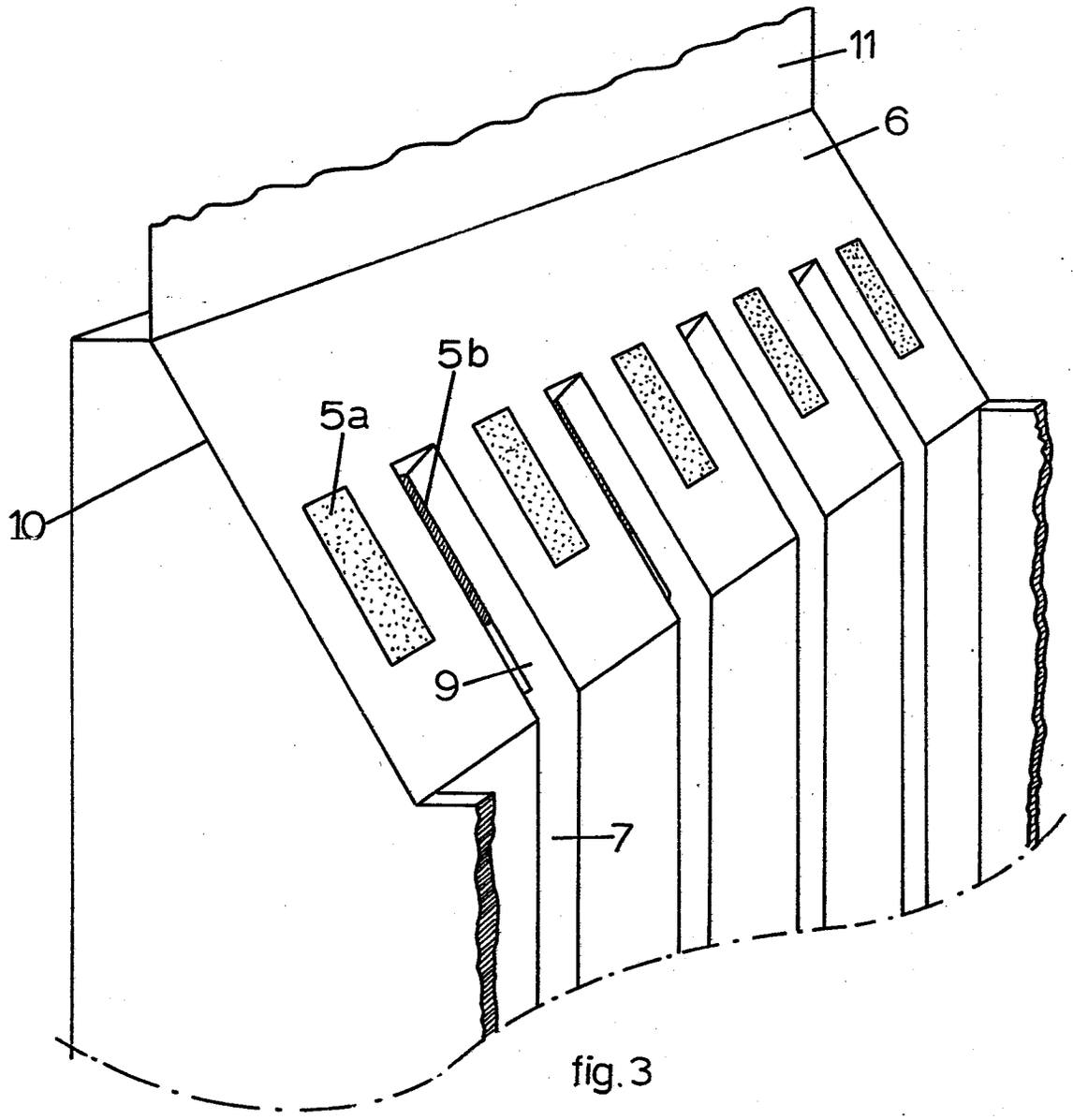


fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

0090096
Application number

EP 82 20 0389

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A,D	DE-A-1 803 984 (DIDIER-WERKE A.G.) *Page 3, line 6 - page 5, line 8; page 7, first lin - page 8, last line; figures 2,3* & US - A - 3 568 932 & GB - A - 1 290 503	1,2,3	F 23 D 15/00 C 21 B 9/10
A	US-A-2 583 736 (HESS) *Column 1, line 50 - column 5, line 69; figures 2,3*	1	
A	FR-A-2 083 311 (KONINLIJKE NEDERLANDSCHE HOOGOVENS EN STAALFABRIEKEN N.V.) *Page 4, line 32 - page 5, line 22; figures 1,2* & GB - A - 1 324 297 & NL - A - 70 03 722	1	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 23 D
C 21 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01-12-1982	SARRE K.J.K.TH.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82