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(54) A solid fuel burner unit and a method for cleaning a combustion chamber of a solid fuel burner unit

(57) The invention relates to a solid fuel burner unit (2) comprising, at least one combustion chamber (9). The solid fuel burner unit (2) is characterized, in that the burner unit (2) comprise a cleaning system (20), which in operation substantially cleans the combustion chamber (9) completely for any loose or burned-in material (18).

The invention further relates to a method for cleaning a combustion chamber (9) of a solid fuel burner unit (2).

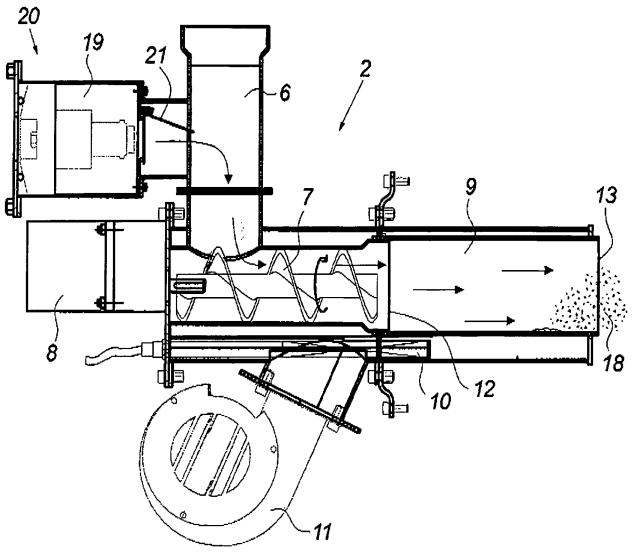

Fig. 4

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Description

Background of the invention

[0001] The invention relates to a solid fuel burner unit according to the preamble of claim 1, and a method for cleaning a combustion chamber of a solid fuel burner unit.

Description of the Related Art

[0002] Systems for removing ash from the combustion chamber in solid fuel furnaces during the combustion process are well known. E.g. in Canadian patent application CA 2,095,098 is disclosed a system for reducing the size of the burn pot in a pellet burning stove, by means of a mechanically moving wall in the burn pot. This moving wall are also used to push the upper material (and thereby the lightest material, which would be the ash) in the burn pot over an edge of the burn pot and down into an ash pan. But heavier material such as cinders, slag or grains of sand are not remove from the burn pot, hereby increasing the risk of an accumulation of this residual material, which could severely affect the combustion process in the burn pot and thereby reduce the efficiency of the stove and increase the risk of pollution. Furthermore the mechanically moving wall or any other moving physical object in or near the combustion process is at risk of being damaged or deformed by the high temperatures or the in other ways aggressive environment.

[0003] In German patent application DE 198 13 113 A1 is disclosed a system for removing the ash from the combustion chamber in a burner unit of a solid fuel furnace. The combustion chamber is cylindrically shaped, where the diameter is reduced towards the exit opening. The air to feed the combustion process is supplied tangentially to the cylinder making the air, gasses and light materials such as ash perform a rotating movement towards the exit opening. Hereby the ash is removed from the combustion chamber during the combustion process, whereas heavier material such as unburned pellets, slag, grains of sand or other residual material are left in the combustion chamber. The residual material accumulates over time and will have to be removed manually occasionally to not reduce the burner units efficiency. Even a relative small amount of residual material can reduce the burner units efficiency, in that it interferes or obstructs the air current provided to enable an efficient combustion process in the combustion chamber.

[0004] An object of the invention is therefore to provide for an advantageous technique for increase the efficiency of a solid fuel burner unit.

The invention

[0005] The invention provides for a solid fuel burner unit comprising, at least one combustion chamber. The solid fuel burner unit is characterized, in that the burner unit comprise a cleaning system, which in operation substantially cleans the combustion chamber completely for any loose or burned-in material.

[0006] To provide the solid fuel burner unit with a cleaning system to supplement the ash removal system is advantageous, in that it hereby is possible to remove material, that is heavier than the ash and/or burned-in material from the combustion chamber, thereby increasing the burner units efficiency.

[0007] Furthermore, by making the burner unit comprise the cleaning system, manual cleaning of the combustion chamber can substantially be avoided, which is advantageous, in that the combustion chamber is hard to access.

[0008] Even further, if the chamber is to be cleaned by hand, it has to cool of for a relatively long period of time before it is possible to access the inner parts of the furnace or the burner unit, without risking getting burned during the cleaning process. It is therefore also advantageous to make the burner unit comprise the cleaning system, it that, when a human is not directly involved in the cleaning of the chamber, the chamber and/or other parts of the burner unit does not have to be cooled before the cleaning process can be started, hereby reducing the time it takes to clean the chamber, hence the overall efficiency of the burner unit is increased.

[0009] Additionally, by only making the cleaning system clean the combustion chamber when in operation, it is possible to run the cleaning process and the combustion process as two separate processes. This is advantageous, in that this enables the possibility of stopping the normal operation of the burner unit, before the cleaning process is started, hereby reducing the risk of the cleaning process interfering negatively with the combustion process e.g. by removing solid fuel from the combustion chamber before it is burned-out.

[0010] Also, the existing ash removal system of burner units known in the art, is dimensioned to only remove light objects such as ash, to ensure that the ash removal system does not remove the solid fuel from the combustion chamber. The ash removal system or the system to supply air to the combustion process in the combustion chamber is also designed to accomplish these tasks (particularly regarding the angle of entry of the supplied air) without blowing the solid fuel out of the combustion chamber before it is completely burned-out. It is therefore also advantageous to use a separate cleaning system for cleaning the combustion chamber, in that this can be designed simpler and it can be both faster and more efficient at removing all unwanted objects from the combustion chamber.

[0011] In an aspect of the invention, said cleaning system comprises means for generating airflow through said combustion chamber.

[0012] Generating airflow through the combustion chamber is a both simple and inexpensive way of cleaning the chamber.

[0013] The combustion chamber becomes several hundred degrees Celsius hot during the combustion

process, and this aggressive environment put heavy demands on mechanical cleaning equipment or any other equipment located in or close to the combustion chamber. Airflow can be generated in safe distance from the chamber, hereby minimising the risk of the cleaning system being damaged by the aggressive in and around the combustion chamber.

[0014] The fact that the airflow can be generated away from the combustion chamber is also advantageous, in that it hereby is possible to design a very simple combustion chamber, which is optimised to run the combustion process as efficiently as possible.

[0015] In an aspect of the invention, said airflow enters said combustion chamber through the same entrance opening, through which said solid fuel is supplied to said combustion chamber during normal operation of said burner unit and said airflow exits said combustion chamber through the same exit opening, through which ash and exhaust gases leaves said combustion chamber during normal operation of said burner unit.

[0016] Using the same openings in the combustion chamber to establish airflow through the combustion chamber, as are use as entrance and exit for the solid fuel and its generated ashes and exhaust gases, is advantageous, in that no additional openings has to be made in the combustion chamber to establish the airflow, hence a simple and thereby inexpensive combustion chamber design is enabled.

[0017] Furthermore, utilizing these openings for establishing an air current through the combustion chamber is also advantageous, in that it hereby is possible to transport the residual material out of the burner unit and thereby the furnace via the same path as the ashes are removed during normal operation of the furnace, hence no extra removal system for the residual material has to be established, in that the existing ash pan or the like can be used.

[0018] In an aspect of the invention, said means for generating airflow through said combustion chamber during a cleaning process, is separate from means for supplying air to the combustion process in said combustion chamber during normal operation of said burner unit.

[0019] The means for supplying air to the combustion process has to generate a relatively low speed air current to ensure, that the solid fuel or parts of the solid fuel are not blown out of the combustion chamber. Furthermore, the air supplied to feed the combustion process has to enter the combustion chamber perpendicular to the direction that the exhaust gases leaves it, in order to ensure that the air is used efficiently.

[0020] The means for generating airflow through the combustion chamber during a cleaning process on the other hand, has to generate a relatively high speed air current to ensure, that the combustion chamber is cleaned thoroughly. Also, to efficiently clean the chamber the cleaning airflow in the chamber has to be directed towards the exit opening of the chamber, making the most effective cleaning air current perpendicular to the most efficient air current used to feed the combustion process. It is therefore advantageous to provide the burner unit with separate means for generating the two different airflows.

[0021] In an aspect of the invention, said airflow has a speed through said combustion chamber of between 1 and 20 m/s, preferably between 2 and 14 m/s and most preferred between 3 and 8 m/s.

[0022] The lower the air current speed becomes, the greater the risk of the airflow not being able to blow out heavy material from the combustion chamber. The higher the air current speed becomes, the more noise it produces and the bigger and more expensive the means for producing the airflow has to be.

[0023] The present airflow speed ranges therefore provides for an advantageous relation between efficiency, noise emission and cost.

[0024] In an aspect of the invention, said solid fuel is pellets substantially made of an organic material such as wood.

[0025] Solid fuel in form of pellets of an organic material has the disadvantage compared to other forms of solid fuel, that pellets also contains small amount of incombustible material such as grains of sand and the like. This material is so heavy, that it will not leave the combustion chamber the same way the ashes does and therefore over time will accumulate in the combustion chamber. It is therefore advantageous to provide a pellet burner unit with a cleaning system according to the invention.

[0026] In an aspect of the invention, said material is incombustible material such as sand grains, slag, clinker, ash or any combination hereof e.g. in form of cakes, which accumulates in said combustion chamber during normal operation of said burner unit.

[0027] Oxygen is needed to enable combustion of solid fuel in the burner unit, and the most common way of providing this, is to supply air to the combustion chamber. This supply of air is also able to carry out light material, such as ashes from the combustion chamber, whereas heavier material such as grains of sand is left in the chamber with the solid fuel. It is therefore advantageous to provide a solid fuel burner unit with a cleaning system capable of removing incombustible material such as grains of sand.

[0028] In an aspect of the invention, said burner unit comprises control means for activating said cleaning system at a fixed or an adjustable time.

[0029] Providing the burner unit with control means comprising a timer for activating the cleaning process is advantageous, in that the cleaning process might produce more noise than the normal operation of the burner unit. It could therefore e.g. be advantageous to set the timer to clean the burner unit in the middle of the day, hereby reducing the risk of disturbing people sleeping.

[0030] Furthermore, the combustion process will have to be stopped during the cleaning process, and since the night time usually is the coldest period of the day, it would also be advantageous to provide the control means with

a timer, that could start the cleaning process during the warmest period of the day, where the normal function of the burner unit is dispensable for the time it takes to clean the combustion chamber.

[0031] The invention further relates to a method for cleaning a combustion chamber of a solid fuel burner unit, said method comprising the steps of

- stopping the supply of solid fuel to said burner unit
- establishing airflow through said combustion chamber when all or substantially all combustible material in said combustion chamber has been burned.

[0032] Establishing airflow through the combustion chamber when the fuel in the combustion chamber has been burned out is advantageous, in that it hereby is possible to clean out all unwanted material from the combustion chamber, without removing any solid fuel in the process.

[0033] It should be emphasised that the term "through the combustion chamber" is to be understood as through the entire length of the chamber and not just local air currents in the combustion chamber as existing system for supplying air to the combustion process generates.

[0034] In an aspect of the invention, one or more sensors detect that all or substantially all combustible material in said combustion chamber has been burned.

[0035] Using a sensor to detect that the combustion process in the chamber has stopped is advantageous, in that it hereby is possible to start the cleaning process immediately after the combustion process has ended, hereby reducing the period of time that the burner unit has to be taken out of normal operation to run a cleaning process.

[0036] Furthermore, using a sensor to detect that the combustion process has stopped is also advantageous, in that no human involvement in the cleaning process hereby is needed. This enables that not only the change from normal operation of the burner unit to the cleaning process and back again, but also the entire cleaning can run automatically and unattended.

Figures

[0037] The invention will be described in the following with reference to the figures in which

fig. 1 illustrates a cross section of a modem solid fuel furnace known in the art, as seen from the side,

fig. 2 illustrates a cross section of an embodiment of a combustion chamber as seen from the side ,

fig. 3 illustrates a cross section of an embodiment of a burner unit during normal operation as seen from the side, and

fig. 4 illustrates a cross section of the same embodiment of a burner unit as shown in fig. 3, during cleaning operation, as seen from the side.

Detailed description

[0038] Fig. 1 illustrates a cross section of a modem solid fuel furnace 1 known in the art, as seen from the side. The solid fuel 4 which in this case is wood pellets, is lead to the burner unit 2 from a fuel container 5 through a hose (not shown) or a pipe 3 e.g. by means of a container worm conveyer (not shown).

[0039] In another embodiment of the invention the solid fuel could also be grain, corn, coal, straw, pellet shaped versions of these materials or another type of combustible particulate material, particularly organic material.

[0040] Controlled portions of the pellets 4 are delivered to the burner unit 2 though an entrance pipe 6 and falls down onto a burner worm conveyer 7. The worm conveyer 7, which in this case is driven by an electrical gear motor 8, conveys the pellets 4 through an entrance opening 12 into the combustion chamber 9.

[0041] If the furnace 1 is just starting up, a hot bulb 10 ignites the pellets 4 in the combustion chamber 9 and if the burner unit 2 is already running in normal operation mode, the new pellet potion is ignited by the burning pellets 4 in the combustion chamber 9.

[0042] During the combustion of the pellets 4 the in the combustion chamber 9, air is provided to the chamber 9, to oxidize the combustion process and thereby ensuring that the pellets 4 are burned efficiently. This air is supplied by a combustion air pump 11, which in this embodiment of the invention is placed on the underside of the burner unit 2.

[0043] Pellet portions are continually feed to the combustion chamber 9, making the existing portion ignite the new portion and ensuring that the energy output from the combustion chamber 9, is kept at a substantially constant level.

[0044] During the combustion process most of the ashes are carried out of the combustion chamber 9 by the air supplied by the combustion air pump 11, making the ashes leave the chamber 9 with the exhaust gases through the chambers exit opening 13.

[0045] In the boiler 14 the ash falls down into the ash pan 15 which are to be manually emptied occasionally and the exhaust gases leaves the boiler through the top of the boiler 14.

[0046] In the boiler 14, or as in this embodiment in the smoke flue, a lambda sensor 16 is placed to measure the oxygen level in the exhaust gases, hereby detecting or at least indicating the efficiency of the combustion process in the combustion chamber 9, and thereby the level of pollution produced. The size and frequencies of the pellet portions, the amount of air supplied in the combustion chamber or other parameters can then be adjusted accordingly, to maintain the combustion process as efficiently as possible, with respect to heat output

and/or pollution.

[0047] Fig. 2 illustrates a cross section of an embodiment of a combustion chamber 9 as seen from the side. In this embodiment of the invention the combustion chamber 9 is formed as a cylindrical pipe, which is perforated by a number of strategically placed air supply holes 17, which in this case have a diameter smaller than the diameter of standard wood pellets 4. In another embodiment the combustion chamber 9 could be shaped differently, such as square, rectangular, polygonal, elliptical or curved.

[0048] The combustion chamber 9 is in one end provided with an entrance opening 12 and in the other end provided with an exit opening 13.

[0049] Fig. 3 illustrates a cross section of an embodiment of a burner unit 2 as seen from the side. As previously mentioned all the ash or at least the majority of the ashes are automatically removed from the combustion chamber 9 during normal operation of the burner unit 2. But over time residual material 18 accumulates in the combustion chamber 9. This material 18 could e.g. be grains of sand or other incombustible material embedded in the pellets 4, it could be caked ash, it could be flakes of burned-in sod or it could be other kinds of incombustible material that are either burned into the combustion chambers 9 wall or too heavy to leave the combustion chamber 9 during normal operation of the burner unit 2.

[0050] When the amount of this residual material 18 in the combustion chamber 9 becomes too big, it starts to affect the combustion process, mainly because it interferes with the airflow in the combustion chamber 9, hereby reducing the burner units 2 efficiency and/or increasing the amount of pollution emitted.

[0051] The previously mentioned lambda sensor 16 or a similar sensor will detect if the combustion process is not running satisfactory, and in burner units 2 known in the art, the residual material 18 will then have to be removed from the combustion chamber 9 manually.

[0052] Traditional burner units 2 are not equipped with a cleaning system and to clean out the residual material 18 from the combustion chamber, the burner unit 2 has to be shut down before the material 18 can be removed manually e.g. by scraping the material 18 out into the ash pan 15 by using the hands, a brush or special made tool. In worst case this has to be done several times a week.

[0053] The burner unit 2 according to the invention as illustrated in fig. 3 is provided with a cleaning system 20 in form of a cleaning air pump 19. In this embodiment of the invention the air pump 19 is placed on the entrance pipe 6 but in another embodiment the air pump 19 could also be placed on the fuel pipe 3 or hose, in the fuel container 5, on the burner unit 2 by the burner worm conveyer 7 or at another location.

[0054] The burner unit 2 is in this embodiment provided with at a simple one way valve 21 in form of shutter which during normal operation of the burner unit 2 ensures that neither ashes, pellets, air, exhaust gases nor other escapes the burner unit 2 through the cleaning air pump 19,

[0055] Fig. 4 illustrates a cross section of the same embodiment of a burner unit 2 as shown in fig. 3, during cleaning operation, as seen from the side.

[0056] In this embodiment of the invention the cleaning air pump 19 comprise an electrical motor and a fan for generating airflow through the combustion chamber 9. The cleaning air pump 19 could e.g. be an ordinary vacuum cleaner motor, which pumps air from the outside of the burner unit 2 into the unit 2 generating an overpressure in the unit 2. In another embodiment the overpressure/airflow could be generated by air released from a compressed air tank, by means of a bellows principle or it could be made by other airflow generating means.

[0057] In another embodiment of the invention, a gas other than or in combination with air could be used in the cleaning system 20. This could e.g. be the exhaust gases, some kind of active or inactive gas or this or these gases could be added some kind of solid material such as crystals of frozen nitrogen or other solid particles which are transformed to gas when a certain temperature is reached e.g. at impact or the cleaning system 20 could use another kind gas, liquid and/or solid combination.

[0058] In this embodiment of the invention the cleaning air pump 19 is completely separate from the combustion air pump 11, but in another embodiment of the invention e.g. the combustion air pump 11 could also provide the air flow needed to run the cleaning process, hereby rendering the separate cleaning air pump 19 unnecessary. In cleaning mode the air from the combustion air pump 11 could then, by mean of a register, a damper, a valve or the like, be redirected, so that the air no longer enters the combustion chamber 9 through the holes 17 in the chamber walls, but instead enters the combustion chamber 9 through the entrance opening 12.

[0059] The airflow from the cleaning air pump 19 is prevented from leaving the burner unit 2 through the fuel pipe 3, in that the solid fuel 4 in the pipe 3, in the container worm conveyer (not shown) and/or in the fuel container 5 will clog this passage, ensuring that the airflow generated by the cleaning air pump 19 leaves the burner unit 2 through the combustion chamber 9.

[0060] In another embodiment of the invention the fuel pipe 3 or the fuel container 5 could be provided with a register, a damper, a valve or the like to ensure that the air flow from the cleaning air pump 19 is directed the right way through the burner unit 2.

[0061] In this embodiment of the invention the cleaning air pump 19 is able to move 27.5 liters of air per second but in another embodiment the cleaning air pump 19 could have a capacity of between 100 and 5 l/sec, preferably between 60 and 10 l/sec and most preferred between 45 and 15 l/sec. These capacity ranges are suitable for cleaning a combustion chamber 9 of 12 to 40 kW burner units 2 with an internal sectional area of between 4,083 and 7,854 mm^2, hereby enabling airflow with a speed of between 1 and 20 m/s, preferably between 2 and 14 m/s and most preferred between 3 and 8 m/s through the combustion chamber 9.

[0062] The arrows in fig. 4 illustrate the airflow during the cleaning process of the combustion chamber 9. Fig. 4 further illustrates that the shutter 21 is blown open by the airflow provided by the cleaning air pump 19, but in another embodiment of the invention the shutter could be opened mechanically during the cleaning process.

[0063] In that the air from the cleaning air pump 19 in this embodiment has to pass the burner worm conveyer 7 the airspeed could locally be higher in the combustion chamber 9. Therefore the burner worm conveyer 7 would rotate during the cleaning process in a preferred embodiment of the invention.

[0064] The cleaning process could be triggered by measurements by the lambda sensor 16. If the measurements of the lambda sensor 16 were feed to control means - for controlling the operation of the burner unit 2 or the entire furnace 1 - during normal operation of the burner unit 2, the control means could automatically start the cleaning process if the measurements of the lambda sensor 16 were above or bellow as certain predefined level. But in a preferred embodiment of the invention the control means are provided with a timer, enabling the cleaning process to be started at a fixed or an adjustable time of the day, of the week, of the month or other.

[0065] When the time to start the cleaning process is reached, the control means stop the feeding of fuel 4 to the burner unit 2. Based on empirical data the control means could start the cleaning air pump 19 after a preset time. In another embodiment of the invention the control means would monitor the measurements of a light sensor (not shown) and then start the cleaning air pump 19 when the light emitted from the combustion process in the combustion chamber 9 drops to below a certain level (i.e. the material in the combustion chamber is all burned out).

[0066] In a preferred embodiment of the invention the control means would monitor the measurements of the lambda sensor 16, and then start the cleaning air pump 19 when the measurements of the lambda sensor 16 are above or bellow as certain predefined level.

[0067] During this the burner worm conveyer 7 is running continuously, or the control means starts the burner worm conveyer 7 when the cleaning air pump 19 is started.

[0068] In an embodiment of the invention the combustion air pump 11 could also be running during the cleaning process, hereby increasing the airflow through the combustion chamber and preventing that air from the cleaning air pump 19 or residual material 18 leaves the combustion chamber 9 through the holes 17 in the combustion chambers 9 wall.

[0069] The cleaning air pump 19 pumps air through the combustion chamber 9 until a preset timer of the control means e.g. after 1 to 100 seconds, preferably between 2 an 30 seconds and most preferred between 3 an 10 seconds, stops the cleaning air pump 19. The control means then starts the feeding of fuel 4 to the burner unit 2 again and normal operation of the burner unit 2 is re-established.

[0070] The control means is in this embodiment of the invention a small PLC (Programmable Logic Controller) build into the furnace 1 to control the entire operation of the furnace 1 both during normal operation of the furnace 1- when the burner unit 2 combusts fuel 4 and thereby produces heat - and during the cleaning process, when the combustion process is stopped and the combustion chamber 9 of the burner unit 9 is cleaned. In another embodiment of the invention the control means could be PC and/or microprocessor based or other and in another embodiment the control means could be placed externally to the furnace 1.

[0071] The control means enables that the entire furnace 1 can run automatically, without the need of human interference for a long time compared to traditional solid fuel furnaces 1 known in the art.

[0072] The invention has been exemplified above with reference to specific examples of burner units 2, combustion chambers 9, cleaning systems 20 and use of such. However, it should be understood that the invention is not limited to the particular examples described above but may be designed and altered in a multitude of varieties within the scope of the invention as specified in the claims.

List

[0073]

1. Solid fuel furnace
2. Burner unit
3. Fuel pipe
4. Solid fuel
5. Fuel container
6. Enterance pipe
7. Burner worm conveyer
8. Worm gear motor
9. Combustion chamber
10. Hot bulb
11. Combustion air pump
12. Enterance opening
13. Exit opening
14. Boiler
15. Ash pan
16, Lambda sensor
17. Air supply holes
18. Residual material
19. Cleaning air pump
20. Cleaning system
21. One-way valve

Claims

1. A solid fuel burner unit (2) comprising,
at least one combustion chamber (9)
characterized in that
said burner unit (2) comprise a cleaning system (20),

which in operation substantially cleans said combustion chamber (9) completely for any loose or burned-in material (18).

2. A solid fuel burner unit (2) according to claim 1, wherein said cleaning system (20) comprises means (19) for generating airflow through said combustion chamber (9).

3. A solid fuel burner unit (2) according to claim 2, wherein said airflow enters said combustion chamber (9) through the same entrance opening (12), through which said solid fuel (4) is supplied to said combustion chamber (9) during normal operation of said burner unit (2) and said airflow exits said combustion chamber (9) through the same exit opening (13), through which ash and exhaust gases leaves said combustion chamber (9) during normal operation of said burner unit (2).

4. A solid fuel burner unit (2) according to claim 2 or 3, wherein said means (19) for generating airflow through said combustion chamber (9) during a cleaning process, is separate from means (11) for supplying air to the combustion process in said combustion chamber (9) during normal operation of said burner unit (2).

5. A solid fuel burner unit (2) according to any of claims 2 to 4, wherein said airflow has a speed through said combustion chamber (9) of between 1 and 20 m/s, preferably between 2 and 14 m/s and most preferred between 3 and 8 m/s.

6. A solid fuel burner unit (2) according to any of the preceding claims, wherein said solid fuel (4) is pellets substantially made of an organic material such as wood.

7. A solid fuel burner unit (2) according to any of the preceding claims, wherein said material (18) is incombustible material such as sand grains, slag, clinker, ash or any combination hereof e.g. in form of cakes, which accumulates in said combustion chamber (9) during normal operation of said burner unit (2).

8. A solid fuel burner unit (2) according to any of the preceding claims, wherein said burner unit (2) comprises control means for activating said cleaning system (20) at a fixed or an adjustable time.

9. A method for cleaning a combustion chamber (9) of a solid fuel burner unit (2), said method comprising the steps of

- stopping the supply of solid fuel (4) to said burner unit (2)
- establishing airflow through said combustion chamber (9) when all or substantially all combustible material (4) in said combustion chamber (9) has been burned.

10. A method according to claim 9, wherein one or more sensors (16) detect that all or substantially all combustible material in said combustion chamber (9) has been burned.

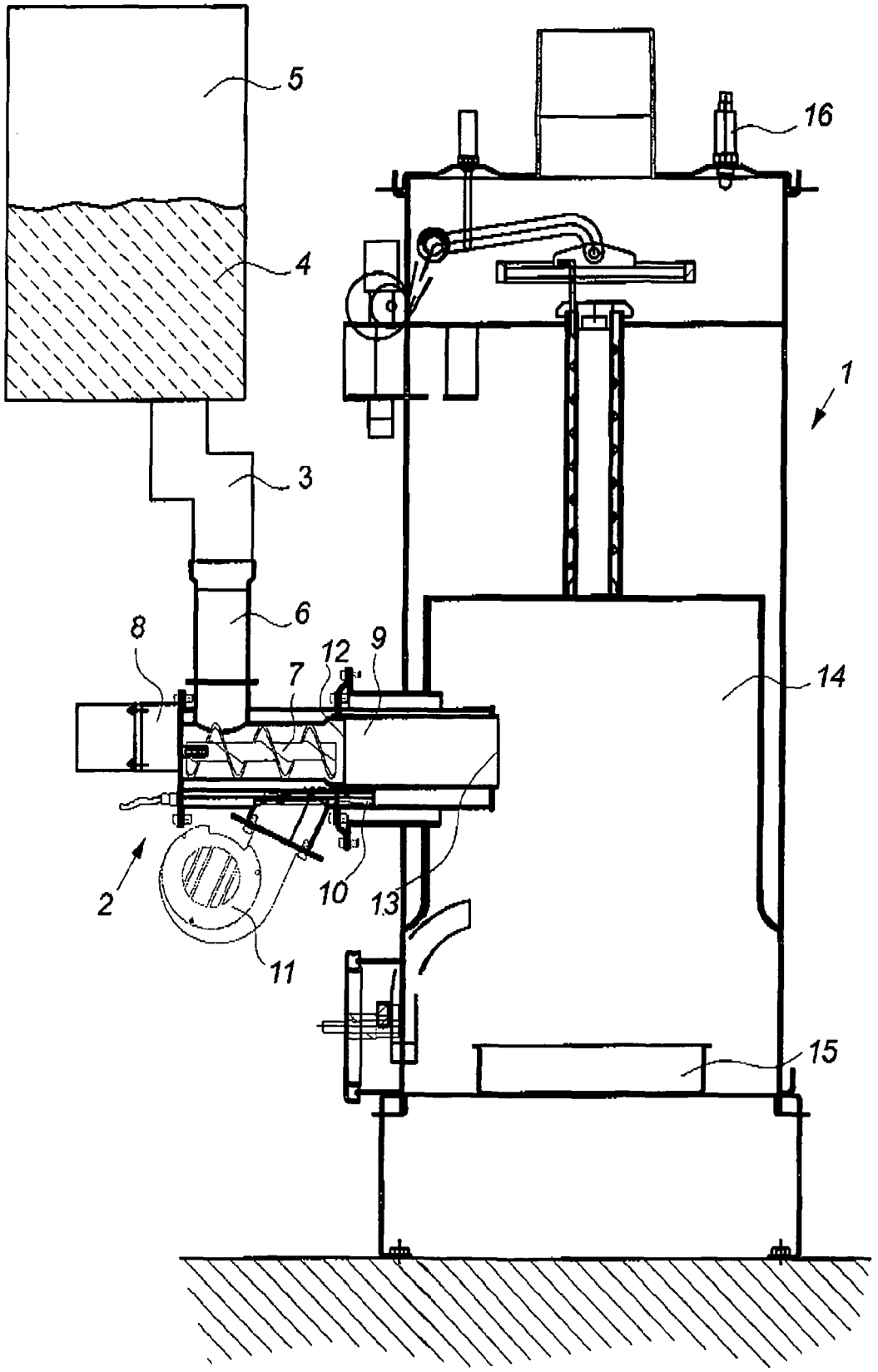

Fig. 1

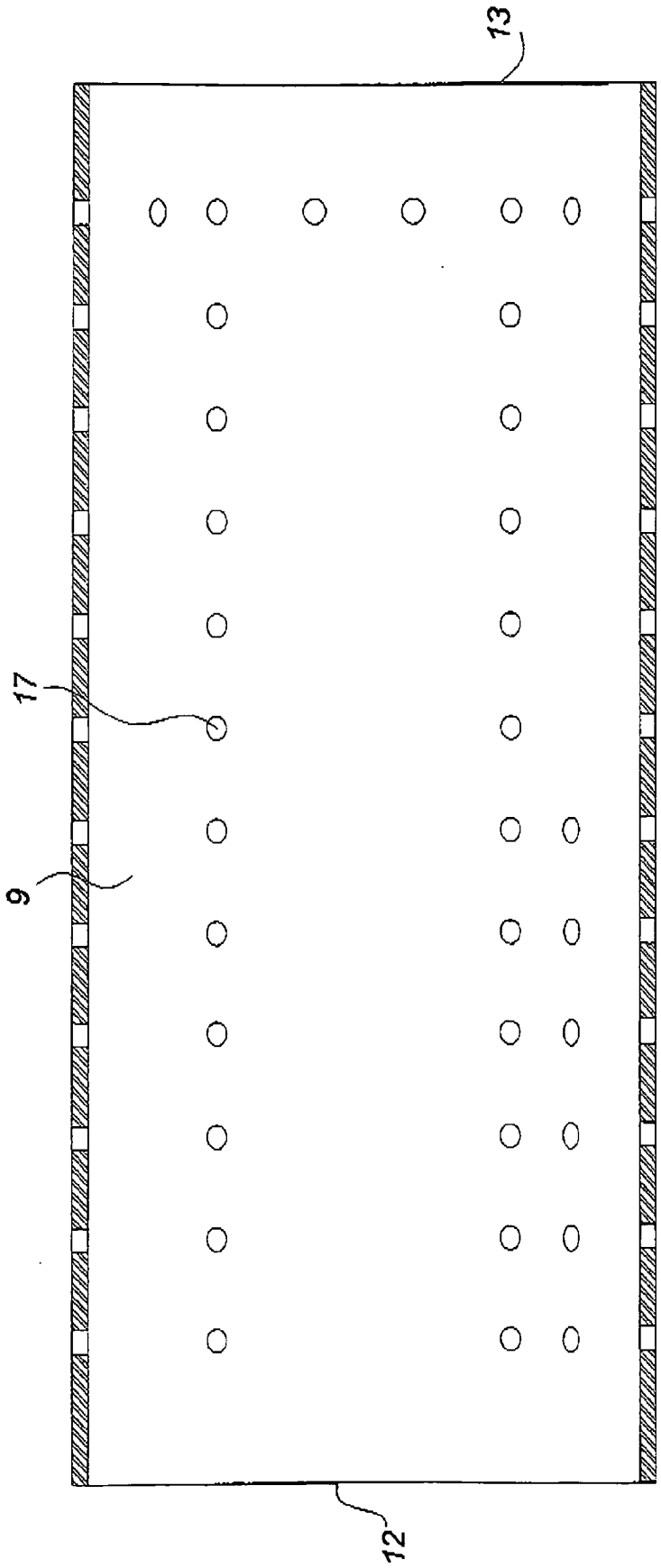

Fig. 2

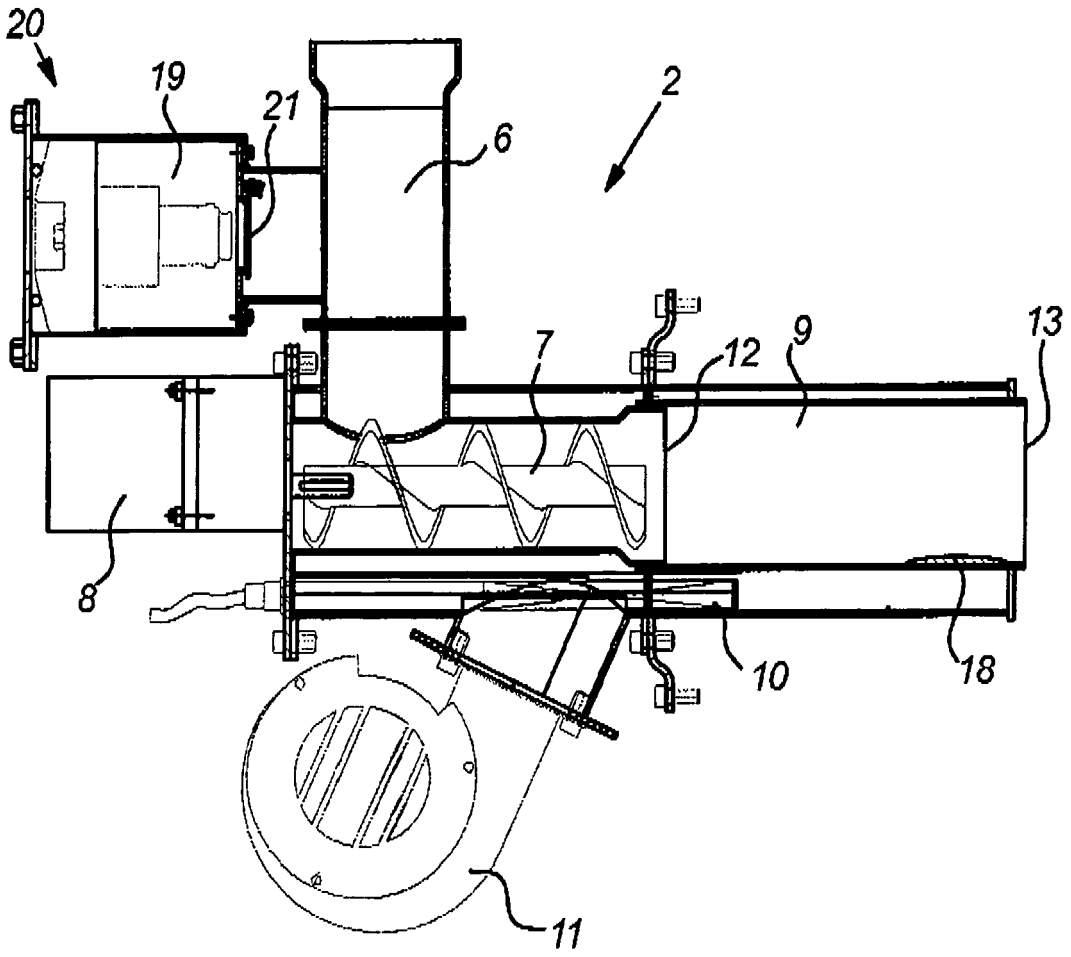

Fig. 3

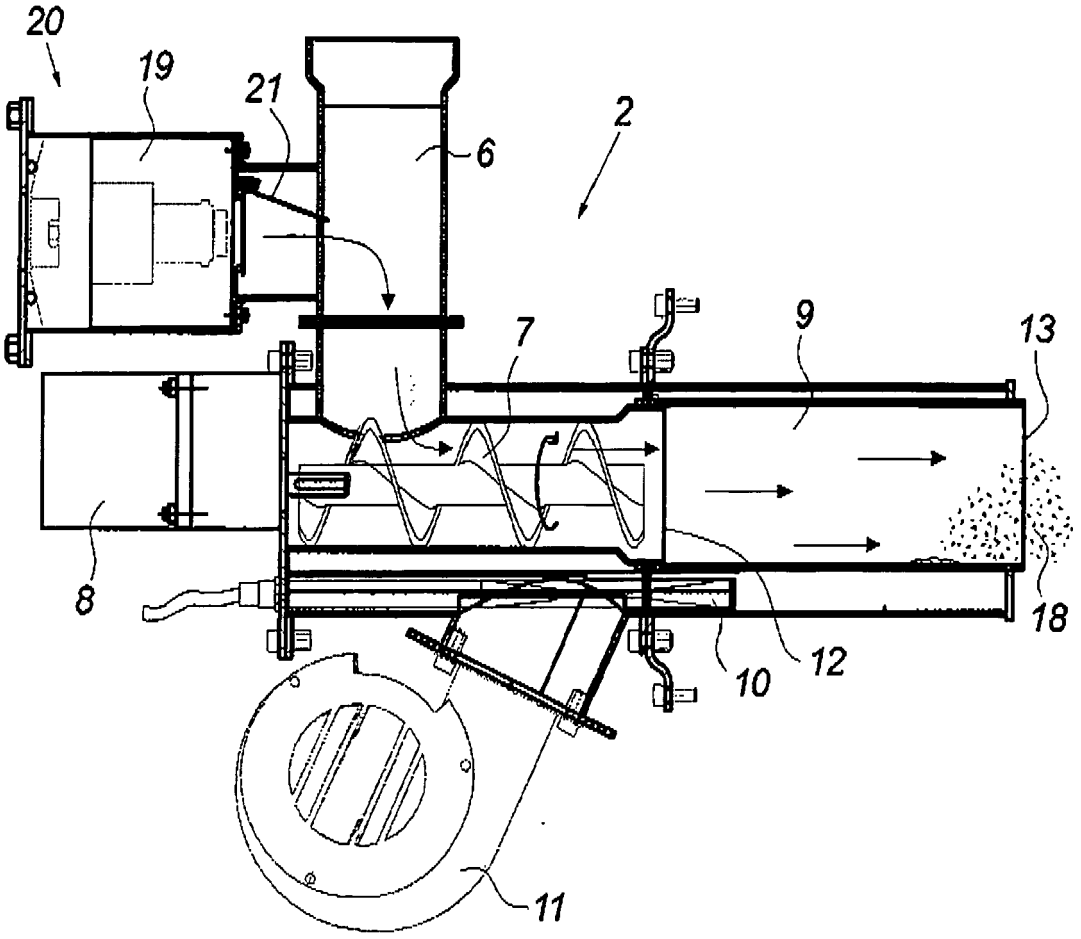

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 00 7075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 32 11 249 A1 (TRUNKENPOLZ MASCHINEN GMBH) 2 December 1982 (1982-12-02) * page 15, last paragraph - page 18, paragraph 2; figures 1-3 *	1,2,6,7	INV. F23B50/12 F23G7/10 F23J1/00
X	DE 41 812 C (GROVE, DAVID) 25 June 1887 (1887-06-25) * the whole document *	1,2,6,7	
D,X	DE 198 13 113 A1 (SCHUSTER, SIEGFRIED) 30 September 1999 (1999-09-30) * column 1, line 3 - line 8 * * column 2, line 24 - line 59 * * figure 1 *	1,2,6,7	
D,X	CA 2 095 098 A1 (TETON STOVE COMPANY, INC) 29 October 1994 (1994-10-29) * page 3, last paragraph - page 5, paragraph 1 * * page 7, paragraph 3 * * page 8, last paragraph - page 9, paragraph 2 * * page 10, paragraph 3 - page 11, paragraph 1; figure 2 *	1,6,7	TECHNICAL FIELDS SEARCHED (IPC) F23B F23G F23J
X	EP 1 559 957 A (THERMOROSSI S.P.A) 3 August 2005 (2005-08-03) * column 1, line 3 - line 5 * * column 2, line 54 - column 3, line 24 * * figures 1-5 *	1,6,7	
A	EP 1 046 862 A (LORENZ, KLAUS) 25 October 2000 (2000-10-25) * column 4, line 17 - column 5, line 25 * * figure 1 *	1,9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 September 2006	Gavriliu, Costin

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

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