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(54) Method and apparatus for drying of fuel

(57) Method and apparatus for drying of fuel, in which a moving fuel bed (FB) is formed on a conveyor (12), to which fuel bed (FB) a hot, gaseous medium is fed perpendicularly to the travel direction of the fuel bed (FB). The fuel is heated before forming the fuel bed (FB), while the fuel is flowing substantially downward, by means of a hot gaseous medium flow perpendicular to the fuel flow.

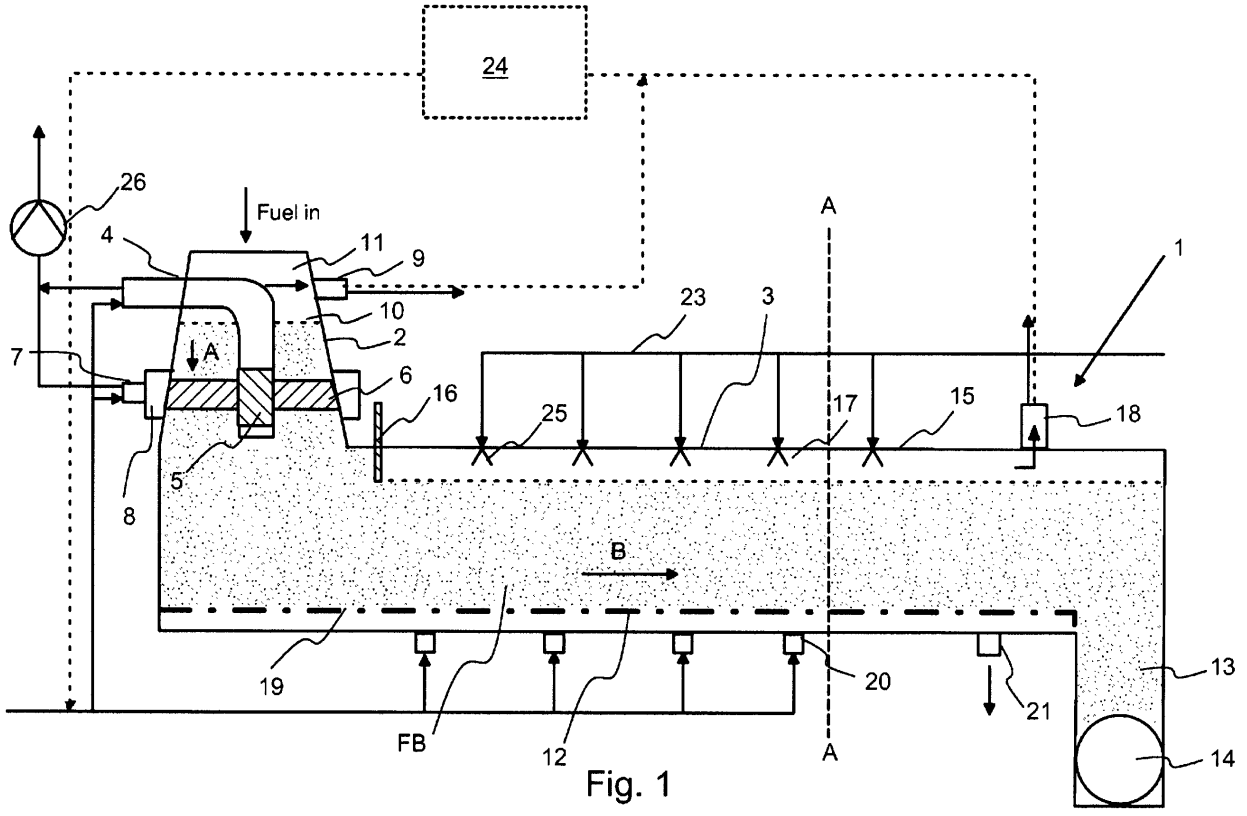

Fig. 1

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Description

Field of the invention

[0001] The invention relates to a method for drying of fuel according to the preamble of the appended claim 1. The invention also relates to an apparatus for implementing the aforementioned method in accordance with the preamble of the appended claim 15.

Background of the invention

[0002] In power plants, numerous different materials are used as fuels, such as bark, chips, coal, peat, compressed sludge or municipal waste. Before the combustion process the fuel is typically crushed, chipped or cut into particles of suitable size for combustion. Thereafter they are stored by the power plant and possibly dried before they are fed to the furnace of the boiler. The properties, composition and particle size of the fuel affect its moisture content. The above-mentioned storing also has an effect therein. For example bark, which is a commonly used fuel in the power boiler of a pulp mill, has naturally a high moisture content. It is especially high in such pulp mills in which wet-debarking is used. The moisture content of chips is also relatively high. The moisture content of bark and chips is also affected by the way in which they are stored. In stacks arranged outdoors, they are exposed to variations caused by the change of seasons. Especially in the northern hemisphere, sun and rain in the summer and snow and ice in the winter affect the moisture content of fuels.

[0003] Sludges are produced in various processes as their final products or waste. For example in paper and pulp mills sludges are produced in a number of different process stages. At present, excess liquid is removed from sludges for example by pressing, and the processed sludge is fed to waste treatment either to be dumped or burned.

[0004] The moisture in fuels is primarily water bound either in the fuel particles or on the surface and between the fuel particles. It is possible that other substances have dissolved in the water from the fuel, or other liquids have been mixed therein in connection with the treatment of fuel.

[0005] In view of the combustion process of the power plant it is very important that the moisture content of the fuel fed to the furnace of the boiler is optimal for the combustion process used. So-called fluidized bed combustion is especially suitable for the purpose of burning wet fuel or fuel with varying moisture content. In fluidized bed combustion, the fuel is introduced into hot fluidized bed material floating in the furnace by means of fluidizing air, in which bed material the fuel first dries and then burns. The moist fuel reduces the temperature of the bed material and thus helps in keeping the temperature within suitable limits. However, the fuel must not be too wet so that the efficiency of the furnace would remain sufficiently high.

[0006] Moisture is removed from fuels in a number of different ways before they are fed for burning. Bark, sludge and municipal waste can be dried for example by mechanical pressing. The presses to be used are, however, heavy and large in size, their acquisition costs are high and they consume great deal of electric energy. Furthermore, when using them, the sufficiently low moisture content required for the burning is seldom reached.

[0007] It is also known to dry fuels by means of different kinds of driers before they are fed for burning. There are for example drum or screw type driers in use, in which a drying medium, such as hot air is fed into the fuel to be dried. Indirect driers based on convection are also known.

[0008] US publication 6,163,981 discloses a process of drying wood material chipped into small particles, such as chips and bark, before they are fed to a power boiler to be burned. In the solution according to the publication, the chips to be dried are fed to a drier, in which a bed of chips is formed on a moving conveyor, said bed of chips moving forward along with the movement of the conveyor. Heated drying gas is fed from below the conveyor, perpendicularly against the movement of the conveyor. The chips to be dried do not, however, spread evenly on the conveyor, which results in that the drying result reached by the apparatus is uneven. Furthermore, if the capacity of the power boiler is high, and it burns a large amount of chips, it is necessary to build the drying apparatus large enough, which is not economical. Furthermore, it is almost impossible to insulate the apparatus from outdoor air, wherein the gas used in the drying can leak into the surrounding air, which is a work safety and environmental risk.

[0009] In US publication 4,888,885 warm gas is also fed through a bed of chips moving forward in a dryer. The bed of chips moves forward on an inclined transport towards its discharge end. The transport enables the penetration of gas. It is a problem in this solution that the transport is easily clogged, because moving of material based merely on gravity is not sufficient for feeding elongated, viscose material typically used in power plants. It is also difficult to attain high drying capacity by means of the apparatus.

[0010] As was mentioned above, the high moisture content of the fuel reduces the efficiency of the power plant. Furthermore, in a fluidized bed boiler the control system of the boiler tends to compensate the reduction in the temperature of the fluidized bed resulting from the supply of moist fuel by reducing the amount of flue-gas containing circulating gas and increasing the amount of air in the fluidizing air. The increase in the amount of combustion air produces a larger combustion flame in the fluidized bed, which would require building the furnace larger in size, which is an expensive investment. Correspondingly, if the fuel to be burned in the boiler is dryer, there is a risk that the temperature of the fluidized bed increases so high that it starts to sinter. The control-

ling of the process is easier if the moisture content of the fuel to be fed is as stable as possible. Thus, the moisture content of the fuel is significant in view of the combustion process and efficiency of the boiler.

Brief description of the invention

[0011] Consequently, it is an aim of the present invention to provide a method for drying of fuel, which avoids the above-mentioned problems, and by means of which it is possible to efficiently dry the fuel to be fed to the power boiler, and the moisture content of the fuel to be dried can be stabilized. Furthermore, it is an aim of the invention to provide an apparatus implementing the aforementioned method.

[0012] To attain this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the independent claim 1.

[0013] The apparatus according to the invention, in turn, is primarily characterized in what will be presented in the characterizing part of the independent claim 15.

[0014] The other, dependent claims will present some preferred embodiments of the invention.

[0015] The invention is based on the idea that the fuel supplied to the furnace of a power boiler is dried in a continuous process in such a manner that the temperature of the fuel is first increased rapidly in a heating phase, whereafter it is introduced to the drying phase. The heating phase and the drying phase are arranged successively in such a manner that the fuel compressed in the heating phase is discharged to the drying phase, and it is passed therethrough as a bed having a substantially uniform thickness. In the heating phase the fuel flows through a vertical heating section, in which hot, gaseous medium is fed to the fuel flow to increase the temperature of the fuel sufficiently high for the drying phase.

[0016] In the heating phase, the hot, gaseous medium is fed crosswisely in relation to the fuel flow travelling downward, to the middle of the flow and to its edges. The fuel heats up rapidly in the heating phase, because the amount of heating medium is large and its flow rate is high, and all material travels through the heating medium flow. In the heating phase the fuel is heated up to the drying temperature or at least close to it. The hot, gaseous medium fed to the fuel flow in the cross direction does not hinder the flow of fuel material.

[0017] After the heating phase the fuel flow is fed as a dense bed through the drying phase comprising a horizontal or an oblique drying section. In the drying phase a hot, gaseous medium is fed through the fuel bed to maintain the drying temperature. Most of the steam necessary for the drying is fed to the heating section. The amount of steam necessary in the drying section is small, because the steam is only used for maintaining the drying temperature attained in the heating section. Correspondingly, the delay time of fuel in the drying section is considerably longer than in the heating section. By means of a long delay time it is possible to ensure steady drying of fuel throughout the entire fuel bed. The gaseous steam released in the drying section is removed from the gas space above the fuel bed. By means of removing steam the desired pressure is maintained in the drying section. The produced condensate is removed from the bottom of the drying section. The final moisture of the fuel can be controlled by controlling the amount of fuel, i.e. the thickness of the fuel bed on the conveyor as well as the delay time and temperature of the fuel in the drying section.

[0018] According to an embodiment of the invention, the moisture content of the fuel can be controlled and thus fuel with a stable, i.e. the same or almost the same moisture content can be attained as a result of the drying process. If necessary, it is possible to spray water or other liquid into the fuel moving in the drying apparatus to control the moisture content.

[0019] It is an advantage of the invention that the particle-like fuel supplied to the power boiler can be dried rapidly and in a simple manner. The feeding of heating medium to the middle and edges of the fuel in the heating section results in that the fuel heats up rapidly to the drying temperature. Thus, the variations in temperature between the fuel particles caused by the storage of fuel can be stabilized, for example frozen lumps of fuel can be defrosted. The transverse steam flow used in the heating section does not cause disturbances in the fuel flow in the heating section, wherein the entire amount of fuel heats up to the desired drying temperature. The drying temperature maintained in the drying section ensures efficient drying of the entire fuel flow. The drying of fuel can also be intensified by sucking steam containing moisture released from the fuel from the drying apparatus. The possibility of controlling the moisture of fuel as suggested by an embodiment of the invention ensures that fuel having precisely the right moisture level is attained in the power boiler in use. The invention can be utilized especially in connection with power boilers in pulp and paper mills, because they usually use as a fuel bark waste and chips produced in pulp and paper making. Furthermore, the sludges produced in pulp and paper mills can be dried by means of the invention and fed to be burned in a power boiler.

Brief description of the drawings

[0020] In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows a drying apparatus according to the invention in a side-view and in a cross-section,

Fig. 2 shows a side-view of a second drying apparatus according to the invention, and

Fig. 3 shows section A-A marked in Fig. 1.

Detailed description of the invention

[0021] In this context the term fuel refers to any burning substance, which has a sufficient thermal value after the drying, so that it can be utilized as a fuel for the power plant. Such fuels include for example chips, bark, coal, peat, sludges from process industry or municipal waste.

[0022] Fig. 1 shows a fuel drying apparatus 1 according to the invention. The apparatus comprises a vertical heating section 2 having the shape of a downward expanding cone. Feeding means (not shown in the figure), such as a bin or a screw are connected to the upper part of the heating section and they feed the fuel to be dried to the heating section 2 from its upper part in accordance with the arrow marked in the figure. The fuel fed to the heating section 2 moves by means of gravity vertically downward as shown by arrow A. The fuel is fed to the drying apparatus constantly in such a manner that the fuel fills substantially the volume of the heating section from the fuel surface 10 formed in the heating section 2. The heating section comprises a feeding pipe 4 for feeding hot, gaseous medium, such as steam into the middle of the heating section 2. At the lower end of the feeding pipe 4 there is a steam distribution member 5 extending around the feeding pipe, which can be a perforation extending around the feeding pipe, or some suitable means attached to the feeding pipe, such as, for example, a screen, which distributes the steam from the steam feeding pipe 4 evenly to the fuel horizontally in an angle of 360 degrees. In the embodiment of Fig. 1, a screen 5 is arranged in the feeding pipe. In the shell of the heating section, on the same height with the screen 5, there is a steam distribution member 6, such as a screen, extending around the entire shell for feeding steam horizontally to the fuel within the perimeter of the entire heating section. A distribution chamber 8 placed on the perimeter of the heating section, substantially on the same height with the screen 6, divides the steam evenly to the screen 6 surrounding the entire perimeter of the heating section. To the distribution chamber, one or several ducts 7 are connected, said duct/ducts feeding steam to the distribution channel 8. The heating section also contains at least one duct 9 for removing the exhaust steam from the gas space 11 above the fuel surface 10.

[0023] The moisture and initial temperature of the fuel to be heated affect the energy demand of the heating. The physical and geometrical properties of the fuel to be heated as well as possible treatment preceding the drying, for example removing of moisture by means of pressing, affect the warming up rate of the fuel. The temperature of the steam to be used also affects the heating result. Rapid heating of fuel in the heating section requires that a sufficient amount of steam is fed as a steady flow to the fuel. In the drying phase the amount of steam required for maintaining the temperature of the fuel is small. The delay time of fuel in the heating section is short, considerably shorter than the delay time of fuel in the drying section.

[0024] The heated fuel is discharged from the lower part of the heating section to the drying section 3. The heating section 2 and the drying section 3 are arranged successively on top of each other in such a manner that the heating section is positioned in an angle of 90 degrees with respect to the drying section 3. The heating section is arranged in connection with the drying section, to one of its ends in such a manner that the heated fuel discharged from the heating section 2 travels substantially through the horizontal drying section 3, fed by a conveyor 12 on the bottom of said drying section. In the heating section 2 and below the same the fuel flow becomes dense and the fuel is fed through the drying section 3 as a dense fuel bed FB.

[0025] The drying section 3 is an elongated vessel, whose length is greater than its cross-section, and whose ends are closed. On the bottom of the drying section a conveyor 12 is arranged, said conveyor carrying the fuel from the heating section 2 end of the drying section to the other end of the drying section 3, which comprises members 13 for removing dried fuel from the drying apparatus 1 to a feed screw 14 that feeds the fuel either to an intermediate storage or to the furnace of the power boiler. At the initial end of the drying section 3, i.e. at the heating section end, there is an adjustment plate 16 attached gas-tightly to the roof 15 the drying section. The adjustment plate 16 is a plate-like element extending across the width of the drying section 3 that protrudes a distance inside the drying section 3 and determines the height and shape of the upper edge of the fuel bed FB formed in the drying section 3. By adjusting the height and shape of the adjustment plate 16 it is possible to adjust the height and shape of the upper edge of the fuel bed FB. The adjustment plate 16 seals the gas space 17 of the drying section 3 remaining between the upper edge of the fuel bed of and the upper surface of the drying section, i.e. the roof 15 in such a manner that the pressure therein may be higher than the pressure in the heating section 2. The upper part of the drying section comprises a duct 18 for removing exhaust steam.

[0026] Hot, gaseous medium, such as steam is fed through the fuel bed via openings 19 arranged on the conveyor, said fuel bed travelling by means of the conveyor 12 in the drying section 13. Steam is brought via one or several ducts 20 attached to the bottom of the drying section 3. The purpose of feeding steam is to maintain a temperature favourable for the drying of fuel, which together with the delay time adjusted by the speed of the conveyor 12 brings about the drying of the fuel. The condensate formed in the drying section is removed via a duct 21 attached to the bottom of the drying section. The condensate is fed to the waste water system of the plant.

[0027] The conveyor 12 arranged on the bottom of the drying section 3 can be any type of a conveyor suitable for feeding fine-grained material, for example a scraper conveyor, a belt conveyor or a slat conveyor. The essential aspect is that the conveyor is formed in such a manner that it is possible to feed hot, gaseous medium through

the fuel bed located on top of the conveyor and moving by means of the same. Thus, the conveyor is provided with a set of openings for the passage of the medium. One possible conveyor is shown in Fig. 3 which will be described later.

[0028] The hot, gaseous medium used in the heating and drying phase can be for example hot air, steam, dry steam or flue gases from the power boiler. It is also possible to use the primary or secondary steam from a steam-generating process, such as a turbine located in the vicinity of the drying device. The exhaust steam produced in the heating phase and in the drying phase can be recovered and compressed and used again in heating or it can be led, for example, elsewhere in the power boiler process. The exhaust steam can also be fed to the flue gas processing system of the power boiler or it can be condensed and removed. The exhaust steam produced in the drying device can also be circulated again to the drying of fuel. Thus, the exhaust steam removed both from the heating section 2 and the drying section 3 is fed back to the heating section 2 and to the drying section 3, which is illustrated by means of broken lines in Fig. 1. If desired, the exhaust steam produced in the heating section 2 and in the drying section 3 can be heated in a heat exchanger 24 illustrated by means of broken lines in Fig. 1, before it is fed back to the heating section and to the drying section.

[0029] According to an embodiment of the invention, the drying of fuel fed to the drying device can also be intensified by sucking exhaust steam containing moisture released from the fuel from the drying apparatus. In the heating section exhaust steam is sucked either through the feeding pipe 4 or through the distribution chamber 8 arranged in the shell. The sucking can be implemented by any suitable means, such as a blower or a pump 26, which is connected to the feeding pipe 4 and to the distribution chamber 8. The essential aspect is that exhaust steam is only sucked from one of them at a time, either through the feeding pipe 4 or the distribution chamber 8 connected to the heating section, because at the same time the other, either the feeding pipe 4 or the distribution chamber 8 that is not connected to the pump 26 feeds hot, gaseous medium to the heating section. In the drying section 3 the suction of exhaust steam takes place via an exhaust steam removal duct 18.

[0030] According to yet another embodiment of the invention it is possible to control the drying of fuel by changing the delay time of fuel and the amount and temperature of the drying gas used in the drying apparatus. If necessary, the final moisture of the fuel discharged from the drying apparatus 1 can also be adjusted by moistening it. Thus, cooling water is sprayed from a cooling water line 23 on the fuel bed travelling in the drying section 3 via nozzles 25 arranged in the top part of the drying section.

[0031] Fig. 2 shows a second drying apparatus 1 according to the invention in which the drying section 3 is divided into two parts in such a manner that the final end of the drying section 3b is arranged so that it inclines downward. The front end 3a of the drying section is horizontal and the conveyor 12 only extends on the length of the front end. The fuel bed travels through the final end 3b of the drying section, being pushed by the conveyor 12 located at the front end 3a. The inclination of the final end 3b of the drying section downward in the flow direction of fuel reduces the force required for feeding the fuel.

[0032] Fig. 3 illustrates a cross-section A - A of the apparatus of Fig 1. Fig. 3 shows a way of feeding the material through the drying section by means of a conveyor according to Finnish patents 83181 (corresponding to US 5134929) and 109103 (corresponding to EP 1140445).

[0033] The feeding apparatus 12 is composed of narrow and long adjacent lamellae 26, which are positioned on supporting rolls 22. The lamellae 26 extend in the direction of the longitudinal shaft of the drying section within its entire length. The lamellae are equipped with a drive that moves the lamellae a predetermined distance back and forth in the longitudinal direction. The movement of the lamellae in the travel direction of the fuel is considerably slower than their return movement. By means of this arrangement a larger number of lamellae move in the travel direction of the material than in the return direction. The net result thus attained is the propagation of fuel in the drying section. When the lamellae are arranged on the bottom of the drying section in the form of a circular arc in accordance with Fig. 3, the fuel to be dried tends to pack towards the central area of the drying section. This reduces friction on the side walls and helps the material to be treated to travel forward as an even bed.

[0034] The steam is fed from the duct 20 and it travels to the fuel to be dried from gaps between the lamellae as shown by arrows drawn in dotted lines. When the heating medium condenses in the heating section and in the drying section, condensate is produced. The condensate runs to the bottom part of the fuel space and is discharged via the duct 21 as shown by the solid arrows.

[0035] The invention is not intended to be limited to the embodiments presented as examples above, but the invention is intended to be applied widely within the scope of the inventive idea as defined in the appended claims. The apparatus according to the invention can thus also be positioned in the immediate vicinity of an outdoor storage of fuel, i.e. bark or chips stored outdoors, for example in a stack, Thus, the dried bark or chips can be fed directly to the furnace of a power boiler, and the drying apparatus can be placed in such a location where it does not cause lack of space in the immediate vicinity of the power boiler. The drying apparatus is also suitable for drying of peat, and it can be placed for example in a peat site, wherein the dried peat can be fed directly to the power boiler to be burned, and a separate drying apparatus is not necessary in the power plant.

Claims

1. A method for drying of fuel, in which method a moving fuel bed (FB) is formed of fuel on a conveyor (12), to which fuel bed (FB) a hot, gaseous medium is fed perpendicularly to the travel direction of the fuel bed (FB), **characterized in that** the fuel is heated before forming the fuel bed (FB), while the fuel flows substantially downward, by means of a hot, gaseous medium flow perpendicular to the fuel flow.

2. The method according to claim 1, **characterized in that** the fuel is heated with a hot, gaseous medium flow that is fed to the fuel flow from the middle and/or edges of the same.

3. The method according to claim 1 or 2, **characterized in that** the fuel is heated to the drying temperature of fuel, or at least close to it.

4. The method according to claim 1, **characterized in that** the fuel bed (FB) is formed of a heated fuel flow that flows substantially downward and is discharged downward.

5. The method according to claim 1, **characterized in** the fuel bed (FB) travels substantially horizontally.

6. The method according to claim 1, **characterized in that** the hot, gaseous medium is fed to the fuel bed (FB) from below the fuel bed (FB), via an opening system (19) arranged in the conveyor (12).

7. The method according to claim 1, **characterized in that** the fuel is heated in a heating section (2) and dried in a drying section (3) comprising the conveyor (12).

8. The method according to claim 7, **characterized in that** the exhaust steam produced in the heating and drying of fuel is removed from the heating section (2) and from the drying section (3).

9. The method according to claim 8, **characterized in that** the exhaust steam is removed from the heating section (2) by sucking it from the middle or edges of the fuel flow.

10. The method according to claim 7 or 8, **characterized in that** the exhaust steam is fed back to the heating section (2) and to the drying section (3).

11. The method according to claim 10, **characterized in that** the exhaust steam is heated before it is fed to the heating section (2) and to the drying section (3).

12. The method according to claim 1, **characterized in that** the moisture content of the fuel is adjusted by changing at least one of the following: delay time of the fuel on the conveyor, temperature of the hot gaseous medium or the amount of fuel on the conveyor.

13. The method according to claim 1, **characterized in that** the moisture content of the dried fuel is adjusted by feeding cooling water or another liquid to the fuel bed (FB).

14. The method according to any of the claims 1 to 13, **characterized in that** the hot, gaseous medium of one of the following: hot air, steam, dry steam, exhaust steam produced in the heating section (2) and/or in the drying section (3) or flue gases of a power boiler.

15. An apparatus for drying of fuel, said apparatus comprising a drying section (3) equipped with a conveyor (12) on top of which a fuel bed (FB) moving along with the movement of the conveyor (12) is arranged to be formed of fuel, and means (20) for feeding a hot gaseous medium to the fuel bed (FB) perpendicularly to the travel direction of the fuel bed (FB), **characterized in that** the apparatus comprises a heating section (2) arranged before the drying section (3), in which heating section (2) fuel is arranged to flow substantially downward, and which comprises means (4, 5, 6, 8) for heating fuel, of which means (4, 5, 6, 8) at least one (4, 5) is arranged to feed the hot gaseous medium perpendicularly to the fuel flow.

16. The apparatus according to claim 15, **characterized in that** the means (4, 5, 6, 8) for heating the fuel flow are arranged in the middle and/or edges of the fuel flow.

17. The apparatus according to claim 15, **characterized in that** the heating section (2) and the drying section (3) are connected to each other and that the heating section (2) is arranged in an angle of 90 degrees with respect to the drying section (3).

18. The apparatus according to claim 15, **characterized in that** in the heating section (2) the fuel forms a dense, downward discharging layer, which is arranged to discharge on the conveyor (12) and which forms a fuel bed (FB).

19. The apparatus according to claim 15, **characterized in that** the conveyor (12) is provided with an opening system (19) via which the hot, gaseous medium is arranged to be fed to the fuel bed (FB).

20. The apparatus according to claim 15, **characterized in** the conveyor (12) is arranged in a substantially horizontally.

21. The apparatus according to claim 15, **characterized in that** the heating section (2) and the drying section (3) comprise means (9, 18) for removing exhaust steam produced in the heating and drying processes.

22. The apparatus according to claim 21, **characterized in that** the apparatus comprises means (26) for sucking exhaust steam from the heating section (2) via means (4, 5, 6, 8) arranged in the middle or at the edges of the fuel flow.

23. The apparatus according to claim 21, **characterized in that** the exhaust steam is arranged to be fed back to the heating section (2) and to the drying section (3).

24. The apparatus according to claim 23, **characterized in that** the apparatus comprises means (24) for heating exhaust steam.

25. The apparatus according to claim 15, **characterized in that** the moisture content of the fuel is arranged to be adjusted by changing at least one of the following: delay time of the fuel on the conveyor, temperature of the hot gaseous medium or the amount of fuel on the conveyor.

26. The apparatus according to claim 15, **characterized in that** the apparatus comprises means (23, 25) for feeding cooling water or another liquid to the fuel bed (FB) and that the moisture content of the fuel is arranged to be adjusted by adjusting the feeding of cooling water or another liquid.

27. The apparatus according to any of the claims 15 to 26, **characterized in that** the hot, gaseous medium of one of the following: hot air, steam, dry steam, exhaust steam produced in the heating section (2) and/or in the drying section (3) or flue gases of a power boiler.

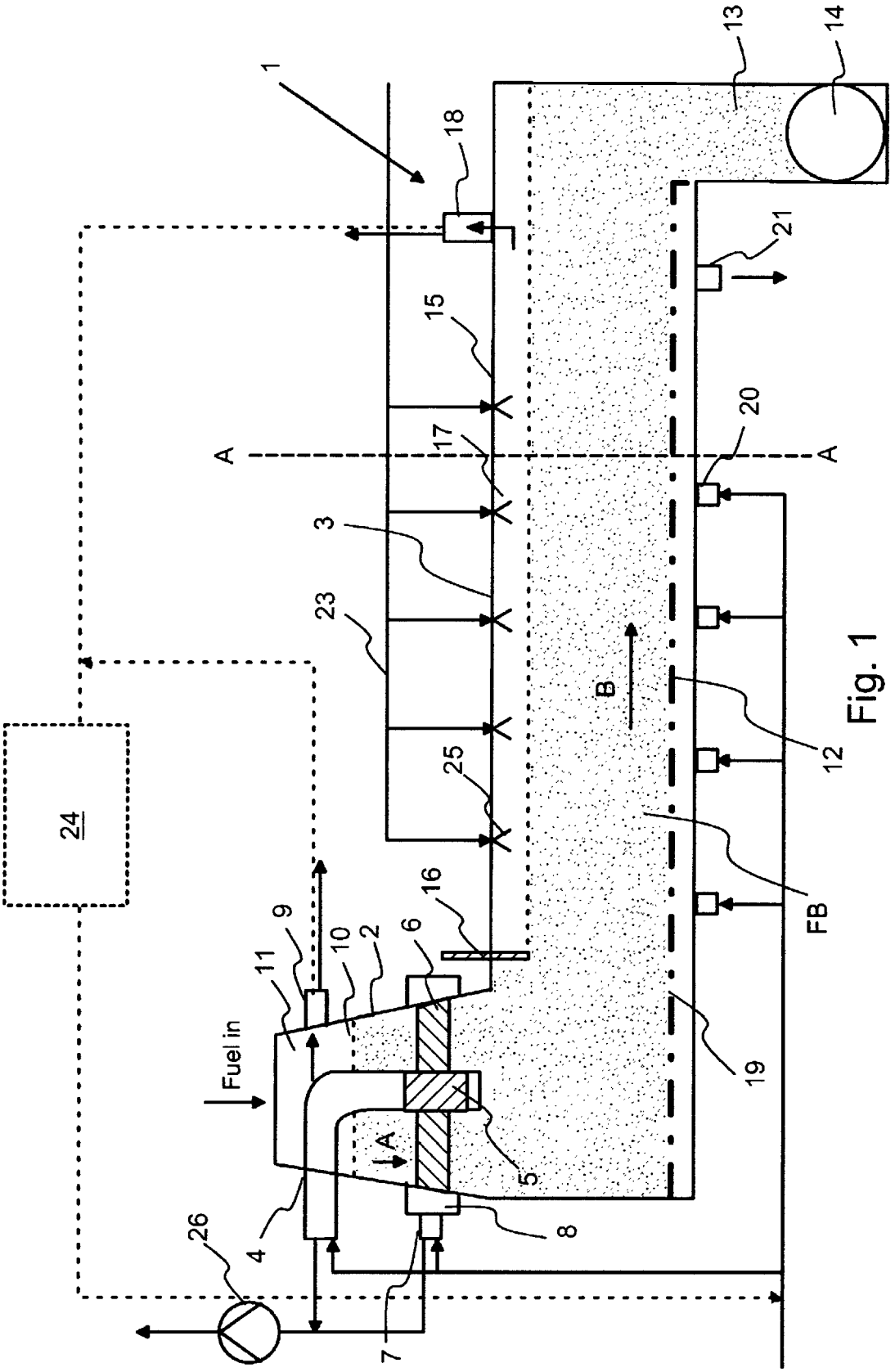
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Fig. 1

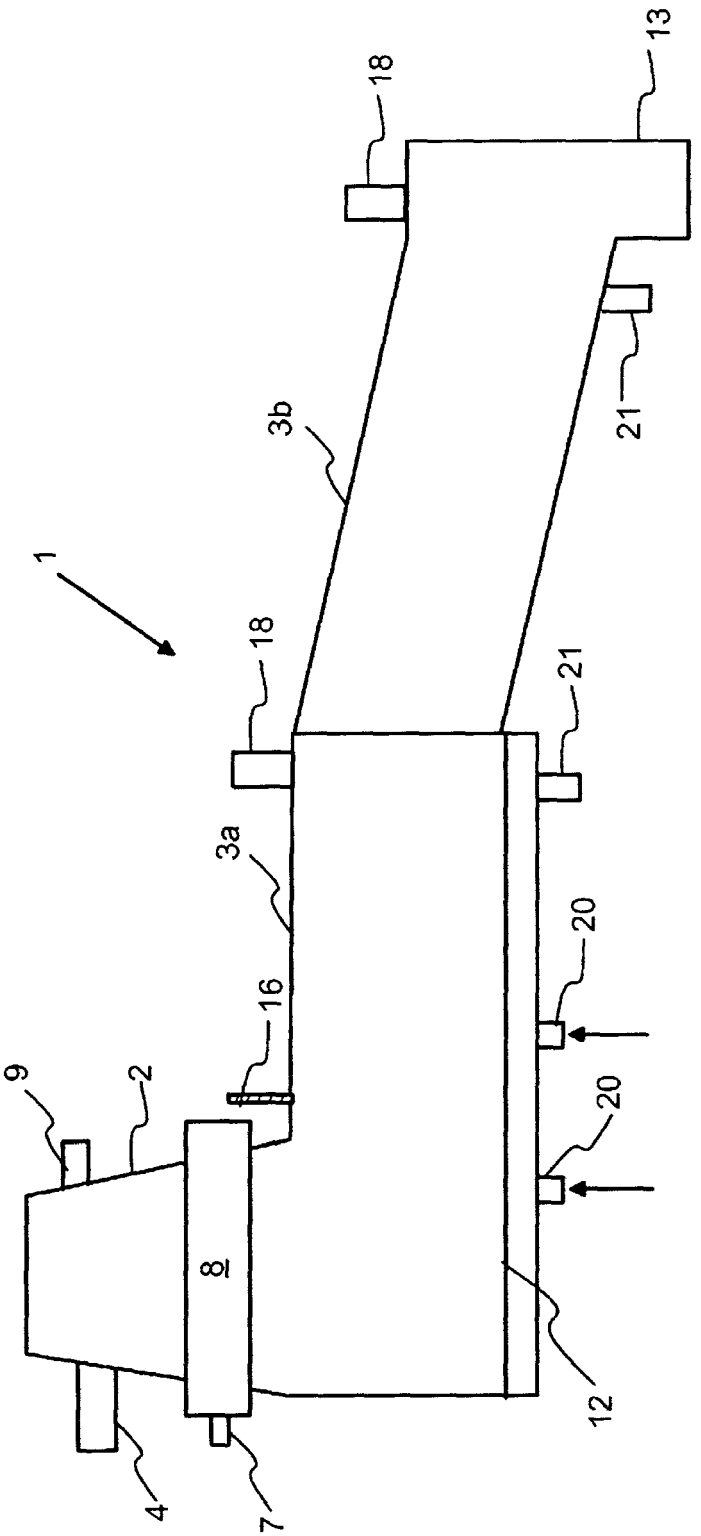

Fig. 2

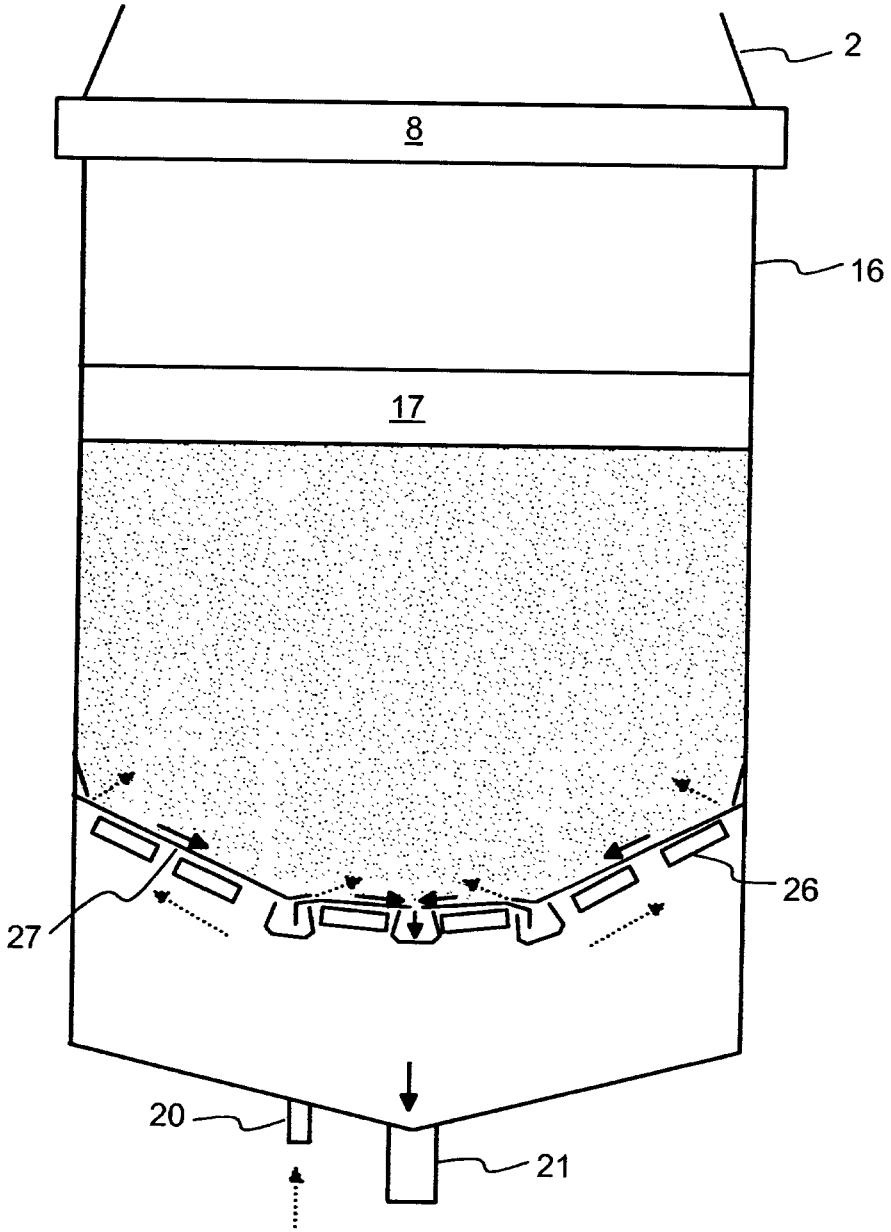

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 39 7019

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 4 635 379 A (KRONELD ET AL) 13 January 1987 (1987-01-13) * the whole document *	1,2,4-7, 14-20,24	F26B17/04 C02F11/12
Y	US 1 568 738 A (JONES MICHAEL DOLAND) 5 January 1926 (1926-01-05) * page 6, line 66 - line 73; figure 1 *	1,2,4-7, 14-20,24	
A	CH 267 638 A (KOCH,HERMANN) 15 April 1950 (1950-04-15) * the whole document *	1-27	
A	US 4 756 092 A (ANDERSON, DECEASED ET AL) 12 July 1988 (1988-07-12) * column 4, line 35 - line 64 *	1-27	
A,D	US 4 888 885 A (CAUGHEY ET AL) 26 December 1989 (1989-12-26) * figures 1,2 *	1-27	

TECHNICAL FIELDS SEARCHED (IPC)

C02F
F26B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 March 2006	González Arias, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 39 7019

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13-03-2006

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