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

(11) EP 3 517 840 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.07.2019 Bulletin 2019/31

(21) Application number: **18466003.3**

(22) Date of filing: **23.07.2018**

(51) Int Cl.:
F23M 5/00 (2006.01) ***F23M 5/02*** (2006.01)
F23M 3/08 (2006.01)

(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:
KH MA MD TN

(30) Priority: **26.01.2018 CZ 201834634 U**

(71) Applicant: **Viadrus a.s.**
735 81 Bohumín (CZ)

(72) Inventor: **Buric, Ales**
735 81 Bohumín (CZ)

(74) Representative: **Vandelikova, Jana**
Vodickova 791/41
110 00 Praha 1 (CZ)

(54) **SOLID FUEL BOILER**

(57) The invention deals with a solid fuel boiler according to the presented invention, in particular a sectional cast iron boiler, consisting of a heat exchanger formed by mutually linked boiler sections, equipped with a furnace with a grate and a system of heat exchange channels, a combustion air inlet both to the fuel furnace space, and below the boiler grate, and also to combustion paths in the combustion chamber. The combustion chamber is situated between at least two modified boiler sections in the rear part of the boiler, whose essence is that in the combustion chamber there is a demountable brickwork for combustion gas exhaust from the furnace, consisting of individual ceramic liners which are combined to one unit together with a ceramic nozzle with a T-shaped through channel, which has at least two lines of holes for combustion air passage to the combustion chamber.

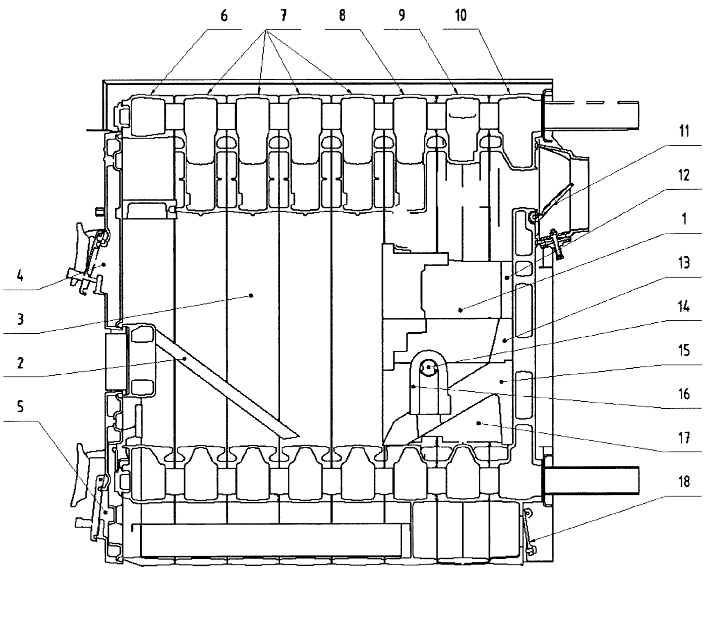

Figure 1

EP 3 517 840 A1

Description

Field of the Invention

[0001] The invention relates to hot water gasification solid fuel boilers, in particular the design of the boiler combustion chamber in which final fuel combustion occurs.

Background of the invention

[0002] When combusting solid fuels, which may include coal or wood, burn-through or burnup boilers are most frequently used in case of manual fuel feeding.

[0003] Burn-through boilers have a boiler grate on the bottom of the stocking area, on which fuel is deposited which subsequently gradually burns in the furnace only. Such boilers used to be wide-spread in the past, however, due to incomplete combustion, they had a low efficiency, and they have not currently met prescribed emission standards.

[0004] At present, gasification solid fuel boilers are most frequently used, where fuel does not burn through in the furnace. The fuel is only burnt up in the furnace, which includes fixed or movable grates, and flame and combustion gases are then conducted outside the furnace to the combustion chamber of the boiler where another, more efficient combustion of fuel is carried out. To achieve a high boiler efficiency and low emissions, it is therefore preferable that combustion in the combustion chamber is as complete as possible.

[0005] The combustion gas changer is situated in the rear part of the boiler body at known types of gasification boilers. For a more environmentally friendly way of combustion, the combustion chamber is lined with brickwork and combustion air is led to upper flames through a system of holes, which is mixed with residues of gases and enables their better burning.

[0006] Another known design solution of gasification boilers is where combustion air is led through the boiler shell to the combustion chamber and its outputs are designed as holes in an air tube wall, situated in the centre of the combustion chamber below the lower ends of the ceramic brickwork which lines up the combustion chamber.

[0007] More perfect technical solutions of the combustion chamber are also known, where a ceramic brickwork and a ceramic nozzles with through holes for air inlet are situated in the combustion chamber. Combustion gases formed during burnup of the fuel in the furnace flow to the combustion chamber, and at the same time combustion air is led to it, which is preheated, which partially improves combustion.

[0008] A disadvantage of these designs is that combustion chambers are relatively large due to long flue ways and combustion gas exhaust must be ensured by means of exhaust fans. This increases material costs for an adequate construction area of the combustion chamber and operating costs associated with power consumption for fan operation. Another disadvantage is that despite a more perfect solution of combustion chambers with air inlets sufficient amount of air does not get to the centre of the core of the burning volatile flammable substance, and this portion of the burning volatile flammable substance is not mixed and sufficiently burnt. Such unburnt particle then burden the surrounding environment.

Summary of the invention

[0009] The mentioned deficiencies of previously used solid fuel boilers are removed by a solid fuel boiler according to the presented invention, in particular a sectional cast iron boiler, consisting of a heat exchanger formed by mutually linked boiler sections, equipped with a furnace with a grate and a system of heat exchange channels, a combustion air inlet both to the fuel furnace space, and below the boiler grate, and also to combustion paths in the combustion chamber. The combustion chamber is situated between at least two modified boiler sections in the rear part of the boiler, whose essence is that in the combustion chamber there is a demountable brickwork for combustion gas exhaust from the furnace, consisting of individual ceramic liners which are combined to one unit together with a ceramic nozzle with a T-shaped through channel, which has at least two lines of holes for combustion air passage to the combustion chamber. It has a dynamic intermediate member for the distribution of combustion air inlet in the longer part of the tube of the ceramic nozzle in front of the outlet from the ceramic nozzle, and in the upper part of the combustion chamber there is a hole for short-circuit flap to the chimney exhaust hole in the rear boiler section.

[0010] A preferred embodiment of the solid fuel boiler is the one if the dynamic intermediate member situated in a tube of the ceramic nozzle has one or both ends equipped with holes for combustion air passage.

[0011] An advantage of this embodiment of the boiler is that to burn fuel with a large proportion of volatile combustible matter in the combustion chamber, there is a common demountable ceramic liner and a hollow ceramic nozzle with a T-shaped through channel in the combustion chamber, where possibility to demount the brickwork is not maintenance-demanding, is reliable during operation and easily produced, and repairable. Combustion gases formed by burning up the fuel in the furnace flow to the combustion chamber through the lower ceramic liner and at the same time combustion air is led to the combustion chamber. The lower ceramic liner is equipped with a brickwork with a shaped cavity in the lower part for pre-heating the combustion air, and with a flange in the upper part for precise location of a ceramic nozzle with a cylindrical T-shaped flow-through channel, and a system of at least two lines of tangentially led through holes for combustion air inlet to the combustion chamber. Combustion air is heated up thanks to the contact with heat-transferring ceramic liners and the ceramic nozzle to a high temperature, and therefore it is better mixed in the contact with the volatile combustible matter at the inlet to the combustion chamber.

[0012] The ceramic nozzle is preferably situated in an optimum place of the inlet upward draught of the combustion chamber so that in the direct contact with the volatile combustible matter with the lower shell of the ceramic nozzle, the volatile combustible matter is divided to several streams of combustible gases passing around the ceramic nozzle, and the preheated combustion air could more easily and very quickly penetrate into the divided streams of the volatile combustible matter by means of tangentially led through holes.

[0013] It is more preferable to place a dynamic member to the longer part of the ceramic nozzle tube, i.e. to the upper section of the through channel of the combustion air in the ceramic nozzle, which equally distributes the stream of heated combustion air to side through holes of the nozzle, and also adjusts combustion air flow rate to the flow rate of the burning volatile combustible matter in the combustion chamber. If the dynamic intermediate member also has holes in its limit ends, the combustion air also flows to several sides of the ceramic nozzle, which results in an optimum mixing along the entire inner cross-section of the combustion chamber.

[0014] It is preferable that the said division of one stream of the volatile combustible matter to more streams of volatile combustible matter and the inlet of combustion air through the ceramic nozzle with a dynamic intermediate member enables a more efficient control of an optimum volume of heated combustion air which is necessary for their mutual thorough mixing and enables to achieve air turbulence because the combustion air is led through the ceramic nozzle along its whole cross-section. As a result of this equal and very fast mixing of the heated combustion air with the volatile combustible matter, oxidation in the gas phase increases and hydrocarbon, carbon oxide and unburnt particle emissions are reduced, and at the same time the space necessary for the production of the combustion chamber and ceramic brickwork is also reduced. Forcing the combustion air by means of the ceramic nozzle with a T-shaped through channel with an inserted dynamic intermediate member requires a small amount of energy and it is not necessary to use an exhaust fa, and therefore a drive of such fans is also not necessary. This is a reason why in the rear boiler section there is a shape-optimized short-circuit flap above the area of combustible gas outlet from the combustible chamber. By using this short-circuit flap, flue gas paths are much faster heated and the boiler can be commissioned significantly faster without the necessity to use an exhaust fan, where combustion gases will reach a very high temperature in the combustion chamber very soon, which is optimum for secondary burning and the occurrence of emissions is reduced as early as during commissioning of the boiler.

Brief description of the drawings

[0015] Figure 1 shows a diagram of a solid fuel boiler with areas for combustion of fuel in the furnace and in the combustion chamber, and Figure 2 shows a dynamic intermediate member of the ceramic nozzle and Figure 3 is a side view of the ceramic nozzle with an inserted dynamic intermediate member and their cross-section.

Detailed description of the invention

[0016] The figures show an example of the solid fuel boiler embodiment which consists of a boiler body formed by a system of mutually linked boiler sections, i.e. the front section 6, four middle sections 7, two middle sections and a combustion chamber 8, 9 and a rear section 10, a furnace 3 with a grate and a combustion chamber 1 with a ceramic brickwork and a ceramic nozzle 16. The combustion chamber 1 is created in the area among three last boiler sections 8, 9, and 10. The ceramic brickwork in the combustion chamber 1 consists of a lower ceramic liner 15, a middle ceramic liner 13 and an upper ceramic liner 12, which are composed into one unit by means of connecting lock recesses. A ceramic nozzle 16 with a T-shaped through channel is fixed to the lower ceramic liner 15 in which a dynamic intermediate member 14, which has holes for the passage of combustion air at both its ends for the distribution of inlet of the combustion air. In the upper part of the combustion chamber 1 there is a hole in the rear section 10 for the short-circuit flap 11 to the exhaust chimney hole. In the area of the furnace 3 there is an inclined additional grate 2 for feeding the fuel, whose upper part in fact continues the stoking door 4, and to exhaust combustion gases formed by the burning up fuel in the furnace 3 there is a hole to the area of the combustion chamber 1 in its rear lower part. The boiler is equipped with a stoking door 4 with a regulated input for the inlet of combustion air to the area of fuel, and an ash pan door 5 with a regulated input for the inlet of combustion air under the boiler grate. In the rear part of the boiler there is a with a regulated input 18 of combustion air to combustion paths in the area of the combustion chamber 1 and the chamber 17 for its pre-heating from heat-transferring ceramic brickworks.

Industrial applicability

[0017] The aforementioned solution can be preferably used for combustion chambers of cast iron sectional solid fuel boilers with manual stoking for the preparation of hot water and/or hot domestic water. The aforementioned method can be preferably used for environmentally friendly combustion of fuel wood and wooden compressed fuel.

Claims

1. A solid fuel boiler according to the presented invention, in particular a sectional cast iron boiler, consisting of a heat exchanger formed by mutually linked boiler sections, equipped with a furnace with a grate and a system of heat exchange channels, a combustion air inlet both to the fuel furnace space, and below the boiler grate, and also to combustion paths in the combustion chamber. The combustion chamber is situated between at least two modified boiler sections in the rear part of the boiler, **characterized by the fact** whereas that in the combustion chamber (1) there is a demountable brickwork for combustion gas exhaust from the furnace (3), consisting of individual ceramic liners which are combined to one unit together with a ceramic nozzle (16) with a T-shaped through channel, which has at least two lines of holes for combustion air passage to the combustion chamber (1). It has a dynamic intermediate member (14) for the distribution of combustion air inlet in the longer part of the tube of the ceramic nozzle (16) in front of the outlet from the ceramic nozzle (16), and in the upper part of the combustion chamber (1) there is a hole for short-circuit flap (11) to the chimney exhaust hole in the rear boiler section (10).

2. A solid fuel boiler according to claim 1, **characterized by the fact** that the dynamic intermediate member (14) situated in a tube of the ceramic nozzle (16) has one or both ends equipped with holes for combustion air passage.

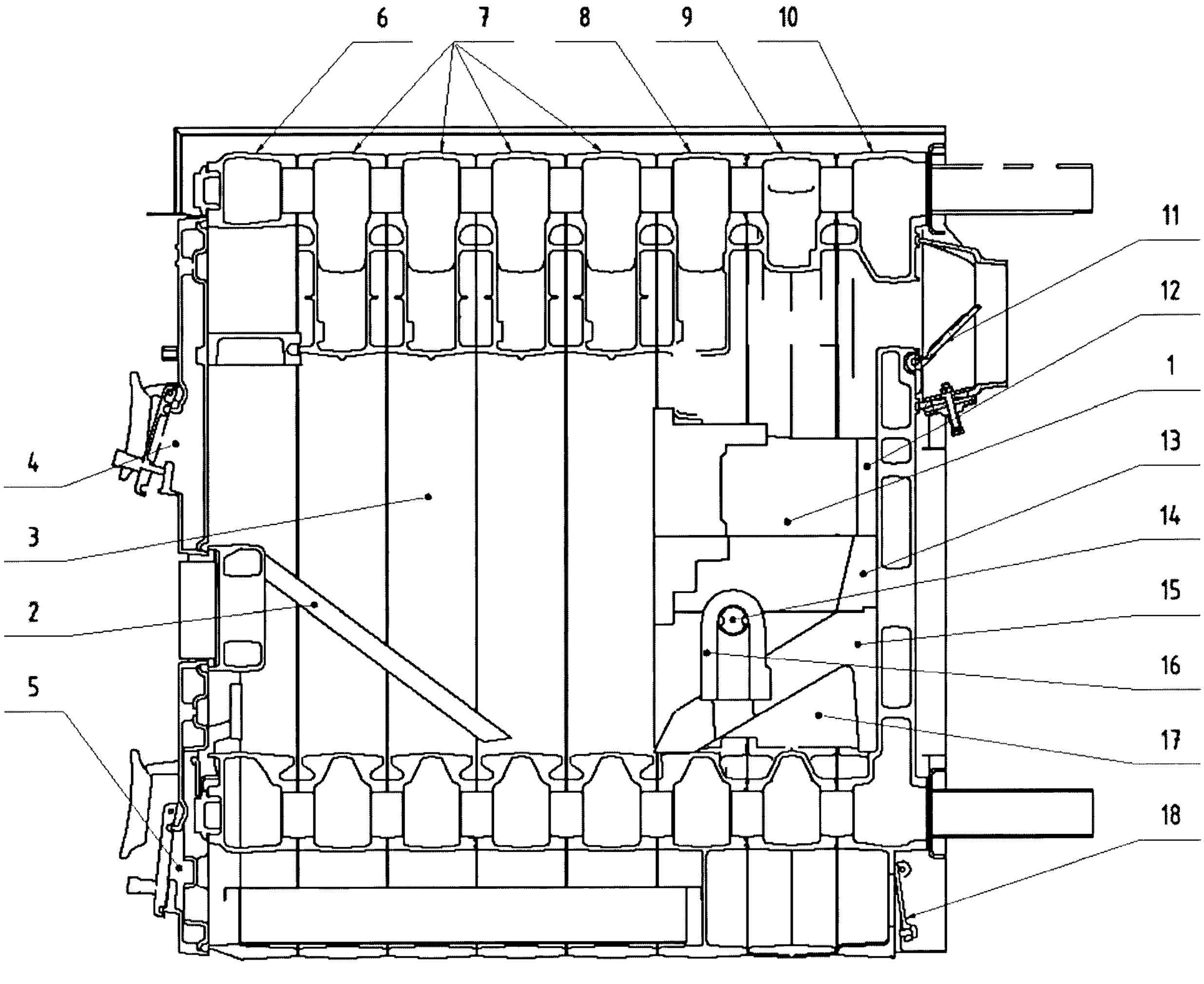

Figure 1

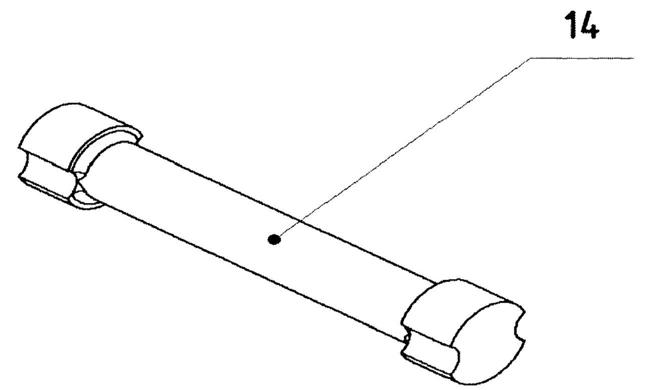

Figure 2

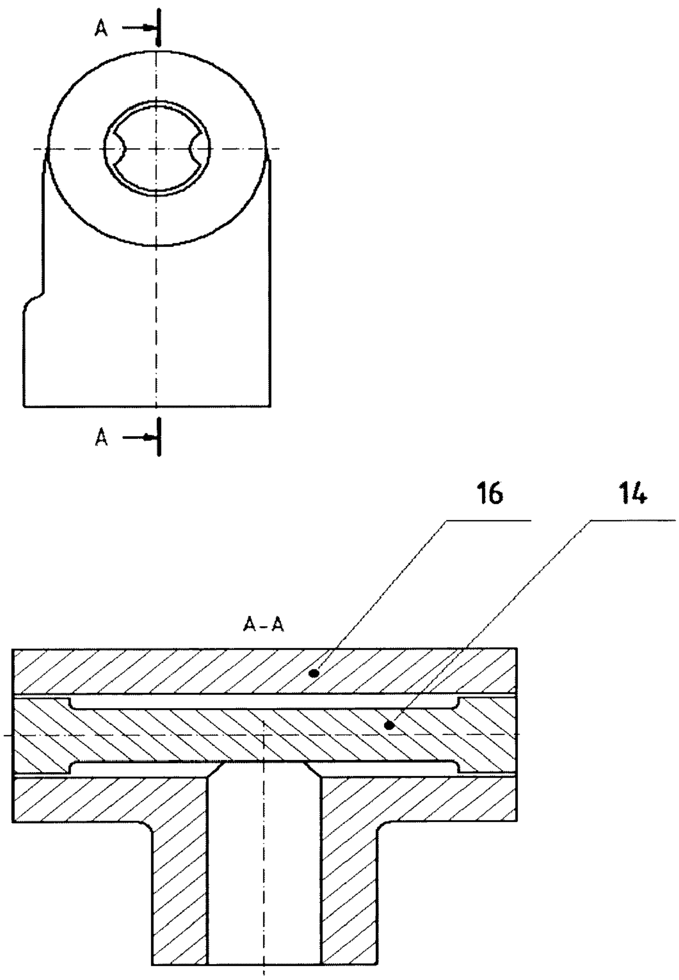

Figure 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 46 6003

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	US 1 753 286 A (RUSSELL DOHERTY JAMES) 8 April 1930 (1930-04-08) * page 1, lines 1-3; figures 1-3 * * page 1, lines 8-25 * * page 1, line 44 - page 2, line 37 * * page 2, line 104 - line 122 * -----	1,2	INV. F23M5/00 F23M5/02 F23M3/08
A	US 2 398 911 A (ABEL LOUIS H) 23 April 1946 (1946-04-23) * page 1, column 1, line 1 - line 5; figures 1-4 * * page 1, column 1, line 54 - page 2, column 1, line 44 * -----	1	
A	DE 646 281 C (GRAF JOSEF) 11 June 1937 (1937-06-11) * page 1, line 1 - line 75; figure 1 * -----	1	
A	DE 34 06 763 A1 (ACKERMANN KARL [DE]) 29 August 1985 (1985-08-29) * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

F23M
F23B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 May 2019	Hauck, Gunther

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 18 46 6003

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.

20-05-2019

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 1753286	A	08-04-1930	NONE		
US 2398911	A	23-04-1946	NONE		
DE 646281	C	11-06-1937	NONE		
DE 3406763	A1	29-08-1985	AT 398825	B	27-02-1995
			DE 3406763	A1	29-08-1985

EPO FORM P0459

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