



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.01.2018 Bulletin 2018/02

(51) Int Cl.:
F23D 14/22 (2006.01)

(21) Application number: **17460040.3**

(22) Date of filing: **06.07.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(72) Inventors:
• **Klein, Marek**
80-301 Gdansk (PL)
• **Heda, Lukasz**
80-180 Gdansk (PL)
• **Dariusz, Kaminski**
03-028 Warszawa (PL)

(30) Priority: **06.07.2016 PL 41786416**

(74) Representative: **Jedrzejewski, Michal**
Kancelaria prawno-patentowa
ul. Rogalinska 1/44
01-206 Warszawa (PL)

(71) Applicant: **Metal Expert Sp. z o. o. sp. j.**
00-195 Warszawa (PL)

(54) **HIGH-TEMPERATURE GAS-FIRED BURNER**

(57) A high-temperature gas-fired burner having a main burner and a pilot burner, an air inlet pipe and a fuel inlet pipe, and a ring channel that supplies fuel, characterised in that it has a main burner (1a) and a pilot burner (1) with adjustable power, positioned centrally on the mounting plate (2), in the housing of the main burner. In the housing of the main burner (1a), around the pilot burner (1) there is an internal, ring-type fuel inlet channel (8) and an external, ring-type air inlet channel (9). At the end of the internal ring-type fuel inlet channel (8), there is a fuel gap (4) with an adjustment thread (3), and the said fuel gap is equipped with fuel swirling blades (6). At the end of the external ring-type air inlet channel (9), there is an air gap (5) equipped with air swirling blades (5). The ring-type fuel inlet channel (4) has an electric heating coil.

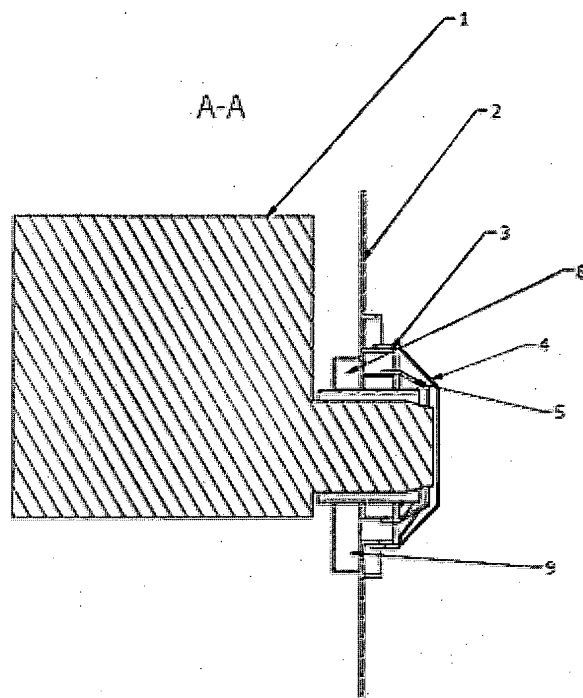


Fig. 3

Description

[0001] The subject of the invention is a high-temperature gas-fired burner. According to the invention, the burner can be used in industrial combustion systems, combustion chambers of power generation boilers, or steam generators.

[0002] Patent literature describes a number of types of gas-fired burners, including burners fired with low-calorific gas and pyrolytic gas.

[0003] A structural solution in the form of a burner used for powering a rotary furnace which, in turn, produces clinker-based cement, is known from patent description PL 190798. In this solution, the pilot burner is located centrally in the burner axis. Fuel is supplied via a middle ring channel, and the air is supplied through two external channels, which are arranged primarily concentrically and around the fuel line; the portion of the air in one of the air lines flows primarily axially, whereas the portion of the air in the second air line contains the air that has a component of rotation around the central axis of the burner, and the amount of primary air in the said two parts is controlled independently.

[0004] Patent document PL 296849 describes another known solution used for powering heating furnaces, in which gaseous fuel is supplied via an outer ring, and an oxidizing agent is supplied via an internal channel. This burner has been designed for standardised gaseous fuel, and after ignition, the burner burns in an autonomous manner.

[0005] The manner of combustion and the burner for burning pyrolytic gases, described in patent document PL 363413, is also known, characterised in that it contains an internal sleeve with a diffuser, the outer sleeve, and three middle sleeves. The internal sleeve and the external sleeve, as well as the three middle sleeves, form channels, including the internal channel that supplies pyrolytic waste gas for burning, the adjacent middle channel that supplies primary air to the diffuser, and the further two middle channels that supply natural gas and air for burning, whereas the open external channel is used for supplying secondary air. In the described solution, it was assumed that the gas derived from the pyrolysis process is low-calorific, and it is supplied via an internal channel, whereas a high-calorific gas, e.g. methane, is supplied via one of the external rings. The use of the pilot burner is not necessary since the mixture is enriched with methane and burns spontaneously. Process gas flows through the diffuser, the use of which has an adverse effect on contaminated streams, due to their possible clogging.

[0006] The solutions used so far, however, pose a problem with clogging of the nozzles by heavy hydrocarbons condensing inside.

[0007] The essence of the invention is a high-temperature gas-fired burner having a main burner and a pilot burner, an air inlet pipe and a fuel inlet pipe, and a ring channel that supplies fuel, characterised in that it has a main burner and a pilot burner with adjustable power,

positioned centrally on the mounting plate, in the housing of the main burner. In the housing of the main burner, around the pilot burner there is an internal, ring-type fuel inlet channel, and an external, ring-type air inlet channel. At the end of the internal ring-type fuel inlet channel, there is a fuel gap with an adjustment thread, and the said fuel gap is equipped with fuel swirling blades. At the end of the external ring-type air inlet channel, there is an air gap equipped with air swirling blades. The ring-type fuel inlet channel has an electric heating coil.

[0008] The main advantage of the subject of the invention is that it provides a continuous, stable flame of hot pyrolytic gas. Due to its simplified structure, the solution is free of problems with nozzle clogging.

[0009] An example embodiment of the invention has been schematically presented in the drawing, in which Fig. 1 shows the entire device in side view,

[0010] Fig. 2 - the inlet pipes of the device, Fig. 3 - a longitudinal section of the burner, and Fig. 4 - a cross-section of the burner.

[0011] The embodiment of the invention as per Fig. 1-3 applies to the pyrolysis process. As a result of the pyrolysis process conducted in a classical manner, three types of products are obtained: a gaseous stream, a liquid stream, and solid products. When the process is directed so that the maximum possible amount of gaseous products is generated, it is beneficial to direct the entire gaseous stream directly to the gas burner, avoiding cooling of the gaseous stream and condensation of heavy hydrocarbons. Gases with high temperatures in the range of 200-800°C, derived from the pyrolysis process, contain components of varying composition, which include heavy hydrocarbons. These gases, when cooled, partly condense. The use of a high-temperature burner makes it possible to carry out the combustion process at a temperature so high that there is no need for a complicated gas cleaning system, and the waste fraction of heavy hydrocarbons is not formed.

[0012] The high-temperature gas-fired burner has a main burner 1a and a pilot burner 1 with adjustable power, positioned centrally on the mounting plate 2 in the housing of the main burner 1a. The air is supplied to the main burner 1a via an air inlet pipe 10, and the fuel is supplied via a fuel inlet pipe 10a. In the housing of the main burner 1a, around the pilot burner 1, there is an internal, ring-type fuel inlet channel 8 and an external, ring-type air inlet channel 9. At the end of the internal ring-type fuel inlet channel 8, there is a fuel gap 4 equipped with fuel swirling blades 6. At the end of the external ring-type air inlet channel 9, there is an air gap 5 equipped with air swirling blades 7. The ring-type fuel inlet channel 8 has an electric heating coil not shown in the drawing. The fuel gap 4 has an adjustment thread 3. Both the gaps 4 and 5 act as nozzles.

[0013] The process of combustion of high-temperature gases consists in supplying the gas derived from the pyrolysis process into the gas inlet channel 8, and then into the fuel gap 4 with a flow rate of 5 to 1000 m³. Via air

inlet channel 9, the air in the total amount needed for combustion is also supplied, and at the outlet of both the channels, there are fuel swirling blades 6 and air swirling blades 7. The fuel gap 4 is, additionally, resistively heated to avoid condensation of heavy hydrocarbons during starting and extinguishing of the system.

[0014] The pilot burner 1 is positioned centrally on the mounting plate 2 in the housing of the main burner, and functions both as the source of ignition, and the element that stabilises the combustion of high-temperature gas. The pilot burner can be fired with natural gas, LPG or fuel oil. Furthermore, the burner allows continuous power adjustment, depending on steam pressure in steam generators or temperature in boilers. The air and the fuel are supplied to the main burner 1a through the inlet pipes 10 and 10a, and through the ring-type fuel inlet channel 8 and the ring-type air inlet channel 9. As for the combustion chamber, the air and the fuel are supplied to the said chamber via two gaps - the external fuel gap 4 and the internal air gap 5. On each of the gaps 4 and 5, swirling blades 6 and 7 are installed. The fuel gap 4 provides the possibility to adjust the opening size with the adjustment thread 3, and this allows for coarse adjustment of the burner's power, thereby ensuring a wide operating range. The main burner 1a, due to the applied continuous power adjustment for the pilot burner 1, allows working with gases with calorific value of less than 1000 kcal/m³ - i.e. the gases that cannot spontaneously combust - as well as with gases with calorific value of more than 1000 kcal/m³, that undergo spontaneous combustion. This feature is essential during starting and extinguishing of the system, when the gases with low heating value are produced, whereas when the process is already underway, the pilot burner 1 can be completely turned off or work at a minimum power. The function of the pilot burner 1 is not only to support and stabilise the work of the main flame, but also to select an adequate level of power - through the continuous power adjustment - so as to provide the required operating parameters (temperature, steam pressure) of the heat receiver, i.e. a boiler or steam generator.

[0015] The burner fired with pyrolytic gas worked for 800 hours. No fluctuations in the operation of the burner were detected, and after its disassembly and dismantling, no deposits of heavy hydrocarbons, that result from combustion of low-quality fuel, were observed. After 1000 hours, the burner was not clogged.

[0016] According to the invention, the burner is characterised by simple design and absence of complex stabilising and swirling elements, the result of which is simple manufacturing and low production costs. The burner also allows for adjustment of the size of the fuel gap 4 in the main burner. An initial adjustment is all that it takes to adapt the burner to the gas obtained in the system. The ring-type gas inlet channel 8, via which the fuel is supplied, has an electric heating coil installed, which is useful at the stage of starting and extinguishing the operation of the system. Electric resistive heating is aimed

at minimising the possibility of clogging the burner by hydrocarbons that undergo condensation.

5 Claims

1. A high-temperature gas-fired burner having a main burner and a pilot burner, an air inlet pipe and a fuel inlet pipe, and a ring channel that supplies fuel, **characterised in that** it has a main burner (1a) and a pilot burner (1) with adjustable power, positioned centrally on the mounting plate (2) in the housing of the main burner, and in the housing of the main burner (1a), around the pilot burner (1), there is an internal, ring-type fuel inlet channel (8) and an external, ring-type air inlet channel (9); and furthermore, at the end of the internal ring-type fuel inlet channel (8), there is a fuel gap (4) with an adjustment thread (3), and the said fuel gap is equipped with fuel swirling blades (6), whereas at the end of the external ring-type air inlet channel (9), there is an air gap (5) equipped with air swirling blades (5), and the ring-type fuel inlet channel (4) has an electric heating coil.

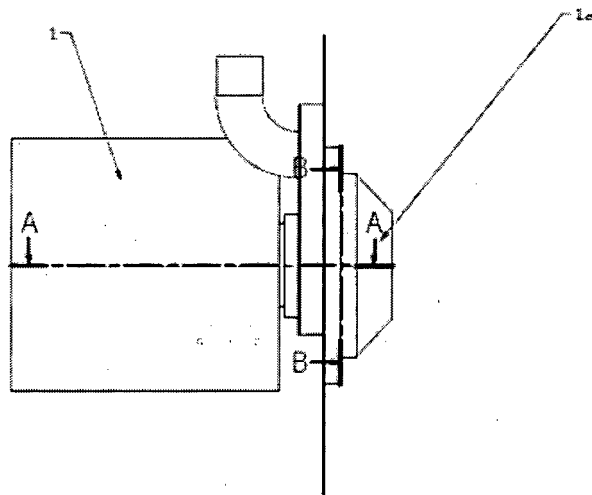


Fig. 1

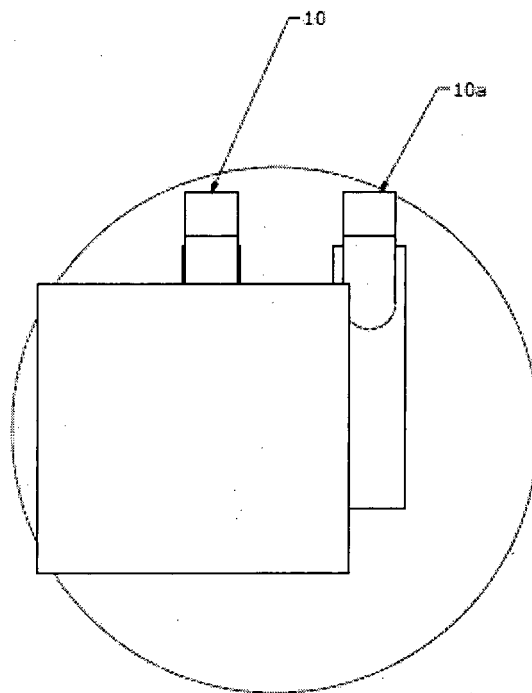


Fig. 2

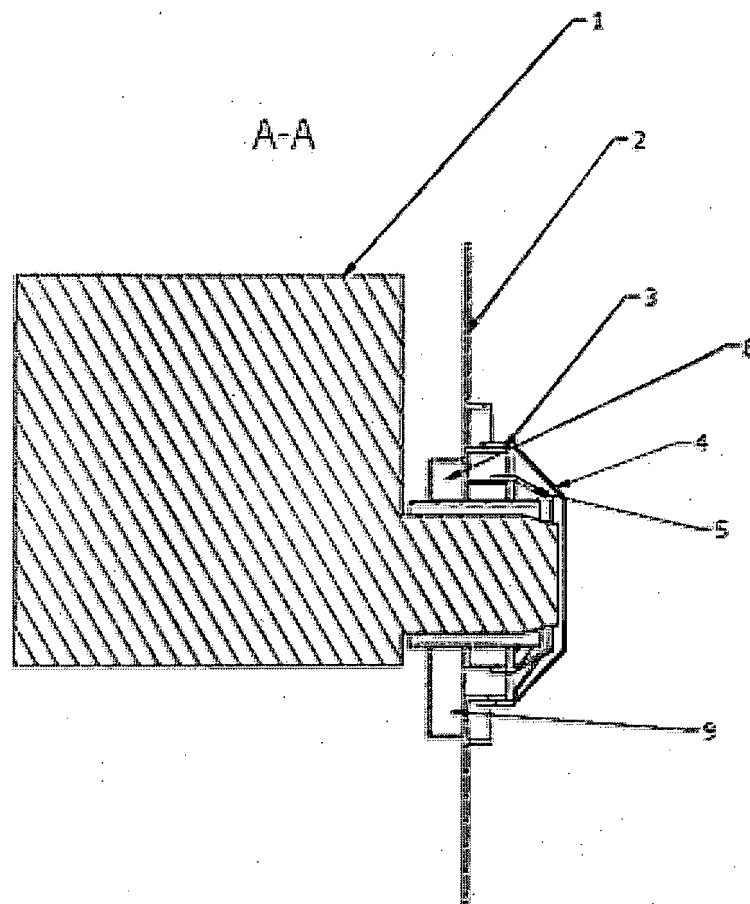


Fig. 3

B-B

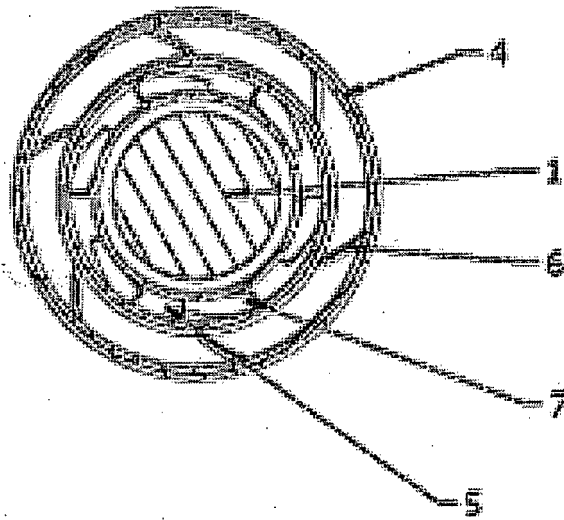


Fig. 4



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 46 0040

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT				
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)	
Y	US 2008/163627 A1 (ELKADY AHMED MOSTAFA [US] ET AL) 10 July 2008 (2008-07-10) * paragraphs [0034], [0042], [0053]; figures 4, 8 *	1	INV. F23D14/22	
Y	GB 501 298 A (GEN GAS APPLIANCES LTD; FREDERICK STEWART COLEMAN) 24 February 1939 (1939-02-24) * page 1, lines 16-31; figures 2-4 *	1		
Y	US 2 255 318 A (HAWLEY JAMES R) 9 September 1941 (1941-09-09) * page 3, lines 65-66 * * page 4, lines 25-27 *	1		
A	US 2005/097889 A1 (PILATIS NICKOLAOS [GB] ET AL) 12 May 2005 (2005-05-12) * figure 2 *	1		
A	US 3 713 588 A (SHARPE C) 30 January 1973 (1973-01-30) * figure 3 *	1		TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 407 720 A2 (GEN ELECTRIC [US]) 18 January 2012 (2012-01-18) * figures 7-9 *	1		F23D F23C F23G F23R
A	GB 346 969 A (REGENT MALLEABLE CASTINGS LTD; ALFRED ERNEST DAVIES) 23 April 1931 (1931-04-23) * page 1, lines 25-48; figures 1, 2 *	1		
A	WO 03/083366 A1 (JUNG HYUN-BAE [KR]; LEE SANG-KYOO [KR]) 9 October 2003 (2003-10-09) * page 4, lines 17-18 * * page 6, lines 16-18 * * figures 1-2 *	1		
		-/--		
The present search report has been drawn up for all claims				
Place of search The Hague		Date of completion of the search 8 November 2017	Examiner Nicolas, Pascal	
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				



EUROPEAN SEARCH REPORT

Application Number
EP 17 46 0040

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2014 218219 A1 (SIEMENS AG [DE]) 17 March 2016 (2016-03-17) * claim 1 * * Bezugszeichenliste; page 3 * * paragraphs [0028], [0029]; figure 1 * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 November 2017	Examiner Nicolas, Pascal
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 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 46 0040

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-11-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008163627 A1	10-07-2008	CN 101220953 A	16-07-2008
		DE 102008003300 A1	17-07-2008
		JP 5330693 B2	30-10-2013
		JP 2008170146 A	24-07-2008
		KR 20080065935 A	15-07-2008
		US 2008163627 A1	10-07-2008

GB 501298 A	24-02-1939	NONE	

US 2255318 A	09-09-1941	NONE	

US 2005097889 A1	12-05-2005	EP 1391653 A2	25-02-2004
		US 2005097889 A1	12-05-2005

US 3713588 A	30-01-1973	CA 947097 A	14-05-1974
		GB 1328623 A	30-08-1973
		US 3713588 A	30-01-1973

EP 2407720 A2	18-01-2012	CN 102330978 A	25-01-2012
		EP 2407720 A2	18-01-2012
		US 2012011854 A1	19-01-2012

GB 346969 A	23-04-1931	NONE	

WO 03083366 A1	09-10-2003	AU 2003225357 A1	13-10-2003
		WO 03083366 A1	09-10-2003

DE 102014218219 A1	17-03-2016	CN 107076410 A	18-08-2017
		DE 102014218219 A1	17-03-2016
		DE 112015004157 A5	24-05-2017
		US 2017254534 A1	07-09-2017
		WO 2016037846 A1	17-03-2016

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- PL 190798 [0003]
- PL 296849 [0004]
- PL 363413 [0005]