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(54) **Pellet-burning heating apparatus**

(57) A pellet-burning heating apparatus, includes a pellet feeding means adapted to feed a combustion chamber which includes a firebox and a discharge circuit for the exhaust gases and the hot combustion gases which is connected to the combustion chamber. The apparatus includes a system for automatic control of the feeding of pellets, constituted by a means for measuring the pressure of the exhaust gases, a means for measuring the temperature of the exhaust gases and an electronic control means adapted to process the data originating from the measurement means and to operate so as to modify the feeding rate of the pellets.

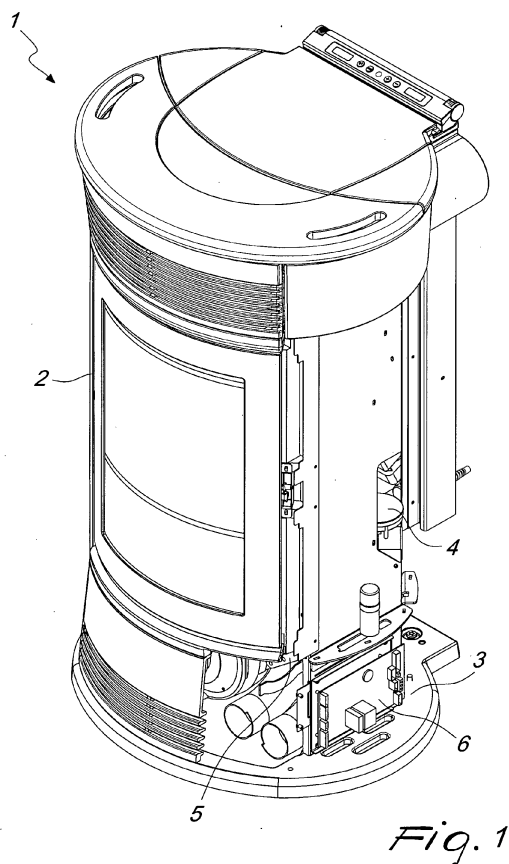


Fig. 1

Description

[0001] The present invention relates to a pellet-burning heating apparatus.

[0002] Various kinds of pellet-burning stoves, i.e. stoves fed with compressed pieces having a standardized format obtained from the pressing of wood sawdust, are known.

[0003] A typical pellet-burning stove is constituted by a metallic box-like structure which contains a pellet feeding tank, a combustion chamber in which a firebox is provided, and a discharge circuit for the exhaust gases and the hot combustion gases.

[0004] Modern stoves also have control systems for an automatic operation and for safety.

[0005] Conventional pellet-burning stoves, however, have problems related to their installation and operation.

[0006] First of all, during installation it is necessary to adjust the operation of the stove according to the characteristics of the chimney-flue, such as the number of bends, its total length, its structure, etcetera.

[0007] One must also consider that the accumulation of dirt inside the flue chimney changes its behavior, the so-called "draft", and combustion should be adapted to the changed conditions to ensure its good efficiency.

[0008] The external environmental conditions, wind, humidity, barometric pressure also modify the behavior of the flue and therefore the efficiency of the combustion.

[0009] Another problem is constituted by the variable quality of the pellet used in the stove, with particular reference to the heat value, which determines the efficiency of the stove. The combustion parameters should be adjusted according to the type of pellet used, but in practice different pellets are used without changing the adjustments of the stove, taking care exclusively not to use pellets of insufficient quality.

[0010] The aim of the present invention is to provide a pellet-burning heating apparatus that overcomes the drawbacks of the cited prior art.

[0011] Within the scope of this aim, an object of the invention is to provide an apparatus that eases the installation by adapting automatically to the characteristics of the flue, such as dimensions, position, shape, etcetera, even when they are not fully appropriate.

[0012] A further object of the invention is to provide a pellet-burning apparatus that is capable of adapting automatically to the type of pellet used and of ensuring the most efficient combustion.

[0013] A further object is to provide an apparatus that is capable of adapting to changeable climate conditions, always ensuring the best thermal performance.

[0014] A further object of the invention is to provide an apparatus that requires reduced and simplified maintenance.

[0015] A further object of the present invention is to provide an apparatus which, by virtue of its particular constructive characteristics, is capable of giving the greatest assurances of reliability and safety in use.

[0016] This aim and these and other objects that will become better apparent hereinafter are achieved by a pellet-burning heating apparatus, comprising a pellet feeding means adapted to feed a combustion chamber which comprises a firebox, a discharge circuit for the exhaust gases and the hot combustion gases, said circuit being connected to said combustion chamber, characterized in that it comprises a system for automatic control of the feeding of the pellets, said system comprises a means for measuring the pressure of the exhaust gases, a means for measuring the temperature of the exhaust gases and an electronic control means adapted to process the data originating from said exhaust gas pressure measurement means and from said exhaust gas temperature measurement means; said system modifies the feeding rate of said pellets.

[0017] This aim and these objects, as well as others that will become better apparent hereinafter, are also achieved by a method of controlling a pellet-burning heating apparatus, characterized in that it comprises the steps of:

measuring a value of the pressure of the exhaust gases by means of a vacuumeter;
generating an electrical signal which corresponds to the measured pressure value and sending it to an electronic control board;
comparing the measured pressure value with a predefined pressure value;
modifying the speed of the exhaust gas extractor in proportion to the difference between the measured pressure value and the predefined pressure value.

[0018] The method also includes the steps of:

measuring the value of the temperature of the exhaust gases by means of a temperature probe;
generating an electrical signal that corresponds to the measured temperature value and sending it to the electronic control board;
comparing the measured temperature value with a predefined temperature value;
modifying the rate of feeding of the pellets to the combustion chamber in proportion to the difference between the measured temperature value and the predefined temperature value.

[0019] Further characteristics and advantages will become better apparent from the description of preferred but not exclusive embodiments of the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a partially cutout perspective view of a pellet-burning stove, according to the present invention;

Figure 2 is a side view of the stove of the figure 1;

Figure 3 is a rear view of the stove;

Figure 4 is a front view of the stove.

[0020] With reference to the cited figures, the pellet-burning heating apparatus according to the invention, generally designated by the reference numeral 1, is constituted in this specific case by a pellet-burning stove, which includes a containment structure 2 which rises on a footing 3.

[0021] The containment structure forms a combustion chamber for pellets, which includes a firebox and a discharge circuit for the exhaust gases and the hot combustion gases, in a per se known manner.

[0022] According to the present invention, the apparatus is provided with a system for automatic control of combustion, which is constituted by an electronic differential vacuumeter, designated by the reference numeral 4, a temperature probe 5 and an electronic control board 6 which is managed by a microprocessor.

[0023] It should be noted that the vacuumeter 4 is of the electronic differential type and is not an electromechanical vacuumeter and includes a pressure intake port 7 whose position is indicated schematically in Figure 3.

[0024] The system according to the invention allows to automate the operating conditions of a firebox on the basis of three functions:

- the installation conditions, i.e., the structure of the flue;
- the weather conditions;
- the characteristics of the fuel (pellets).

[0025] The vacuumeter 4 is constituted by a ceramic plate with a resistive film which bends according to the partial vacuum to which it is subjected.

[0026] The bending of the film modifies the electrical resistance, thus achieving indirectly the indication of the modified pressure on the basis of an electrical measurement.

[0027] The probe 5, of a per se known type, detects the temperature of the exhaust gases.

[0028] The electronic board 6 is provided with specific software, which continuously adapts the draft to the installation and weather conditions and adapts the combustion to the characteristics of the fuel.

[0029] Adaptation of the draft to the installation and weather conditions is performed by the board by analyzing the electrical signal emitted by the vacuumeter 4, by comparing it with the target value set in laboratory, and by acting on the exhaust gas extractor to increase or decrease the speed so as to reach the target value.

[0030] The combustion is adjusted to the characteristics of the fuel by the control board 6 that analyzes the value of the exhaust gas temperature that originates from the probe, and compares it with the target value set in laboratory, and then acts on the pellet loading system, which is normally constituted by a screw feeder with a gearmotor, in order to reach the target value.

[0031] The control system according to the present in-

vention allows to manage the combustion automatically in order to maximize thermal performance, optimize consumption, minimize emissions into the atmosphere, facilitate use of the firebox and maintain the maximum healthfulness in the installation environment.

[0032] The operation of the apparatus according to the invention comprises a first step of verifying the so-called "draft", i.e. the partial vacuum in the combustion chamber.

[0033] If the value of the partial vacuum in the combustion chamber is too low, this means that there is insufficient draft and accordingly the system acts in order to increase the action of the exhaust gas extractor.

[0034] If the partial vacuum is excessive, the system reduces the draft by reducing the rotation rate of the extractor.

[0035] The goal of this operation is to adapt the draft to the characteristics of the chimney flue (bends, length, geometry, dirt) and to the variation in atmospheric conditions (wind, humidity, barometric pressure).

[0036] A second step is identifying the quality of the pellet.

[0037] If the pellet is of excellent quality, and therefore has a high heat value, the system reduces its hourly consumption.

[0038] If instead the pellet is of poor quality, with a low heat value, the system increases the fall of pellets into the crucible, increasing consumption but ensuring the same thermal performance.

[0039] The characteristics that differentiate the various types of pellet are the type of wood, humidity and compactness.

[0040] A further operation, within the first step of operation, is identifying the atmospheric conditions.

[0041] The firebox self-adjusts, detecting variations in atmospheric conditions as well. This function is very useful in windy regions, where the wind affects the draft, and when the atmospheric pressure changes, as between rainy and sunny days.

[0042] In practice it has been found that the invention achieves the intended aim and objects, a pellet-burning heating apparatus having been provided which has an innovative control system that allows to manage the combustion automatically by means of two sensors, which detect respectively the partial vacuum in the combustion chamber and the temperature of the exhaust gases.

[0043] The control system according to the present invention allows to maximize thermal performance, optimize consumption, minimize emissions into the atmosphere, facilitate the operation in general of the firebox and maintain the maximum healthfulness of the environment where the stove is installed.

[0044] The apparatus according to the present invention is easy to install, because all the complications due to less than ideal characteristics of the flue, such as dimensions, position, etcetera, are solved by means of the control system, which analyzes the situation and optimizes the combustion, adjusting itself on the basis of the flue

(draft) always within the limits of a correct installation.

[0045] Another advantage of the apparatus according to the present invention relates to the problem of the choice of the type of pellet, which is no longer critical, because the present system adapts automatically to the pellet used.

[0046] Another advantage of the apparatus according to the present invention is that it allows an optimized combustion for each type of climate; when the wind is strong or outside atmospheric pressure changes, the thermal performance indoors is always the best. This characteristic is particularly useful when the stove is used at high altitude.

[0047] Another advantage of the apparatus according to the present invention is that it requires reduced maintenance by virtue of the autonomous endurance of the system.

[0048] The control system also helps to keep cleaner the glass of the door for accessing the combustion chamber.

[0049] This application claims the priority of Italian Patent Application No. MI2010A000084, filed on January 25, 2010, the subject matter of which is incorporated herein by reference.

Claims

1. A pellet-burning heating apparatus, comprising a pellet feeding means adapted to feed a combustion chamber which comprises a firebox, a discharge circuit for the exhaust gases and the hot combustion gases, said circuit being connected to said combustion chamber, **characterized in that** it comprises a system for automatic control of the feeding of the pellets, said system comprises a means for measuring the pressure of the exhaust gases, a means for measuring the temperature of the exhaust gases and an electronic control means adapted to process the data originating from said exhaust gas pressure measurement means and from said exhaust gas temperature measurement means; said system modifies the feeding rate of said pellets.
2. The apparatus according to claim 1, **characterized in that** said pressure measurement means comprises an electronic differential vacuumeter, said vacuumeter being constituted by a ceramic plate with a resistive film which bends in relation to the partial vacuum to which it is subjected, modifying the electric resistance and thus obtaining an indication of the modified pressure on the basis of an electrical measurement.
3. The apparatus according to claim 1 or 2, **characterized in that** said temperature measurement means comprises a temperature probe.

4. The apparatus according to one or more of the preceding claims, **characterized in that** said electronic control means comprises an electronic control board which is managed by a microprocessor.

5. A method of controlling a pellet-burning heating apparatus, **characterized in that** it comprises the steps of:

measuring a value of the pressure of the exhaust gases by means of a vacuumeter;
generating an electrical signal which corresponds to the measured pressure value and sending it to an electronic control board;
comparing the measured pressure value with a predefined pressure value;
modifying the speed of the exhaust gas extractor in proportion to the difference between the measured pressure value and the predefined pressure value.

6. The method according to claim 5, **characterized in that** it further comprises the steps of:

measuring the value of the temperature of the exhaust gases by means of a temperature probe;
generating an electrical signal which corresponds to the measured temperature value and sending it to said electronic control board;
comparing the measured temperature value with a predefined temperature value;
modifying the rate of feeding of the pellets to the combustion chamber in proportion to the difference between the measured temperature value and the predefined temperature value.

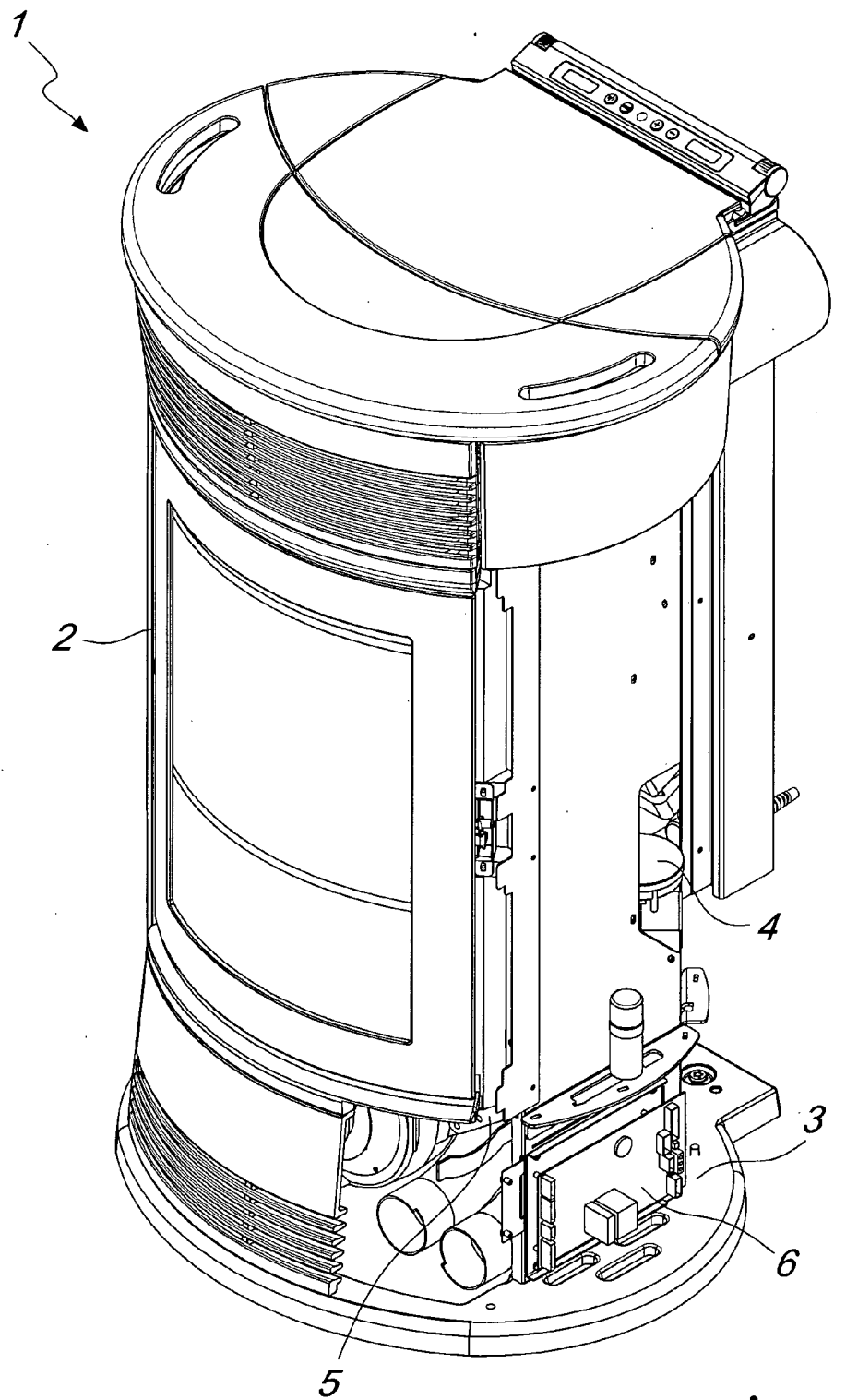
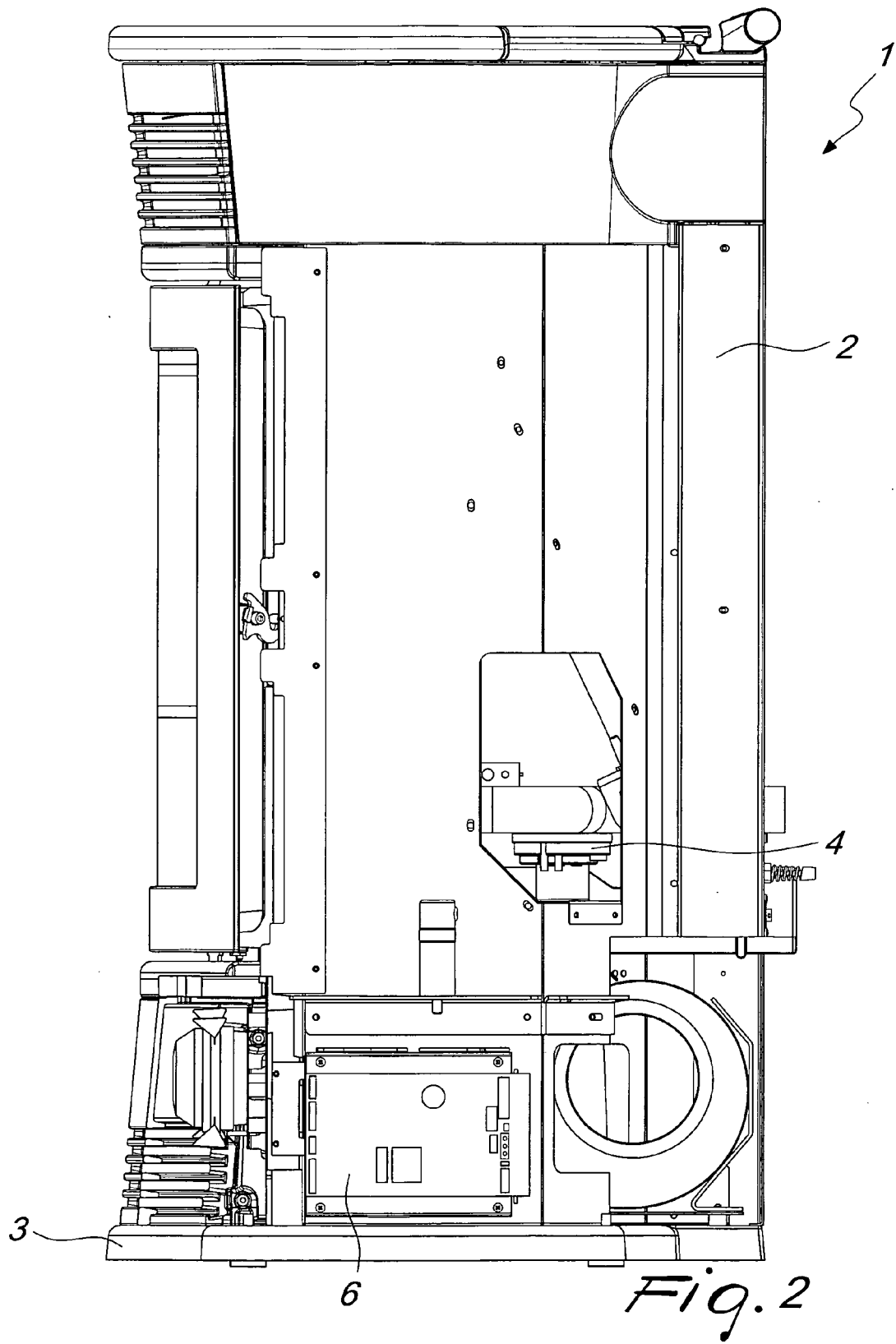


Fig. 1



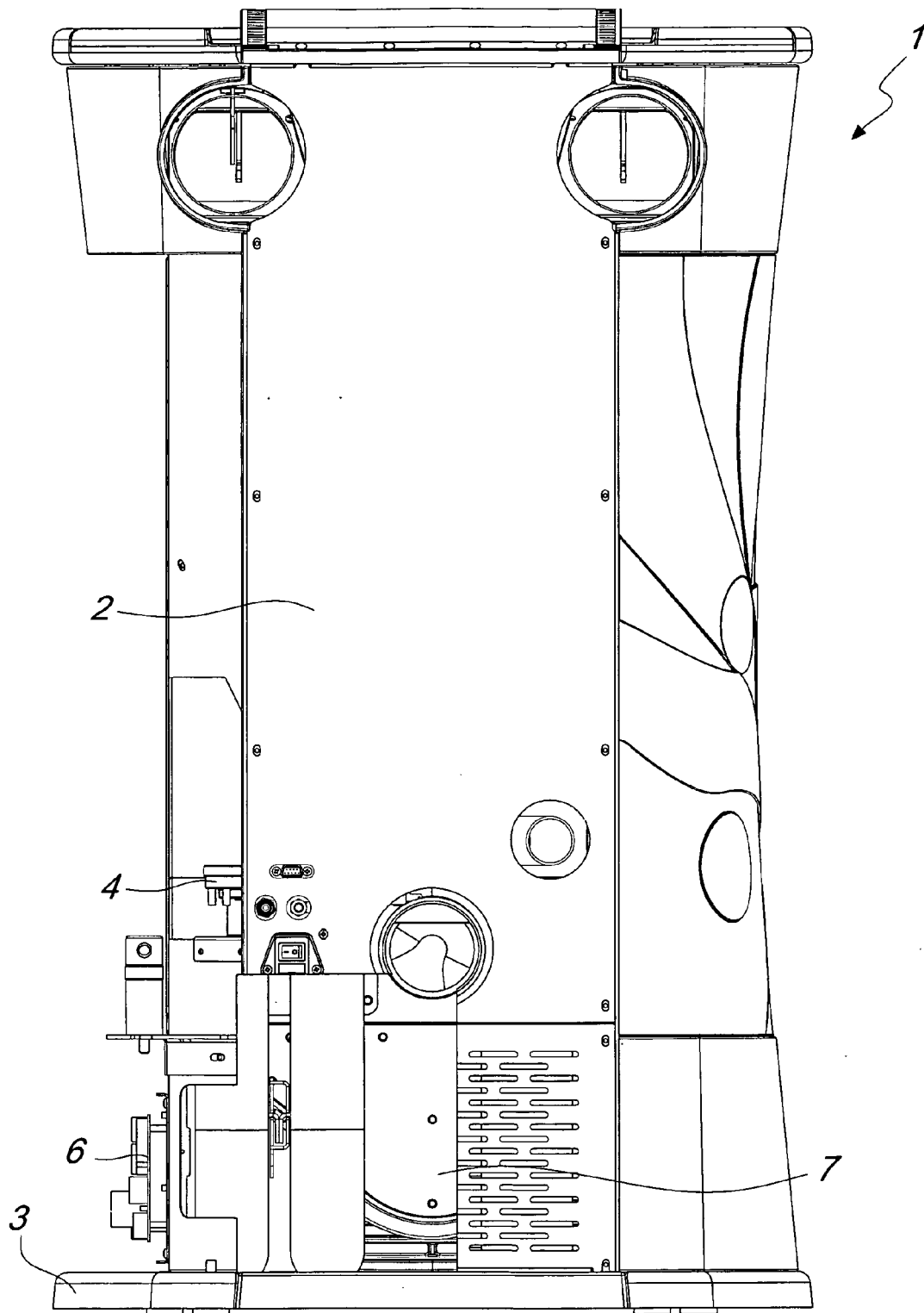


Fig. 3

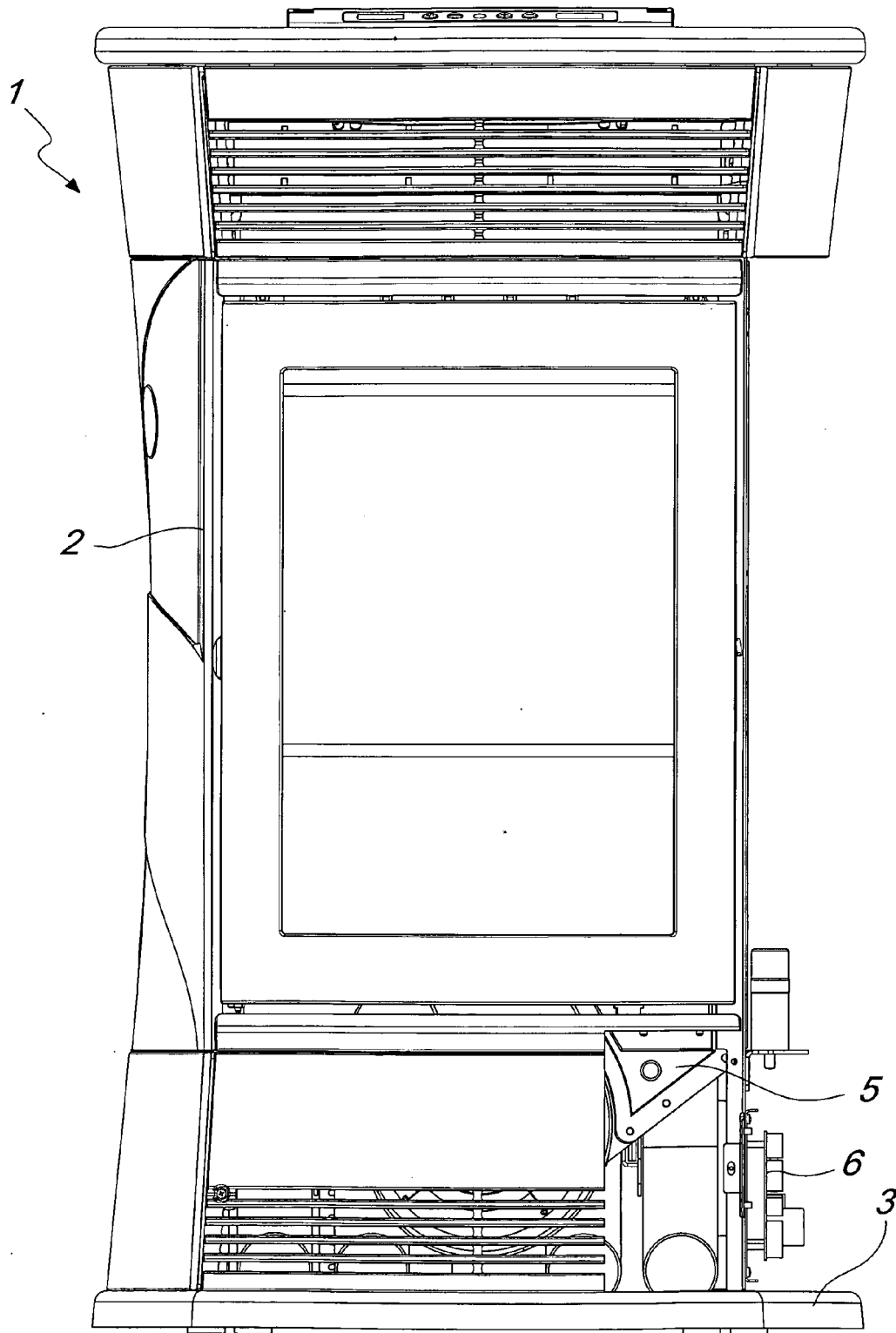


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 11 00 0378

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			F23G F23N
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 7 June 2011	Examiner Theis, Gilbert
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 00 0378

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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07-06-2011

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