(51) International Patent Classification: F23B 20/00 (2006.01)
(21) International Application Number: PCT/IT2006/000252
(22) International Filing Date: 13 April 2006 (13.04.2006)
(25) Filing Language: Italian
(26) Publication Language: English
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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published: without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the “Guidance Notes on Codes and Abbreviations” appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PELLET-FED COMPACT AND PORTABLE STOVE AND METHOD FOR THE USE OF THE STOVE

(57) Abstract: A pellet-fed type stove comprises a pellet hopper (13), a duct (14) for transferring the pellets to a burn chamber (15) and a motor to feed the pellets from the hopper to the burn chamber, means (16) for igniting the pellets when they are in the burn chamber (15), at least one burn chamber and a vent (20) for discharging the smoke generated by the combustion of the pellets. The stove also comprises a circuit for heating the ambient air fitted with an external air suction motor (22), at least one heat exchanger (21, 21') in contact with the combustion chamber and at least one radiator (24) for output of the air heated in the heat exchanger. It also comprises an extractable pan (19) situated between the combustion chamber and the smoke vent (20), this extractable pan (19) being designed to collect and store toxic residues, powder and fine ash generated by the combustion smoke.
"PELLET-FED COMPACT AND PORTABLE STOVE AND METHOD FOR THE USE OF THE STOVE"

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TECHNICAL FIELD

This invention concerns a pellet-fed compact and portable stove and a method for the use of the stove.

More specifically, this invention refers to a pellet-fed stove with extremely reduced dimensions and weight, and equipped with technical measures that allow it to be easily moved from room to another and immediately used.

This invention also refers to a method which makes it possible on one hand to automate the stove ignition stages and on the other to safely control its functioning.

The stove according to the invention is fitted with wheels and is designed with construction criteria that allow the stove to be safely moved even by car, also thanks to the extremely compact dimensions of the stove.

Thanks to its compactness, safety and mobility, the stove according to the invention can also be positioned wherever considered appropriate and can be connected to extremely compact smoke vent means that can be positioned in any situation with very limited or even no modifications to the building structure.

This invention can be applied in the stove production sector, in particular pellet-fed stoves.

BACKGROUND ART

It is known that stoves are very well-known devices for the production of heat and widely used both in homes and in civil engineering in general.

It is also known that one of the most widely used
types of stove is the pellet-fed type, pellets being small cylinders of pressed wood made from untreated wood waste, such as sawdust and shavings, which does not contain any additive and is in fact the same lignin present in wood acting as a natural bonding agent.

The numerous advantages of pellets for heating include the high yield and the fact that this product does not pollute the environment as combustion of the pellets does not increase the amount of CO₂ in the atmosphere.

Pellet stoves currently known are constructed with a generally vertically arranged body, the front part of which is equipped with a combustion chamber at the bottom and a pellet feeder which is usually the screw type.

When the pellets burn, they produce a flow of air heated by the combustion gases which, during their movement towards the vent, lick the special heat exchangers in which a flow of air circulates which is then emitted into the room to be heated by means of a fan.

Currently known stoves have a number of disadvantages, the first being relative to their safety.

The safety of a stove type heating device is of fundamental importance, since many risk factors involved in controlling the functioning of the stove depend on its safety.

The latest generation of stoves are fitted with devices that make it possible to automate the stove ignition and operating stages. These devices were not, however, designed to operate in emergency conditions as they do not envisage the occurrence of dangerous situations, the first of these being the lack of
electrical power.

In the absence of electricity, a stove can become extremely dangerous as when the operating conditions are restored the stove is unable to remember the condition it was in before the black-out.

This can cause extremely risky situations, due for example to the fact that the screw starts to load the stove with pellets again when the previous supply of pellets had not been finished. This can cause excessive or at least abnormal overheating of the stove, with all the extremely dangerous consequences imaginable.

In order to limit the possible damage that a stove can cause, manufacturers are forced to provide a voluminous instruction manual with the stove with all the indications of danger that must be avoided. Obviously users do not always follow to the letter the instructions that exonerate the manufacturer from all responsibility, meaning that the problem of safety of traditional stoves remains unresolved.

In addition, there are currently no stoves that can be easily moved and positioned in any location inside a building, since to date they have instead been designed for fixed installation.

This also means that it is impossible to move the pellet-fed stove during ordinary and extraordinary maintenance for example, so that maintenance workers are obliged to periodically visit the location of each stove, with all the consequent disadvantages and financial outlay that this involves.
DESCRIPTION OF THE INVENTION

This invention proposes to provide a pellet-type stove which can eliminate or at least reduce the drawbacks described above.

The invention also proposes to provide a stove that is on one hand light and easy to move and on the other is equipped with means that allow it to be always used in maximum safety, above all in following more or less prolonged black-out periods.

This is achieved by means of a pellet stove whose features are described in the main claim.

The dependent claims described advantageous embodiments of the invention.

The main advantages of this solution, in addition to those ensuing from the construction simplicity, concern first of all the fact that the stove is equipped with electrical equipment connected to a control unit, for example the PLC type which manages and controls both the ignition stages and the steady state functioning.

The pellet stove according to the invention is operated according to a method which, by means of an appropriate electronic board, foresees that any power cuts lasting less than 1 minute are followed by restart with intermittent loading, while black-outs lasting more than 1 minute foresee an emergency stop.

The electronic board is also able to fully manage all the ignition stages of the stove and to recognise at what point in the ignition stage the black-out occurred, starting up under the conditions most appropriate to the time when the black-out occurred.
The stove is also mounted on a supporting frame with wheels and its shape and dimensions are extremely limited, allowing it to be easily moved and positioned as required in the room to be heated as well as allowing it to be transported to the best equipped service centre.

DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will become clear on reading the following description of one embodiment of the invention, given as a non-binding example, with the help of the accompanying drawings in which:

- figure 1 shows a schematic side view of a stove according to the invention in a vertical cross-section;
- figure 2 is a schematic view of the rear of a stove according to the invention;
- figure 3 shows a schematic plan view of the stove according to the invention;
- figure 4 shows a block diagram of the method for the use of pellet stoves according to the invention.

DESCRIPTION OF ONE EMBODIMENT OF THE INVENTION

With reference to the accompanying figures, the pellet stove according to the invention substantially consists of a frame 10 coated with appropriate refractory material, the frame being positioned on a base plate 11 resting on wheels 12.

The stove comprises a series of internal components including a pellet hopper 13, which discharges the combustible product by means of a screw motor 30 (see fig.
2) through a duct 14 into the burn chamber 15.

The pellets are ignited in the burn chamber 15 by means of an electrical resistance 16, advantageously in combination with a suction fan (not shown in the drawings) for the heated air which is collected and returned to the burn chamber through a tube 17.

The high temperature gases emitted by the combustion in the burn chamber are driven through chambers inside the stove by means of a suction motor, indicated with the reference number 18 in figure 1 and in figure 2.

It can be noted that this motor 18 is located in an intermediate position in the stove, next to the burn chamber 15, leaving the lower part of the stove free to house a pan 19 which collects the smoke residues, the very small particles like fine powder and ash produced by the smoke.

The pan 19, which can be accessed from the back of the stove, therefore collects the very fine powder contained in the smoke and can be periodically emptied during the ordinary and extraordinary maintenance of the stove.

Having deposited the fine powder in the pan 19, the smoke aspirated by the motor 18 is discharged through a flexible duct (not shown in the figures) which is connected to the vent 20, visible in figure 2, located at the back of the stove.

The interior of the stove, close to the chambers for the passage of the high temperature gases, is equipped with heat exchangers 21, 21' consisting of two ducts through which the air to be heated passes.
The ambient air is aspirated through a series of slits in the bottom and/or the lower rear wall of the stove by means of another motor 22, for example a convector motor, and once it has been heated is discharged through at least one radiator 24 (see fig. 1) positioned in the upper part of the stove or in another more appropriate position.

The stove is also normally equipped with a pan 25 which collects the combustion ashes of the pellets, accessible from the front part of the stove. Although not shown in the figures, the stove is also fitted with numerous probes which check the operating temperature and the discharged smoke temperature.

The stove is extremely compact allowing it to be easily moved, and, to achieve high thermal efficiency, it is internally equipped with an exchanger and a flue pipe, which makes it possible to use an external smoke vent 20 of extremely reduced dimensions, that is to say in the region of around 60 mm, with respect to the 80 mm vents traditionally used in prior art pellet stoves.

Thanks to the use of this reduced size vent, which allows an increase in the performance of the stove, it is possible to use a special flexible tube which provides the stove with maximum mobility and also allows it to positioned several metres away from the wall through which the smoke is discharged.

According to the invention, this tube is made with a triple fibre glass stocking, coated externally and internally with silicone, while internally it also comprises harmonic steel loops.
Given its particular structure, the flexible tube according to the invention can withstand a working temperature in the region of 300°C.

According to a particularly advantageous embodiment of the invention, the smoke discharge vent 20 can also be attached to a particular connector (not shown in the figures) which enlarges the diameter of the vent to the standard 80 mm size. This makes it possible to connect the stove directly to a traditional type vent present in the wall of the room in which the stove is installed; alternatively, the smoke vent 20 is directly connected to the aforesaid high thermal resistance flexible tube, which allows the smoke to be discharged, free of toxic residues, powder and ash, directly into the room where the stove is located, through a small hole or opening (60 mm) in the wall of the room.

With this configuration, the connecting element is directly connected to an appropriate safety switch so that the stove is always turned off when the flexible tube is fitted in the connector 20.

The portable pellet stove is also extremely light, around 50 kg, and the small sized smoke vent allows it to be easily moved to the room to be heated and, at the end of the season, to removed and, if necessary, easily transported even by car to the nearest service centre, without having to wait for a technician to make a house call.

The stove according to the invention is equipped with a control unit or electronic board or PLC, which automatically controls the following operating stages
shown in the block diagram in figure 4:

the upper part shows a time line divided into six sectors indicated with the letters from A to F, each divided by time intervals from Start > 2 minutes (phase A), from 2 minutes to 4 minutes (phase B), from 4 minutes to 8 minutes (phase C), from 8 to 15 minutes (phase D), from 15 to 25 minutes (phase E), and finally over 25 minutes (phase F).

The operating method of the stove according to the invention therefore foresees the following phases:

- when the stove is turned on (manually or automatically), the screw loads pellets from the hopper 13 into the burn chamber 15 for 2 minutes (phase A), then the screw stops for 2 minutes up to the end of the fourth full minute (phase B);
- pellet loading starts again intermittently at a factory pre-set frequency, up to 8 minutes (phase C) and during this period the ignition device, consisting of the electrical resistance or glow plug 16, is enabled;
- from the eighth to the fifteenth minute (phase D) the system checks the temperature of the discharged smoke by means of an appropriate probe and if this temperature is above 50°C functioning continues normally, while if the temperature is below this level, the stove turns off and the motor 18 and the convection motor fan 22 stop;
- if allowed by the probe, air ventilation starts at minimum level from the fifteenth minute to the twenty-fifth minute (phase E), after which, if
allowed by all the signals and probes, the operating cycle begins, during which the user can set the required temperature and power; the power level is managed manually (or automatically if ambient temperature probes are used) and memorised.

A black-out safety system is also foreseen whereby depending on whether the black-out lasts less than a minute, indicatively, the stove starts up again with intermittent pellet loading, while if the black-out lasts more than a minute, the stove goes into an emergency stop phase which can only be reset manually or by means of the timer.

The system also foresees a shut-down safety cycle, particularly useful in the event of prolonged black-outs. According to this emergency cycle, manual or timed ignition takes place, without pellet loading (screw loader stationary).

In this stage only the electrical resistance ignition device intervenes, igniting any residues of unburnt pellets in the burn pot as a result of the black-out. At the end of the safety cycle, the stove starts up again with the normal ignition phases, whether manually or programmed as described above.

Another safety device is represented by the fact that the operating programme is connected to a timer which intervenes after around 1000 hours, after which the stove emits a warning to the user that maintenance is required.

After a period of around 1100 hours, the stove shuts down and can only be reset by the manufacturer's authorised personnel.
This type of safety device prevents the user from carrying out maintenance operations, which in the majority of cases he/she is unable to perform correctly without risk.

The stove according to the invention therefore offers the following advantages:

1) maximum compactness and very limited weight;
2) minimum dimensions of the smoke vent;
3) mobility due to the fact that the stove is on wheels;
4) high thermal performance compared to size;
5) silent operating;
6) easy installation, which can be done by the user, following the manufacturer's instruction manual;
7) no need for home service as the stove can be easily transported to the nearest authorised service centre;
8) smoke vent can be positioned at the back of the stove or on the left (or right) side;
9) presence of a visual warning indicator to display emergency signals such as stove cleaning necessary after a certain period of time.

The invention is described above with reference to a preferred embodiment. It is nevertheless clear that the invention is susceptible to numerous variations that lie within the framework of technical equivalents.
CLAIMS

1. A pellet-fed type stove comprising a pellet hopper (13), a duct (14) for transferring the pellets to a burn chamber (15) and a motor to feed the pellets from the hopper to the burn chamber, means (16) for igniting the pellets when they are in the burn chamber (15), at least one combustion chamber and a vent (20) for discharging the smoke generated by the combustion of the pellets, also comprising a circuit for heating the ambient air fitted with an external air suction motor (22), at least one heat exchanger (21, 21') in contact with the combustion chamber and at least one radiator (24) for output of the air heated in the heat exchanger, the stove being characterised in that it comprises an extractable pan (19) situated between the combustion chamber and the smoke vent (20), this extractable pan (19) being designed to collect and store toxic residues, powder and fine ash generated by the combustion smoke.

2. A stove according to claim 1, characterised in that it also comprises another motor (18) designed to aspirate the combustion smoke and direct it towards the extractable pan and the smoke vent, this motor (18) being located above the extractable pan, in particular at the height of the burn chamber (15).

3. A stove according to either of the foregoing claims, characterised in that it comprises a smoke vent with a diameter which is smaller than the standard traditional dimensions of stoves for domestic use.
4. A stove according to claim 3, characterised in that the smoke vent has a diameter of around 60 mm.

5. A stove according to claim 3 or 4, characterised in that it comprises a connector element that can be attached to the smoke vent and which makes it possible to increase the diameter of the vent to the standard traditional dimensions of stoves for domestic use, in particular up to a diameter of around 80 mm.

6. A stove according to claim 3 or 4, characterised in that it also comprises a high thermal resistance flexible tube that can be connected to the smoke vent, the flexible tube consisting of a triple fibre glass stocking, coated internally and externally with silicone, while the inner part of the tube comprises harmonic steel loops.

7. A stove according to any of the foregoing claims, characterised in that it is mounted on wheels (12).

8. A method for the use of a pellet-fed type stove comprising a pellet hopper (13), a duct (14) for transferring the pellets to a burn chamber (15) and a screw motor to feed the pellets from the hopper to the burn chamber, means (16) for igniting the pellets when they are in the burn chamber (15), at least one combustion chamber and a vent (20) for discharging the smoke generated by the combustion of the pellets, also comprising a circuit for heating the ambient air fitted
with an external air suction motor (22), at least one heat exchanger (21, 21') in contact with the combustion chamber and at least one radiator (24) for output of the air heated in the heat exchanger, also comprising an electronic control unit for management of the operating parameters of the stove, the method being characterised in that the control unit controls the following ignition and operating phases:

a) on manual or automatic start-up of the stove the screw loads pellets from the hopper (13) to the burn chamber (15);
b) pellet loading stops temporarily;
c) pellet loading starts again intermittently at a factory pre-set frequency and the ignition device intervenes during this period (16);
d) the system checks the temperature of the discharged smoke by means of an appropriate probe and if this temperature is above 50°C, the procedure continues normally, while if the temperature is below this level the stove shuts down and the motor (18) and the convection fan (22) stop;
e) if allowed by the probe, air ventilation starts, after which, if allowed by all the signals and probes, the operating cycle begins, during which the user can set the required temperature and power; the power level is managed manually (or automatically if ambient temperature probes are used) and memorised.

9. A method according to claim 8, characterised in that the smoke suction motor (18) is located above the pan (19)
designed to collect the residues generated by the smoke, that is to say the most minute particles.

10. A method according to claim 8 or 9, characterised in that it foresees a black-out safety system whereby depending on whether the black-out lasts less than a minute, indicatively, the stove starts up again with intermittent pellet loading, while if the black-out last more than a minute, the stove goes into an emergency stop phase which can only be reset manually or by means of the timer.

11. A method according to any of the claims from 8 to 10, characterised in that it foresees a shut-down safety cycle, particularly useful in the event of prolonged black-outs. According to this emergency cycle, manual or timed ignition takes place, without pellet loading (screw loader stationary).

12. A method according to any of the claims from 8 to 11, characterised in that the operating programme is connected to a timer which intervenes after around one thousand hours, after which the stove emits a warning to the user that maintenance is required. If this is not carried out, the stove shuts down and can only be reset by the manufacturer's authorised personnel.
A: Start 2 min.
B: 4 min.
C: 8 min.
D: 15 min.
E: 25 min.

- Resistance ON
- Continuous pellet loading for 2 min.
- Intermittent pellet loading at pre-set frequency

End of lighting cycle and start of operating cycle

If allowed by the probe, air ventilation starts at minimum level

Manual power level with memory effect

Resistance off if allowed by the probe

Loading pause for 2 min.

Fig. 4

NO
-50°
OFF

YES
+50°