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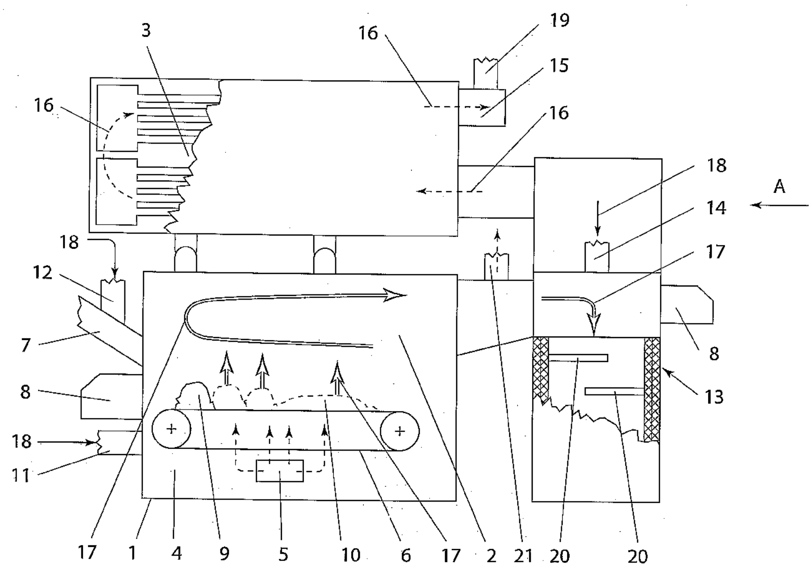
(54) Title: METHOD AND APPARATUS FOR GASIFYING AND BURNING PELLETS MADE FROM HERBACEOUS PLANTS



(57) Abstract: The object of the invention is a method for gasifying and burning pellets made from herbaceous plants, particularly from energy grass in a boiler. The method involves determining in advance the melting point of pellet ash, feeding the pellets on a travelling grate located in the combustion chamber of the boiler and igniting the in- fed pellets. Gasifying air and recycled flue gas is passed trough the pellet bed, where the supplied gasifying air is sufficient only for the incomplete combustion of pellets, with the produced combustible gas being burned utilizing in-fed auxiliary air, and combustion heat being captured by passing the flue gases through flue gas tubes of the water-heating heat exchanger of the boiler.

WO 2006/117579 A1

Method and apparatus for gasifying and burning pellets made from herbaceous plants

The object of the invention is a method for gasifying and burning pellets made from herbaceous plants, particularly from energy grass in a boiler, comprising the steps of determining in advance the melting point of pellet ash, feeding the pellets on a travelling grate located in the combustion chamber of the boiler and igniting the in-fed pellets. Gasifying air and recycled flue gas is passed trough the pellet bed, where the supplied gasifying air is sufficient only for the incomplete combustion of pellets, with the produced combustible gas being burned utilizing in-fed auxiliary air, and combustion heat being captured by passing the flue gases through flue gas tubes of the water-heating heat exchanger of the boiler.

A further object of the invention is a boiler for carrying out the inventive method, comprising a combustion chamber disposed in an insulated boiler body, and a water-heating heat exchanger connected to the combustion chamber. A travelling grate is disposed in the combustion chamber, and a feed spout, adapted for feeding the pellets on the travelling grate, is connected to the combustion chamber. An ignition device extends into the combustion chamber, the combustion chamber being fitted with a duct for the introduction of gasifying air. The boiler further comprises a control unit controlling the amount of in-fed air flows, the amount of in-fed fuel and the ignition of the ignition device depending on the temperature of hot water generated in the water-heating heat exchanger and/or the composition of flue gases.

The inventive method can be expediently applied primarily for satisfying larger power needs (100 kW-2 MW), such as the heat demand placed by the hot-water heating systems of industrial and office buildings. The inventive boiler is suited especially for burning energy grass pellets or ground rape-cake.

Heat generating and heat recovery apparatuses have been known and used for a very long time. The state of the art includes apparatuses and methods utilizing various fuels, all striving to make use of an ever wider range of fuel types more and more economically, observing environmental regulations at the same time.

An apparatus suitable for burning lump and granular fuel is disclosed by utility model description AT 004 798U. The boiler comprises a combustion chamber bounded by thermally insulated walls, with the combustion chamber being separated from the ash space disposed below by a grate. A burner is attached to the combustion chamber above the grate. The burner has a casing comprising slanting side walls, with a fuel feeding conveyor screw being introduced into the casing, and with primary air inlet openings being disposed at the bottom of the casing and secondary air inlet openings being disposed on the upper portion thereof. The introduction of secondary air from above makes it possible to achieve an explicitly horizontal flue gas outflow from the burner, the flow being directed upwards and getting mixed with flue gases from fuel burned on the grate only above the grate, which makes feasible independent firing through the grate and the burner.

Rising energy prices and the growing need for recycling rapidly accumulating waste has lead to the development of boilers suitable for the burning of combustible by-product materials such as coal fines or sawdust. Such a combustion apparatus, suitable for granular solid fuel such as wood pellets or granulated sawdust is disclosed by EP 1277012. The apparatus comprises a combustion chamber with a fan feeding air into it. A feed spout opens into the combustion chamber, with a feed screw transferring fuel from the feed spout to the combustion chamber. Air inlet openings adapted for the introduction of air into the combustion chamber are disposed on the bottom and side wall of the combustion chamber.

Besides conventional fuels and combustion methods, devices utilizing renewable energy have been assuming an increasing role. Plants developed for energetic purposes have several advantages over conventional fuels. These advantages are becoming manifest on the one hand in replacing known (fossil) fuels that will inevitably be depleted, and on the other in observing stricter and stricter environmental regulations. Utilized as fuel, grass species that produce high amounts of dry matter and high quality raw cellulose can replace conventional fuels used for smaller-scale applications and in larger generating plants. The heating value of certain energy grass cultivars may reach or exceed the heating value of certain woods, for instance poplar, willow, and locust, and thus they are exceedingly suitable for generating electricity. These grass varieties can be grown on various soil types, are weather-hardy, disease-resistant and undemanding. The above advantages call for the development of combustion methods and combustion apparatus that can burn such plants, for instance energy cane or energy grass in an economical and environmentally friendly way.

Burning energy grass may be carried out by making uniform-sized pellets from the grass and utilizing it as fuel. Because of the high amount of harmful materials contained in their flue gases (way above environmental emission limits), energy grass pellets cannot be burned in an economical and environmentally friendly way in conventional combustion devices or boilers conventionally applied for burning wood pellets. A further difficulty is posed by combustion products getting deposited on the boiler wall during the burning of energy grass. Accumulated deposits form a non-removable layer which results in permanent damage to the boiler.

Another group of combustion methods includes fuel gasification. Fuel gasification has been used since the 19th century, e.g. for producing combustible gas, the so-called "town gas" from coal. However, with the discovery of natural gas reserves and the building of pipelines this type of fuel has lost its market. Since the 1970s natural gas demand and prices have been growing steadily, and the danger of natural gas reserves getting depleted directed interest towards gasifying once again. Recently, climate change and the undertakings arising from the Kyoto Treaty have foregrounded gasifying methods, as this type of energy generation is much cleaner than conventional methods, such as burning coal.

Gasification systems primarily apply coal or oil as feedstocks, but methods for gasifying biomass are also known. Because gasification characteristics of biomass and coal are very different, new methods and apparatuses were needed for biomass gasification. In the 90s, large biomass gasification plants were built in Europe. These plants, however, had several construction, operation and safety issues, which has significantly injured the industry's reputation.

Our invention is based on the recognition that in case fuel is gasified and also burned in the combustion chamber of the boiler, problems related to gas storage and transport can be avoided, and an efficient and environmentally friendly method can be realised.

Combustion characteristics of pellets made from herbaceous plants are affected by physical and chemical parameters. Physical characteristics, such as particle size, density, shape or strength depend on the parameters of the production method. Chemical parameters, of which the most important are moisture content and ash content from the aspect of combustion characteristics, may widely vary depending on the plant variety, on growing conditions and soil parameters. The main components of fuels made from herbaceous plants are C, H, O, N, S, Cl on the one hand, and Si, Al, Ca, K, Ma, P, Na and Fe on the other, which latter are responsible for ash characteristics. Known methods for chemical analysis use either the fuel or its ash for establishing the quantity of relevant elements.

From the aspect of combustion technology, it is the N, S and Cl content of the pellet what is really important because NO_x, SO_2 and HCl emission is determined by the amounts of these elements. The amount of alkali metals, alkaline earth metals and silicium contained in the pellet is also important because the melting point of pellet ash is determined by the mixture of oxides, sulphates, or carbonates of these elements. On the basis of combustion characteristics and the composition of the pellet the melting point of the ash can also be determined using phase diagrams known from literature, or in case the pellets in question are available at hand, ash melting point can be measured. Melted ash may cause deposits on the inner wall of the burner, which can lead to reduced combustion efficiency, or in adverse cases even to explosion.

Our inventive insight includes the recognition that, even though pellets made from herbaceous plants have high Si, alkali metal and alkaline earth metal content, these pellets can be gasified without the formation of deposits potentially damaging the interior of the boiler.

The inventive objective is realised according to the method described in the introduction, by carrying out the gasifying and burning of the pellet in the combustion chamber of the boiler, with the combustible gas being burned in a post-combuster, adjusting at the same time the amount of gasifying air and recycled flue gas and/or the thickness of the pellet bed such that the temperature thereof remains below the melting point temperature of the produced ash, and adjusting the amount of auxiliary air, the temperature and retention time of flue gases in the post-combuster to ensure the perfect combustion of the combustible gas.

The method advantagously comprises the step of introducing the recycled flue gas into the combustion chamber under the travelling grate. Gasifying air is introduced into the combustion chamber in the vicinity of the ignition device and/or through the feed spout.

The amount of gasifying air is controlled depending on the temperature of hot water generated in the water-heating heat exchanger and/or the composition of the produced flue gases.

In a preferred way of carrying out the inventive method, the temperature of combustible gas entering the post-combuster is set to a value in the range of 800 - 1000 ^{O}C. It is also advantageous if the transition time of the combustible gas through the post-combuster is chosen to be at least 2 seconds.

The inventive method is carried out with the application of the boiler described in the introduction, which is essentially characterised by that a duct adapted for recycling flue gas and a duct adapted for introducing gasifying air into the feed spout are connected to the combustion chamber under the travelling grate, and by that a post-combuster comprising an ignition device and a duct adapted for introducing auxiliary air is disposed downstream of the combustion chamber and upstream of the water-heating heat exchanger.

According to a preferred embodiment of the inventive boiler the ignition device is a burner for wood pellets. Another preferred embodiment has the ignition device implemented as a gas or oil burner.

According to a further preferred embodiment, gaps between the elements of the travelling grate are increasing in the direction of translation. The travelling grate can be moved intermittently or continuously.

According to a still further preferred embodiment of the inventive boiler the post-combuster has thermally insulated walls and flue gas baffle plates. In the post-combuster the ignition device is disposed opposite the combustible gas inlet duct. The duct adapted for introducing auxiliary air is disposed at the upper part of the post-combuster in such a way that it leads auxiliary air into the combustible gas flow.

In a preferred embodiment of the boiler a chamber separator is disposed in the post-combuster. According to a still further preferred embodiment the duct adapted for introducing combustible gas into the post-combuster comprises a flue gas safety vent.

For recycling flue gas a return section is built into the flue gas duct.

The invention is described in detail by referring to the accompanying drawings, where

Fig. 1 is the schematic view of the boiler according to the invention, and

Fig. 2 shows the post-combuster from the direction indicated by an arrow in Fig. 1.

Fig. 1 shows the schematic view of the boiler body 1, combustion chamber 2, water-heating heat exchanger 3, and post-combuster 13 of the inventive boiler. The post-combuster 13 connects the combustion chamber 2 and the water-heating heat exchanger 3, the post-combuster 13 being located downstream of the former and upstream of the latter. The dimensions and general configuration of the water-cooled boiler body 1, the combustion chamber 2 and the water-heating heat exchanger 3 is identical with conventional boilers known in the art. Gasifying air and auxiliary air are indicated in the drawings with continuous arrows 18. Combustible gas is indicated with double arrows 17, and flue gases are indicated with dashed arrows 18.

A travelling grate 6 is built into the combustion chamber 2 of the boiler. The travelling grate is disposed in the combustion chamber 2 in a manner that a small gap is left at the fuel-feed location, that is, the pellet feed spout 7, between the boiler body 1 and the travelling grate 6, thereby preventing in-fed pellets from falling down to the ash space 4. The size of the gap between the travelling grate 6 and the boiler body 1 at the other end of the travelling grate 6 is chosen so as to enable burnt-out ash to fall down to the ash space 4 located under the travelling grate 6. The travelling grate 6 consists of elements connected by a chain welded to them. Between the links welded to the elements other, loosely fitted links are disposed that enable grate elements to move relative to each other and also to roll on the built-in wheels. The chains roll on grooved and grooved and sprocketed wheels and move the grate by means of a three-phase electric motor. Such a configuration of the travelling grate 6 enables the formation of varying-width gaps between grate elements.

The varying-width gap between the elements of the travelling grate 6 can be provided by other means as well. For instance, the solution according to which the driven sprocket wheel is turned to some extent in reverse direction with respect to the direction of translation in case the travelling grate 6 is being moved intermittently also falls within the scope of our invention. Another possible solution can be the addition of a supporting sprocket wheel between the driving and driven sprocket wheels and setting gap sizes between grate elements to different values in the two chain sections. Differently sized gaps between grate elements ensure the perfect gasifying or burning-out of pellets advancing on the travelling grate 6.

According to the preferred embodiment of the invention, the travelling grate 6 is moved intermittently. As soon as the first pellet batch 9 fed on the grate has been ignited, the grate is moved forward a predefined amount, and the next pellet batch 9 is fed on the grate. Moving forward inside the combustion chamber 2, pellet batches get gasified and collapse to form a pellet bed 10. The amount of in-fed pellet depends on the rated power of the boiler. The solution according to which the travelling grate 6 is moved continuously also falls into the scope of the invention. In that case grate speed should be chosen such that the pellet bed 10 is completely gasified or burnt out when it reaches the end of the grate.

A feed spout 7 is connected to the combustion chamber 2. The feed spout 7 is connected to a pellet container (not shown in the drawing) via a feeding means. The feed spout 7 is directed through the boiler body towards the combustion chamber such that the pellet batch 9 falls onto the travelling grate 6. Above the travelling grate 6 a guide plate is disposed in the combustion chamber. The guide plate is utilized for setting the height of the pellet batch 9 and for that purpose it can be moved in the combustion chamber 2 in a direction perpendicular to the translation direction of the travelling grate 6.

A duct 12 adapted for introducing gasifying air is connected to the feed spout, through which air can be fed into the combustion chamber 2 together with the pellets. Such a manner of introducing gasifying air improves the drying of pellets and makes it easier to feed pellets into the combustion chamber 2.

Under the feed spout 7 an ignition device 8 is passed through the boiler body 1, extending into the combustion chamber. The ignition device 8 may be a conventional oil or gas burner but other types of burner, such as burners for wood pellets can also be applied. The pellet batch 9 fed on the travelling grate 6 is ignited with the application of the ignition device 8 and by air passed through it. The ignition device 8 is operated until pellets heaped on the travelling grate 6 are ignited.

An inlet opening for a duct 5 adapted for introducing flue gas is disposed in the combustion chamber under the travelling grate 6. Through the duct 5 a portion of the flue gases is reintroduced into the combustion chamber 2 from the flue gas duct 15 via return section 15. The heat content of recycled flue gas can thus be utilized, and the temperature of the pellet bed 10 can be controlled effectively by mixing the flue gas with gasifying air.

Under the ignition device 8 a duct 11 adapted for introducing gasifying air enters the combustion chamber 2. Air introduced through gasifying air duct 11 gets mixed with air fed in through duct 12 and with recycled flue gases, getting passed through the grate and the pellet bed 10 located thereon. Passing through the pellet bed 10 the gas mixture carries off volatile combustible substances released from the pellets. The flow of combustible gas is indicated by a double arrow 17 in the drawing. Air and flue gas inlet ducts may be disposed in a number or configuration different from the one described above. It may be advantageous for the better distribution of introduced air and flue gas if the boiler body 1 has an inlet duct in the vicinity of the end of the travelling grate 6, implemented in such a way that the gas stream enters the boiler space between the two sections of the grate and subsequently passes through it. Gasifying air introduced in the vicinity of the end of the travelling grate 6 contributes to the perfect gasifying and burning of the pellets and prevents particles not yet entirely burnt from falling into the ash space. The scope of our claims includes a configuration where gasifying air and recycled flue gas is introduced into the combustion chamber 2 through multiple ducts and/or a duct or ducts disposed at alternative locations (with respect to those described above) of the combustion chamber 2, where the gases can be directed into the desired direction by means of baffle plates.

Combustible gases are lead from the combustion chamber 2 into the post-combuster 13. The post-combuster is permanently attached to the boiler and is implemented as a thermally insulated block-shaped body with rectangular cross section and concrete walls covered with sheet iron. Introduced flue gases pass through the post-combuster along an U-shaped path. Portions forming the stems of the U-shaped passage are connected at the bottom with an increased cross-section chamber separator that reverses the direction of flow. Due to the reduced flow speed in the separator, solid pollutants are trapped. The length of the U-shaped passages is chosen such that gases are kept in the post-combuster 13 for at least 2 seconds. Flue gas baffle plates 20 adapted for disturbing the laminar flow of gas and facilitating the mixing of combustible gas are built into the post-combuster 13. The flue gas baffle plates 20 are implemented as refractory plates, preferably concrete plates fitted together in a manner resembling the teeth of a comb.

An ignition device 8 is disposed in the post-combuster 13 opposite the combustible gas inlet duct. Such a placement of the ignition device 8 serves the perfect combustion of the in-fed combustible gas. According to the preferred embodiment the ignition device 8 is a burner for wood pellets operated intermittently. A duct 14 adapted for introducing gasifying air is disposed at the upper portion of the post-combuster, through which air needed for the perfect combustion of combustible gas is fed into the post-combuster 13. The inlet of the duct 14 feeding air into the post-combuster 13 is implemented in such a way that in-fed air is thoroughly mixed with the combustible gas, directing the gas flow downwards inside the post-combuster 13.

Flue gases leaving the post-combuster 13 are lead into the water-heating heat exchanger 3 where they transfer their heat cotent to the water to be heated.

A flue gas safety vent 21 is connected to the duct section which connects the combustion chamber 2 with the post-combuster 13. Flue gases can leave the apparatus through flue gas safety vent 21 due to natural draught even if the operation of the post-combuster 13 is halted because of a power outage or for any other reason.

The boiler is equipped with a control unit that is known in the art. The control unit receives signals about water temperature in the hot water conduit and about the composition of the flue gases, and takes action to control the thickness of the pellet batch 9 and the amount of gasifying and auxiliary air. Signals received by the control unit can be applied for controlling the fuel supply and on and off times of the ignition devices 8.

The boiler is also equipped with structural elements conventionally utilized with known art boilers, such as air feed and flue gas exhaust fans, recycling fans, feeders, and appliances utilized for monitoring and safety purposes.

By adjusting the amount of gasifying air and recycled flue gas the amount of combustible gases leaving the pellet bed 10 and thus the temperature of hot water produced in the water-heating heat exchanger can be controlled. In case higher-temperature water is needed, the amount of combustible gases can be increased by raising the amount of gasifying air. However, the amount of gasifying air should be increased only to a point where temperatures remain below the melting point of ash and below the ash sintering temperature.

The output power of the boiler depends on the amount of in-fed pellets and the length of the travelling grate 6. The size of the travelling grate 6 should be chosen such that under optimal circumstances all combustible substances contained in the pellet bed 10 are completely gasified or burnt before they reach the end of the grate.

Combustible gases driven out of the pellet bed 10 by gasifying air and recycled flue gases flow into the upper portion of the combustion chamber 2 and subsequently into the post-combuster 13, where they get mixed with air fed in through the duct 14 adapted for introducing auxiliary air and are burnt at the increased temperature provided by the ignition device 8. The amount of air fed into the post-combuster 13 through the duct 14 adapted for introducing auxiliary air is chosen to ensure perfect combustion. The ignition device 8 is operated with a frequency providing that the initial temperature of gases entering the post-combuster is in the range of 800 - 1000 ^{o}C. The composition of flue gases can be monitored by means of sensors located in the flue gas outlet duct, and the measured data can be used to adjust the amount of auxiliary air.

Flue gases are passed from the post-combuster 13 into the water-heating heat exchanger 3 along the path indicated by the dashed arrow 16, where they transfer their heat content to the water to be heated. According to a preferred embodiment of the boiler a portion of flue gases can be recycled from the flue gas duct 15 into the combustion chamber 2 through return portion 19. With the above configuration it is provided that a part of the heat content of the flue gases and residual combustible material potentially present in the boiler can be exploited.

Example

We used the inventive boiler for burning pellets made from "Szarvasi-1" energy grass. The composiiton of the pellet was the following: 42,5 C%, 0,42 N%, 5,78 H%, 44,6 O% and <1 Cl%, moisture content 6,08% avg., volatile content 67,86% avg. The heating value of the pellet was 17356 kJ/kg. The initial temperature of pellet ash sintering was 650-680 ^{o}C, with ash softening beginning at 750-780 ^{o}C, and intensive melting beginning at 800-820 ^{o}C. SiO_2 content of the slag was 607 g/kg, with K_2O, Na_2O, Fe_2O_3, Al_2O_3, CaO, and P_2O_5 content being significant.

Knowing the composition of the applied fuel, and the melting and sintering point of ash it is obvious that the temperature of the pellet bed in the boiler should be kept under 650 ^{o}C to prevent slag from melting and also to prevent undesired deposits. Thus, the temperature of the pellet bed was adjusted such that the boiler operated with a safe margin below the initial temperature of ash sintering. The amount of gasifying air and recycled flue gas being passed through the pellet bed was chosen in such a way that pellet bed temperature was kept under 470 °C to safely ensure the prevention of damage caused by layers potentially deposited on the boiler body.

The "Szarvasi-1" energy grass pellet was burnt in an automatic three-pass hot water boiler having the following main features:

rated power	350 kW
maximum operating pressure	3 bar
combustion chamber pressure	-30 Pa
fuel consumption	46 kg/h of energy grass
ignition devices	wood pellet burners
Overall dimensions of the boiler	
height	2980 mm
width	1400 mm
length	3910 mm

Starting the boiler involved first igniting the ignition device 8 implemented as a burner for wood pellets, and then starting the grass pellet feeder and flue gas exhaust devices. We started burning the pellet batches 9 ensuring that temperature was kept low enough (under 470 °C), by adjusting the thickness of the pellet bed 10 formed from energy grass pellets falling onto the travelling grate 6 and the amount of gasifying air. Combustion temperature can also be checked by monitoring slag colour. If slag has brownish colour and its texture is porous, without any melting or agglomeration occurring and with the colour changing into gray and the slag getting easily crumbled when cooled off, the temperature of combustion is successfully kept low enough.

The temperature of flue gases leaving the boiler during its operation was 230 °C. The following amounts of harmful substances were measured in the flue gases:

Harmful emissions

CO_2	7,2 %
CO	43 ppm
NO_x	33 ppm
O_2	11 %

The main advantage of the invention is that it provides a possibility for utilizing cheaply producible herbaceous plants for energetic purposes. With the method carried out applying the inventive boiler, pellets made from herbaceous plants can be utilized for energy generation both on a smaller and larger (power plant) scale, in a manner that can be competitive with known energy sources.

List of reference numerals

boiler body
combustion chamber
water-heating heat exchanger
ash space
duct
travelling grate
feed spout
ignition device
pellet batch
pellet bed
duct
duct
post-combuster
duct
flue gas duct
arrow
arrow
arrow
return section
flue gas baffle plate
flue gas safety vent

Claims

1. Method for gasifying and burning pellets made from herbaceous plants, particularly from energy grass in a boiler, comprising the steps of determining in advance the melting point of pellet ash, feeding the pellets on a travelling grate located in the combustion chamber of the boiler, igniting the in-fed pellets, directing gasifying air and recycled flue gas trough the pellet bed, where supplied gasifying air is sufficient only for the incomplete combustion of pellets, burning the produced combustible gas utilizing in-fed auxiliary air, and capturing combustion heat by passing the flue gases through flue gas tubes of the water-heating heat exchanger of the boiler,

characterised by that

the gasifying and burning of pellet is carried out in the combustion chamber of the boiler, with the combustible gas being burned in a post-combuster, adjusting at the same time the amount of gasifying air and recycled flue gas and/or the thickness of the pellet bed such that the temperature thereof remains below the melting point temperature of the produced ash, and adjusting the amount of auxiliary air, the temperature and retention time of flue gases in the post-combuster to ensure the perfect combustion of the combustible gas.

2. The method according to Claim 1, characterised by that the recycled flue gas is introduced into the combustion chamber under the travelling grate.

3. The method according to Claim 1, characterised by that gasifying air is introduced into the combustion chamber in the vicinity of the ignition device and/or through the feed spout.

4. The method according to Claim 1, characterised by that the amount of gasifying air is controlled depending on the temperature of hot water generated in the water-heating heat exchanger and/or the composition of the produced flue gases.

5. The method according to Claim 1, characterised by that the temperature of combustible gas entering the post-combuster is set to a value in the range of 800 - 1000 ^{o}C.

6. The method according to Claim 1, characterised by that the transition time of the combustible gas through the post-combuster is at least 2 seconds.

7. Boiler for carrying out the method according to Claim 1, comprising a combustion chamber (2) disposed in an insulated boiler body (1), a water-heating heat exchanger (3) connected to the combustion chamber (2), with a travelling grate (6) being disposed in the combustion chamber, and with a feed spout (7) adapted for feeding the pellets on the travelling grate (6) being connected to the combustion chamber, and with an ignition device (8) extending into the combustion chamber (2), the combustion chamber being fitted with a duct (11) for the introduction of gasifying air, the boiler further comprising a control unit controlling the amount of in-fed air flows, the amount of in-fed fuel and the ignition of the ignition device (8) depending on the temperature of hot water generated in the water-heating heat exchanger (3) and/or the composition of flue gases,

characterised by that

a duct (5) adapted for recycling flue gas and a duct (12) adapted for introducing gasifying air into the feed spout (7) are connected to the combustion chamber under the travelling grate (6), and by that a post-combuster (13) comprising an ignition device (8) and a duct (14) adapted for introducing auxiliary air is disposed downstream of the combustion chamber (2) and upstream of the water-heating heat exchanger (3).

8. The boiler according to Claim 7, characterised by that the ignition device (8) is a burner for wood pellets.

9. The boiler according to Claim 7, characterised by that the ignition device (8) is a gas or oil burner.

10. The boiler according to Claim 7, characterised by that the travelling grate (6) is moved intermittently.

11. The boiler according to Claim 7, characterised by that the post-combuster (13) is made of concrete and has concrete flue gas baffle plates (20).

12. The boiler according to Claim 7, characterised by that the ignition device (8) is disposed opposite the combustible gas inlet duct in the post-combuster (13).

13. The boiler according to Claim 7, characterised by that the duct (14) adapted for introducing auxiliary air is disposed at the upper part of the post-combuster (13) in such a way that it leads auxiliary air into the combustible gas flow.

14. The boiler according to Claim 7, characterised by that a chamber separator is disposed in the post-combuster (13).

15. The boiler according to Claim 7, characterised by that the duct adapted for introducing combustible gas into the post-combuster (13) comprises a flue gas safety vent (21).

16. The boiler according to Claim 7, characterised by that a return section (19) is built into the flue gas duct (15).

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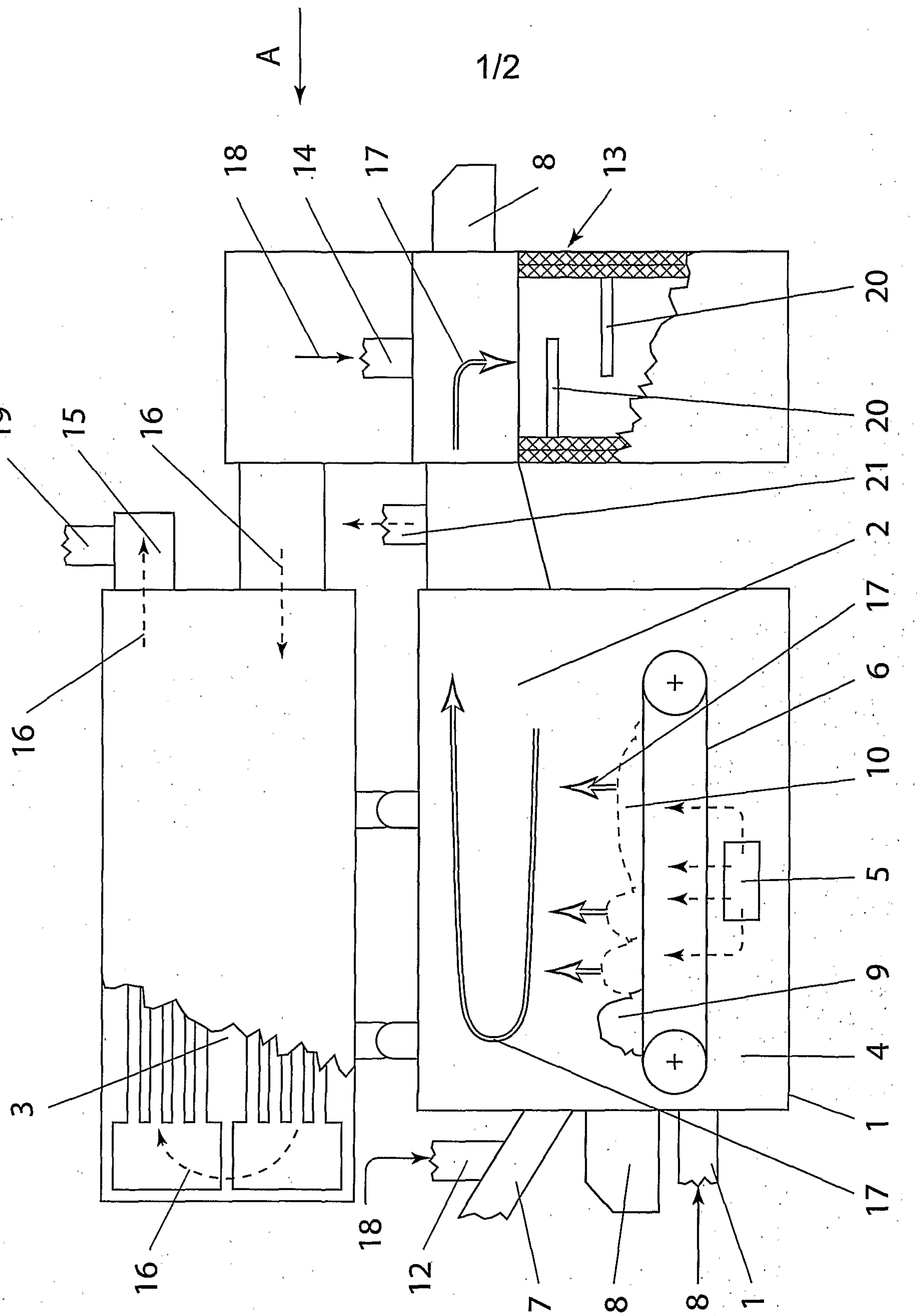

Fig. 1

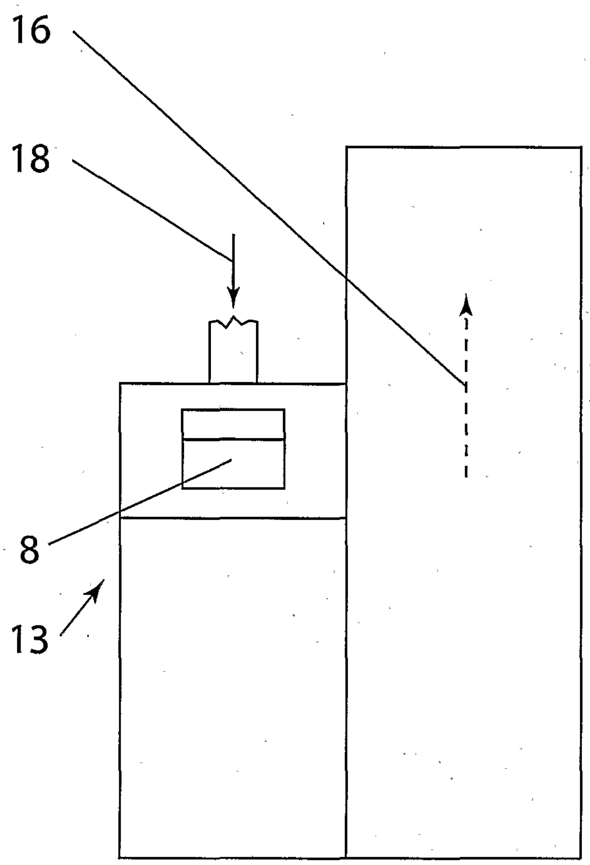

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/HU2006/000034

A. CLASSIFICATION OF SUBJECT MATTER
INV. F23J3/04 F23B30/06 F23B80/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F23B F23J F23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 299 22 216 U1 (STEINBRECHT, DIETER; GARSKE, WOLFGANG; MATZMOHR, ROLAND) 21 September 2000 (2000-09-21) page 1, paragraph 1 page 2, paragraph 5 page 4, paragraph 5 page 3, paragraphs 3,5	1-16
Y	US 1 929 424 A (HEATON HERMAN C) 10 October 1933 (1933-10-10) page 1, line 66 - line 75; figure 1	1-16
Y	DE 493 817 C (STOCKHOLMS AKTIEBOLAGET PRIVAT) 14 March 1930 (1930-03-14) page 1, line 36 - line 51; figure 1	2,7

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 August 2006	24/08/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mougey, M

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 738 205 A (BEIERLE ET AL) 19 April 1988 (1988-04-19)	7,12
A	column 1, line 39 - column 2, line 15 column 5, line 65 - column 6, line 2 figures 1,3	1
Y	US 4 432 339 A (HEBERT ET AL) 21 February 1984 (1984-02-21) figure 3 column 4, line 19 - line 21 column 4, line 61 - column 5, line 4	11
A	US 6 485 296 B1 (BENDER ROBERT J ET AL) 26 November 2002 (2002-11-26) abstract column 1, line 40 - line 50 column 5, line 20 - line 54	1,4,7, 12,13,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/HU2006/000034

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 29922216	U1	21-09-2000	NONE		
US 1929424	A	10-10-1933	NONE		
DE 493817	C	14-03-1930	NONE		
US 4738205	A	19-04-1988	AR 241550	A1	31-08-1992
			CA 1306939	C	01-09-1992
			CN 1030470	A	18-01-1989
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			JP 2500771	T	15-03-1990
			WO 8809903	A1	15-12-1988
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US 6485296	B1	26-11-2002	WO 03029741	A1	10-04-2003