(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 843 094 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.10.2007 Bulletin 2007/41

(51) Int Cl.:
F23N 1/02 *(2006.01)*

(21) Application number: **07075259.7**

(22) Date of filing: **04.04.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **05.04.2006 NL 1031520**

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(54) **Heating device**

(57) Heating device, such as a hot water boiler and/or a central heating boiler, comprising a fuel combustion chamber (1) with a heat exchanger, an internal fuel supply conduit (6) with a connection for an external fuel supply conduit, an internal air inlet conduit (5) with a connection for an external air inlet pipe and an internal flue gas outlet pipe (3) with a connection for an external flue gas outlet pipe, wherein a fan (4) is placed in the internal air inlet pipe and/or in the internal flue gas outlet pipe, wherein the heating device is provided with a pressure gauge (8) which can measure the pressure or a change in the pressure at a location in the internal space formed by the internal air inlet pipe, the internal flue gas outlet pipe, the fuel combustion chamber and internal sub-spaces (15) in the device in open connection therewith, or in the ambient air, and the fan has a variable rotation speed, wherein the heating device is further provided with regulating means which can adjust the rotation speed of the fan subject to the measured pressure or the measured change in pressure.

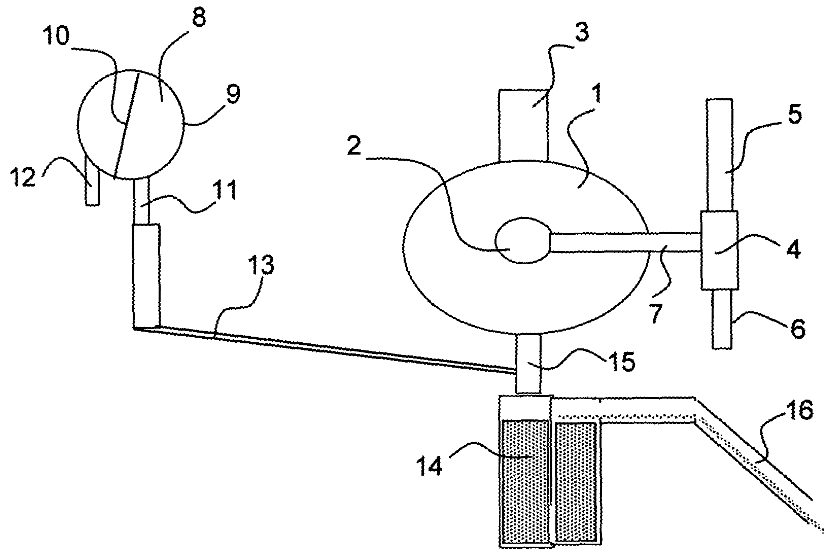

FIG. 1

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Description

[0001] The invention relates to a heating device, such as a hot water boiler and/or a central heating boiler, comprising a fuel combustion chamber with a heat exchanger, an internal fuel supply conduit with a connection for an external fuel supply conduit, an internal air inlet conduit with a connection for an external air inlet pipe and an internal flue gas outlet pipe with a connection for an external flue gas outlet pipe, wherein a fan is placed in the internal air inlet pipe and/or in the internal flue gas outlet pipe.

[0002] The present invention relates particularly to the control of a heating apparatus, in particular a central heating boiler with a built-in fan, either for drawing in the combustion air or for extracting the flue gases.

[0003] The invention relates more particularly to a so-called premix combustion system. Such a heating apparatus has a mixing device, wherein the correct amount of combustion air and a determined amount of gas are brought together before being carried to the burner and are fed in mixed form to the burner in the combustion chamber such that during the subsequent combustion process no further additional air is supplied or drawn in.

[0004] In such a combustion system the combustion air is generally drawn in from the outside atmosphere by means of the built-in fan, and not from the space in which the heating apparatus is set up, while the flue gases are likewise discharged to the outside atmosphere. Such a system requires a casing closed to the environment around the apparatus in order to prevent air being drawn in from the setup area. Pipes which are sealed relative to the space through which the pipes pass can also run from the outside atmosphere to the heating apparatus, which pipes are here connected air-tightly to a heat exchanger which is sealed relative to the setup area, and flue gas outlet pipes which also run to the outside atmosphere, while a fan is arranged at a predetermined location for transport of the combustion air or the flue gases.

[0005] Such systems which are closed relative to the setup area are referred to as closed systems or space-independent systems. If deemed desirable however, air can under determined conditions be drawn in from the setup area instead of the air being drawn in from the outside atmosphere.

[0006] The system described here will preferably use as energy carrier fossil fuel in gas form, such as natural gas, propane, butane, or oil converted into gas form (injector) in a burner suitable for this purpose.

[0007] The invention has for its object to keep the functioning and the energy capacity of the device as constant as possible during changing ambient factors, such as air pressure, ambient temperature and/or connection to diverse types, forms and lengths of inlet and outlet pipes.

[0008] The heating device is provided for this purpose with a pressure gauge which can measure the pressure or a change in the pressure at a location in the internal space formed by the internal air inlet pipe, the internal flue gas outlet pipe, the fuel combustion chamber and internal sub-spaces in the device in open connection therewith, or in the ambient air, and that the fan has a variable rotation speed, wherein the heating device is further provided with regulating means which can adjust the rotation speed of the fan subject to the measured pressure or the measured change in pressure.

[0009] In a preferred embodiment the pressure gauge is a pressure difference gauge which can measure the pressure difference or a change in the pressure difference between the pressure at a location in the internal space formed by the internal air inlet pipe, the internal flue gas outlet pipe, the fuel combustion chamber and internal sub-spaces in the device in open connection therewith on the one hand and in the ambient air on the other, wherein regulating means can adjust the rotation speed of the fan subject to the measured pressure difference or the measured change in the pressure difference. The pressure difference gauge preferably has a provision for giving one side thereof a fixed pressure value such that the pressure difference gauge can be used as pressure gauge which can measure the pressure or a change in the pressure in the internal space or in the ambient air, wherein the regulating means can adjust the rotation speed of the fan to the measured pressure or the measured change in pressure in the internal space.

[0010] In a subsequent preferred embodiment the heating device is provided with an internal condensation outlet conduit for discharging condensation from the combustion chamber, which internal condensation outlet conduit is provided with a siphon and an opening for discharge to an external condensation outlet conduit, wherein said location of the pressure difference gauge is in the internal condensation outlet conduit or in the siphon such that, when the siphon or the condensation outlet conduit is blocked, the water level in the siphon rises rapidly to above the location of the pressure difference gauge, and wherein the regulating means are adapted to switch off the heating device at a pressure difference above a predetermined threshold value.

[0011] Further features, aspects, advantages and possibilities in respect of diverse inventions relating to the heating device are described hereinbelow on the basis of different exemplary embodiments and with reference to the figures, in which:

Figure 1 shows a heating device schematically;

Figure 2 is a graph showing the relation between the load (L) of the heating device and the resistance ® of the heating device; and

Figure 3 is a graph showing the relation between the rotation speed (ω) of the fan in the heating device and the resistance ® of the heating device.

[0012] The heating apparatus according to Figure 1 is provided with a combustion space 1 in which is situated a heat exchanger (not shown) and in which is situated a burner 2 which is connected by means of a gas/air mixture inlet pipe 7 to an air inlet pipe 5 and a gas inlet pipe 6. Air inlet pipe 5 comprises a pipe part which is present in the device and to which an external pipe of a desired length can be connected. The gas and the air are mixed in a correct ratio and fed to burner 2 by means of a fan 4. The gas/air mixture is converted into thermal energy by means of a burner 2. This energy is carried through the heat exchanger, wherein the resulting heat is relinquished to a medium for heating, preferably water or air. The temperature of the medium is hereby increased, whereafter the combustion gases, the temperature of which has decreased due to this exchange, are carried via a pipe system 3 to the outside atmosphere. The flue gas outlet pipe system 3 comprises a pipe part which is present in the device and to which an external pipe of a desired length can be connected.

[0013] Depending on the construction and the volume of the supplied gas-air mixture and the quantity of combustion gases resulting herefrom, as well as the intended efficiency, this heat exchanger and the pipe system will provide an amount of resistance to throughflow of the flue gases. This resistance can be overcome by applying a fan 4 with a correct pressure increase adjusted to this resistance such that sufficient pressure still remains, and such that the flue gases which have left the heat exchanger can be displaced through pipe system 3 to the outside atmosphere.

[0014] The temperature of the flue gases in the heat exchanger has a direct effect on the volume of the flue gases and therefore a direct effect on the resistance in the exchanger and the pipe system for the flue gases.

[0015] Just as the flue gas outlet pipe system 4 has a determined resistance, the air inlet pipe system 5, if present, will also have an amount of resistance which also has to be overcome by the pressure or underpressure of fan 4.

[0016] A fan 4 will therefore have to be chosen which has sufficient pressure to be able to overcome not only the resistance in combustion space 1 but also the resistance in inlet pipe system 5, 7 and the resistance in flue gas outlet system 3.

[0017] At this pressure account must likewise be taken of different temperatures of the supplied air. These differences in temperature in for instance summer and winter will have a small influence on the volume of this air, but also on the temperature differences in the flue gas temperature. This can have a greater effect on the volume, due to greater differences in temperature between for instance a cold apparatus and a hot apparatus, and therefore on the resistance through outlet pipe system 3.

[0018] The location where a heating apparatus is placed is determined by local conditions, while the location where the flue gases can reach the outside atmosphere is regulated by national standards such as safety requirements, so that the length of pipe system 3 for the flue gases is not predictable.

[0019] The resistance in this pipe system 3 is therefore equally unpredictable and depends on, among other factors, the length, debouchment area, the diameter of the chosen pipe, the number of bends, the temperature of the through-flowing air or flue gases.

[0020] In order to determine the correct side of fan 4 there are two quantities which determine the type of fan:

a. The volume to be transported

b. The resistance in the overall system at this volume (working point).

[0021] The volume to be transported depends on the placing of fan 4: in the combustion air or in the flue gases, and on the quantity of supplied energy in the form of the amount of gas or oil. Account has to be taken here of the maximum temperatures and design temperatures of the medium for heating.

[0022] The pressure to be provided by fan 4 must be determined empirically when fan 4 is arranged and tested under the above mentioned conditions.

[0023] The load of a heating apparatus indicates the amount of energy, stated in kilowatts [kW], supplied to the apparatus per unit of time. The load multiplied by the efficiency of the apparatus results in the capacity, this being the amount of heat supplied to the medium for heating, likewise given in kW. The load of a heating apparatus is determined by the amount of supplied energy, while the capacity is determined by multiplying the load by the efficiency of the heat exchange.

[0024] In addition, the combustion must comply with legal requirements relating to CO (carbon monoxide) formation and possibly also the Nox (nitrogen oxide) formation. These requirements are laid down in CE norms and possibly supplemented by national regulations.

[0025] This determines how much energy can be supplied per unit of time, and the amount of combustion air to be supplied is therefore also determined hereby.

[0026] The inlet and outlet pipe system 3, 5 forms in this entity a quantity which is not known in advance. Every additional metre of pipe and every bend has a direct influence on the resistance of the overall system, and therefore likewise a direct influence on the amount of combustion air displaced by fan 4.

[0027] Since a decrease or increase in the combustion air has direct consequences for the combustion reaction if the amount of energy were to remain constant, controls are applied for this type of apparatus which automatically adjust the energy supply to the amount of combustion air.

[0028] According to national and international standards laid down for combustion devices, the maximal load may not be exceeded, though it may be reduced, so that these apparatus are only approved with a minimal pipe length and a maximum temperature of the medium for heating, so that the load only becomes lower when greater pipe lengths are applied. Data are generally supplied in the technical specifications of such combustion devices from which it is possible to infer the decrease in load per metre of pipe length in the combustion air side and the decrease in load due to the length of pipes 3 in the flue gas outlet side.

[0029] The invention has in mind a device wherein the decrease in load resulting from the pipe length in the supply and discharge part is prevented or reduced.

[0030] According to a first aspect of the invention, a pressure difference gauge 8 is applied for this purpose.

[0031] The pressure difference meter consists for instance of a housing 9 with a membrane 10, which divides the housing into two parts, each half having an opening 11, 12 to the atmosphere. Membrane 10 is coupled to a resistance strain gauge, known as a "thick film". Placed on this resistance strain gauge are two ICs which measure the displacement of the strain gauge and, using a Wheatstone bridge, this displacement is amplified and converted into an electrical signal.

[0032] One of the atmospheric openings 11 of this pressure difference gauge 8 is connected to a location in the pipe system 3, 5, 7 or combustion chamber 1, where the change in pressure can be measured when longer pipes are connected to the apparatus.

[0033] Owing to these longer pipes the resistance in the system changes, the pressure becoming higher in the pressure side of fan 4 and the pressure decreasing in the suction side of fan 4.

[0034] By means of the pressure difference gauge a change in pressure is converted into an electrical analog or digital signal, and this signal is fed to an electronic control (not shown). This electronic control converts the signal by means of a table incorporated in this control, and this results in a change of the rotation speed of the applied fan 4.

[0035] A first method of preventing a chain reaction is as follows according to the invention. At each start of the heating apparatus the resistance of the system is measured immediately at the initial rotation speed of fan 4 (this initial rotation speed is a fixed value and is stored in the memory of the control), even before the gas valve is opened, and compared to a predetermined resistance under nominal conditions. These nominal conditions can be qualified as: a barometric pressure of 1013 mbar, an average heating medium temperature of 25°K above the indrawn air temperature, inlet and outlet pipe length each of 0.5 metre, and a diameter of the size of the connections of the apparatus. If a resistance is measured which is higher or lower than the determined nominal value, the initial rotation speed is adjusted. The correction curve is in principle hereby shifted integrally upward or downward parallel to itself, so that at any other rotation speed, once the apparatus has been ignited, the measured variation is corrected. With a longer burning time of the apparatus, the apparatus can be turned off after a determined burning time, whereafter a restart can follow in order to determine a new correction.

[0036] A following method according to the invention for preventing a chain reaction is as follows. Under the stated nominal conditions the apparatus is placed at maximum capacity (burner 2 on) and the pressure is determined by gauge 8. The correction of the rotation speed takes place only when fan 4 of the apparatus connected to a given length of pipe and diameter has reached a rotation speed of for instance 95% (or other rotation speed higher than the initial rotation speed) or higher of the maximum rotation speed under nominal conditions. The pressure is herein determined and compared to the nominal pressure, and the rotation speed of fan 4 is corrected and this point is then fixed for this rotation speed. If as a result of modulation the rotation speed falls below this 95%, a switch is made to the normal ratio curve between rotation speed and load, wherein the correction is then omitted. As soon as the rotation speed once again rises above this 95%, a measurement is performed again, wherein a renewed correction takes place. The load is here thus only corrected at almost maximum load. At lower loads the pressure decreases quadratically relative to the volume of the air supply or the combustion gas outlet, whereby a compensation will have no further, or only little, influence on the resistance in the supply and discharge pipes.

[0037] A combination of the two foregoing methods is also possible.

[0038] As known in the art, a fan 4 has a characteristic indicating the ratio between the rise height (pressure) and the displaced volume. This line is a logarithmic curve, although this logarithmic curve can be shifted in parallel if the rotation speed of fan 4 is changed.

[0039] It is likewise known from the art that the ratio between the load of a combustion apparatus and the rotation speed is practically a straight line, at least if no other constructions are applied to modify the form of this curve, as is the ratio between the change in resistance of a combustion device, including the connected pipes, and the change in the load resulting herefrom. The relation between the additional resistance on a heating apparatus and the rotation speed has to be determined empirically per sort and type of apparatus.

[0040] In Figures 2 and 3 the lines show the load in relation to the resistance in the heating apparatus and the rotation speed of the fan in relation to the resistance in the heating apparatus. The line marked with squares in Figure 2 shows the decrease in load when there is no adjustment of the fan rotation speed. The increase in resistance can be caused by an increase of the temperature in the apparatus or of the temperature of the indrawn air, or by lengthening of the air inlet pipe or the flue gas outlet pipe. The resistance is also increased if a smaller diameter of inlet pipe or outlet pipe is applied. The line marked with triangles indicates the load when the fan rotation speed is adjusted to said increase in resistance as shown in Figure 3 by means of measurement by pressure gauge 8.

[0041] A subsequent method according to the invention is as follows. As soon as the resistance in the system consisting of combustion air inlet pipe 5, combustion chamber 1 and flue gas outlet pipe 3 changes, this is detected by pressure difference gauge 8. There occurs a difference between the pressure conduit 13 connected to the system and the other opening 12 of housing 9 of pressure difference gauge 8 which is connected to the outer atmosphere, and the rotation speed of fan 4 is changed via a ratio table. By changing the rotation speed the situation is restored to the situation before the resistance was increased. The decrease in load is hereby prevented.

[0042] The characteristics of this method are:

1. The load can be held constant by an automatic rotation speed change on the basis of an analog signal from said pressure difference gauge 8.
2. Within the limitations or within the possibilities of fan 4 the diameter of the pipe system can be decreased relative to a heating apparatus without this control.

[0043] The above stated intention is universal for all heating apparatus provided with a premix gas-air mixing system. Among these devices can however be distinguished so-called high efficiency (HE) condensing devices. These have an overdimensioned heat exchanger whereby the flue gases have a lower temperature such that these flue gases condense when they come into contact with surfaces lower in temperature than, for natural gas, about 58°C, the dew-point of the flue gases. The temperature depends on the type of fuel supplied.

[0044] This type of apparatus has to be provided with a siphon 14 for discharge of this condensation that can occur in combustion chamber 1 and flue gas outlet pipe 3. This siphon 14 is connected directly to combustion chamber 1 and/or to flue gas outlet pipe 3.

[0045] The location where pressure difference gauge 8 is connected is important in respect of the quantity to be measured. As stated, the inlet of the meter can be connected in pipe system 3, 7, 5 or combustion chamber 1, although the following conditions differ greatly and have a great influence on the gauge:

If gauge 8 is connected to the inlet side of the heat exchanger, the quantity to be measured will be high since combustion chamber 1 generally has a high resistance. All increase in resistance is herein measured, except for the increase of the resistance in air inlet pipe 5.

If gauge 8 is connected to the system immediately following the heat exchanger, the measured quantity is markedly lower, and the influence of the change in resistance through lengthening of outlet system 3 is measured directly, while the increase in resistance due to temperature change in the heat exchanger is not measured.

If the overpressure becomes greater, the rotation speed must be increased in order to obtain compensation for the indirect consequence, a decrease in load. If the measured pressure becomes lower, depending on the placing of said pressure gauge 8, the rotation speed must become lower in order to prevent increase in the desired load. The relations according to Figures 2 and 3 are also applicable here.

[0046] The gauge can in principle be connected to the pipe system 3 coming out of the exchanger, although this system can contain a rather large amount of moisture pressure due to condensation.

[0047] A pressure gauge 8 with membrane is generally very sensitive to condensation. It is therefore necessary to seek a location where this condensation is present to a small extent or not at all.

[0048] A siphon 14 is in any case connected to combustion chamber 1, and a possible second or third siphon can be connected to the flue gas outlet system 3 if this results in possible advantages.

[0049] Flue gases do not flow through the air/water column in siphon 14 since the water column prevents this. A relatively stable situation is therefore present herein.

[0050] The pressure in siphon 14 is determined by the resistance in outlet system 3. This pressure is a resultant of the throughflow volume of the flue gases, the length of outlet pipe 3 (including bends and the like) and the diameter. By connecting pressure gauge 8 in connecting part 15 between combustion chamber 1 and siphon 14, or directly onto or in siphon 14, the following advantages apply:

a. balanced pressure: pressure fluctuations are damped under the influence of the water columns.
b. no water vapour due to high flue gas temperature:

condensation water is colder than the dew-point of the flue gases.

c. placing of pressure gauge 8 can be higher than the point of connection of the one leg 11 of the pressure gauge housing and still be situated within the dimensions of the heating apparatus.

[0051] The outlet 16 of siphon 14 is generally connected to the sewer, wherein installation requirements prescribe that there has to be an open connection between this siphon outlet 16 and the sewer in respect of blockage of this sewer or pressure increase therein. In some countries it is only permitted to discharge condensation to the sewer if the condensation is first neutralized such that the pH content is brought to 5, this being between alkaline and acid. Particularly in this latter case it can occur that outlet 16 of siphon 14 of the heating apparatus is blocked, whereby the level of the condensation water in siphon 14 rises, whereby the condensation cannot be removed from combustion chamber 1 and combustion chamber 1 can fill with condensation.

[0052] This is of course undesirable, and in this type of high efficiency devices measures must be taken to render the device inoperative.

[0053] If such a phenomenon occurs during use of the present pressure gauge 8, if the water column of the condensation were to be above the connection in for instance connecting part 15 of pressure gauge 8, the pressure on the membrane of meter 8 will increase.

[0054] The result hereof is that the fan rotation speed will increase by means of said table in the control. This action can be advantageous since the pressure on siphon 14, and therefore on the blockage, will increase whereby the blockage is possibly ended. If this effect does not have the correct outcome, the pressure will begin to increase in magnitude by means of the fan 4, while the level of the condensation reaches the combustion chamber, which is not desirable. A safeguarding action can also be initiated by means of the measured value of the pressure gauge: if the measured pressure becomes higher than a determined value, the heating apparatus is switched off via the control.

[0055] If heating devices are placed at heights greater than sea-level, the air pressure decreases in accordance with a value which can be calculated, depending on the temperature: (273,15+15)-6.5*(height in metres)/1000. While the oxygen percentage at these greater heights does remain at 21%, the oxygen molecules will be at a greater distance from each other, so that less oxygen is supplied per unit of time. The outflowing gas will also be exposed to a lower pressure, whereby the gas molecules will also be a greater distance from each other, which results in a reduced oxygen and energy supply, and so a lower load.

[0056] If at sea-level of the atmospheric opening 12 of the pressure gauge is now closed, or is replaced electronically by a fixed electronic value of the gauge, a negative pressure difference is generated at a greater height without the apparatus functioning. This pressure difference in accordance with the above-mentioned table automatically implies an increase in rotation speed if the apparatus is set into operation together with fan 4. There is a linear relation between the fan rotation speed and the atmospheric pressure.

[0057] By measuring this atmospheric pressure a compensation is obtained for the change in the load of the heating apparatus under these conditions by means of changing the rotation speed of fan 4 when there is a demand for heat.

[0058] In this measuring method there is no change in the resistance of the inlet and outlet pipe systems 3, 5, 7 and there is no increase in the resistance due to temperature in the heat exchanger, because this value (about a maximum of 600 Pa difference) is offset as measurement value against the difference in value at greater height - this can be 300 mbar or 30,000 Pa. This difference of 600 Pa can be deemed as measuring inaccuracy.

[0059] The connection of pressure gauge 8 is directly to siphon 14, or to the connection 15 between the heat exchanger and the siphon, or to a location at the air inlet pipe 5 or the flue gas outlet pipe 3, wherein the atmospheric opening 12 of pressure gauge 8 is closed, whereby a barometric influence can be measured in an apparatus at rest.

[0060] In another embodiment pressure gauge 8 has only one connection 11 intended for connection to the siphon, while the gauge is preprogrammed with a value equal to the atmospheric pressure of the atmosphere at 0 metre height - 1013 mbar.

[0061] This influence can be employed as an offset or a hysteresis for the fan rotation speed. An automatic compensation of the load is hereby obtained when the apparatus is placed at a height other than sea-level.

[0062] A following embodiment relates to a pressure gauge 8 with closed atmospheric opening 12. This can be applied in the following situations.

[0063] If the pressure increase takes place because the inlet or outlet diameter of pipes 3, 5 is reduced, or because the temperature of the flue gases is increased or decreased, or because the length of pipes 3, 5 is increased, an opening 11 of the pressure box of pressure gauge 8 is connected at the location where this change is recorded, while the other opening 12 is not connected but measures the atmospheric pressure.

[0064] If measurement takes place at greater height, this atmospheric measuring opening 12 is closed and replaced by a constant pressure, standard 1013 mbar, to enable the pressure difference to be measured with the atmospheric height.

[0065] If the atmospheric opening 12 is not closed, the pressure gauge is compensated in respect of the atmospheric pressure, and there is only a reaction to the change in the increase or decrease of the apparatus and pipe resistance.

[0066] If the atmospheric opening 12 is closed, there can only be a reaction to the changed pressure in the atmosphere in respect of the height, and no longer to the change in resistance of the apparatus with the connected pipes.

[0067] This difference is important since it is possible to conclude therefrom that, if the choice is made not to close the atmospheric opening 12, at a change of the pressure in the atmosphere - the difference between for instance a highpressure area and a low-pressure area - no compensation will occur in the case of an already placed apparatus, and a compensation will take place here only on the basis of the change in resistance under the influence of temperature of the indrawn air, the temperature of the flue gases in the outlet pipe and the heat exchanger and the length of the pipe system, assuming the nominal resistance of the total when the apparatus is set up under nominal conditions: apparatus at maximum load at 80°C feed and 60°C return, and at an inlet and outlet length of 0.5 metre at an air feed temperature of 20°C.

[0068] If the pressure decreases due to decrease in diameter or pipe lengthening of inlet pipe 5, or temperature change of the air feed, the load is compensated by an increase in rotation speed. If the pressure increases due to tube diameter reduction or lengthening or flue gas temperature increase or decrease, this is likewise compensated by a change in rotation speed. In both cases this results in a constant load due to the change in the rotation speed.

[0069] As stated, when the opening 12 of the pressure difference gauge is closed there will only be a reaction to the change in the atmospheric pressure and, in view of the ratio between the atmospheric pressure and the change in resistance, generally a difference of a factor of 100, the apparatus resistance cannot be measured.

[0070] A pressure difference gauge 8 with a closed chamber having a fixed pressure of a nominal value of 1013 mbar is thus applied to keep the load of a heating apparatus constant, even if the apparatus is placed at great height, so at a lower atmospheric pressure, by measuring the atmospheric pressure in situ relative to said normal pressure of 1013 mbar.

[0071] According to another method a standard value of the pressure is determined under nominal conditions, though before fan 4 is started, as stated for instance at 1013 mbar, and the actual pressure is compared thereto and on the basis hereof the ratio curve between the rotation speed and the load is corrected - offset in parallel - and this is used as basis for a further correction on the basis of pressure differences.

[0072] If a solution for both situations is desired, thus: placing of the apparatus at great height and compensation for this height as well as compensation for the increase or decrease in the resistance over the apparatus, it is possible to opt for the following two possibilities.

[0073] Application of two pressure (difference) gauges 8: one with a closed opening 12 (a pressure gauge) for the height at which the apparatus is placed and one with an open opening 12 (a pressure difference gauge) for measuring the resistance over the apparatus. Pressure gauge 8 with closed opening 12 has priority over the gauge with an open opening 12. Pressure gauge 8 with closed opening 12 determines the basic rotation speed, on which the gauge 8 with open opening 12 superimposes as it were an offset to compensate the pressure of the resistance.

[0074] Application of one pressure gauge 8 for both compensations: in this case a bypass is present on or in pressure gauge 8, wherein before the apparatus (or fan 4) is started the pressure in the closed leg is compared in the first instance with the pressure in the open leg, whereafter the table of the fan rotation relative to the barometric pressure is loaded and the rotation speed is determined. This signal is then blocked and after starting of the apparatus the opening 12 of pressure gauge 8 is opened to the atmosphere and the pressure of the atmosphere is measured relative to the pressure in the system, and the table is opened of the relation of the resistance of the system compared to the standard resistance, and the rotation speed is superimposed as offset rotation speed on the height rotation speed.

[0075] By applying a gauge 8 which can switch electronically a combination can be achieved of measuring an absolute barometric pressure and the local pressure, and the rotation speed of fan 14 can hereby be adjusted in order to obtain a load equal to that at an atmospheric pressure of 1013 mbar, whereafter at startup of the apparatus this atmospheric pressure is replaced by the momentary pressure in the inlet and outlet system, which can represent the resistance of the system and with which the calculation can be made relating to the greater and lesser pressure compared to the nominal resistance and with which the rotation speed of fan 14 can be modified such that the load is set to the nominal value.

[0076] It is known from the literature that premix devices are preferably regulated as modulating devices: the load of the heating apparatus adapts to the heat demand by changing the capacity by means of adjusting the rotation speed. Not only is the amount of combustion air hereby changed but the energy supply of gas or oil in the same ratio, so that the quality of combustion remains at the same level.

[0077] Since the rotation speed is in linear relation to the load, it can be stated that the resistance in the inlet and outlet system is in squared relation to the rotation speed of fan 14 in respect of the load. If the resistance of the inlet and outlet system is increased by an increase or decrease in diameter of pipe system 3, 5 and by lengthening thereof, there will have to be a reaction hereto if the apparatus has a value other than the maximum load.

[0078] The diameter of the inlet and outlet system 3, 5 is however determined on the basis of the greatest flow rate of the flue gases: the maximum quantity. It is not therefore necessary to change the rotation speed of fan 14 within the modulation range: only above about 90% of the maximum capacity does the table with the load/resistance ratio have to become active. In addition, it is important to fix the measuring point of the pressure: if this is located after the exchanger, the resistance is determined solely by the resistance in the outlet system, and not by the load or modulation. If the resistance in this outlet system is higher than the standard resistance, the fan rotation speed is adjusted.

[0079] Since the rotation speed of the fan in the nominal situation (outlet pipe 3 0.5 metre, inlet pipe 5 0.5 metre, combustion temperature 20°C) is determined by the manufacturer of the apparatus, the apparatus will be connected at an unknown location, with unknown height, with unknown barometric pressure and unknown outlet system 3, and be ignited for the first time. During this first use of the apparatus a pressure in outlet system 3 is measured which differs from the pressure under nominal conditions. At the moment the apparatus functions for the first time at a load of more than 95% the pressure in the system is measured. According to the ratio table of the changed pressure to rotation speed incorporated in the control, a changed rotation speed will result herefrom in order to keep the load constant. This initial value is stored as new default value. If after this initialization the pressure changes relative thereto, the rotation speed is constantly adjusted to maintain the load at the desired value.

[0080] Operation takes place thus according to this method:

1. An initialization measurement takes place immediately after placing of the apparatus, whereafter the rotation speed is adjusted in accordance with the table to the changed conditions relative to the standard conditions.
2. This initialization is ended by assigning this new rotation speed as default in the table.
3. In respect of the changes in the pressure after this initialization, the rotation speed is changed by a hysteresis or offset based on this new default in order to keep the load constant: these changes cannot be the consequence of a longer outlet system or a shortening thereof, since it can be assumed that an installed system is not changed but there can be an influence of wind pressure on the combustion air inlet or flue gas outlet, the temperature of the heat exchanger, so flue gas temperature, temperature of the air inlet and the like.

Claims

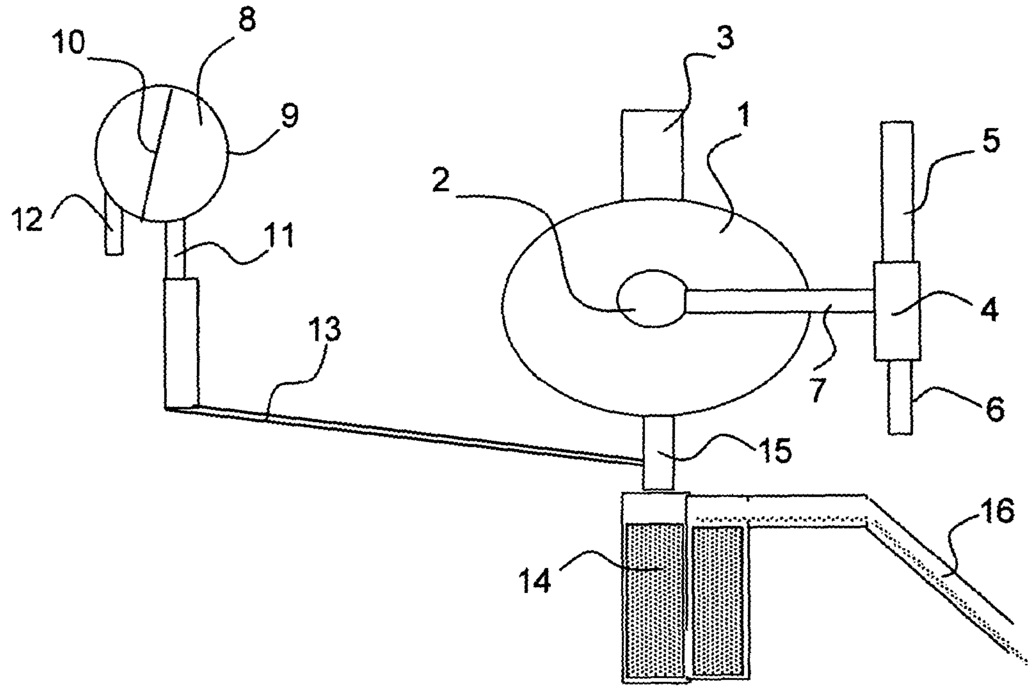
1. Heating device, such as a hot water boiler and/or a central heating boiler, comprising a fuel combustion chamber with a heat exchanger, an internal fuel supply conduit with a connection for an external fuel supply conduit, an internal air inlet conduit with a connection for an external air inlet pipe and an internal flue gas outlet pipe with a connection for an external flue gas outlet pipe, wherein a fan is placed in the internal air inlet pipe and/or in the internal flue gas outlet pipe, **characterized in that** the heating device is provided with a pressure gauge which can measure the pressure or a change in the pressure at a location in the internal space formed by the internal air inlet pipe, the internal flue gas outlet pipe, the fuel combustion chamber and internal sub-spaces in the device in open connection therewith, or in the ambient air, and that the fan has a variable rotation speed, wherein the heating device is further provided with regulating means which can adjust the rotation speed of the fan subject to the measured pressure or the measured change in pressure.

2. Heating device as claimed in claim 1, wherein the pressure gauge is a pressure difference gauge which can measure the pressure difference or a change in the pressure difference between the pressure at a location in the internal space formed by the internal air inlet pipe, the internal flue gas outlet pipe, the fuel combustion chamber and internal sub-spaces in the device in open connection therewith on the one hand and in the ambient air on the other, and wherein regulating means can adjust the rotation speed of the fan subject to the measured pressure difference or the measured change in the pressure difference.

3. Heating device as claimed in claim 2, wherein the pressure difference gauge has a provision for giving one side thereof a fixed pressure value such that the pressure difference gauge can be used as pressure gauge.

4. Heating device as claimed in claim 1, 2 or 3, wherein the heating device is provided with an internal condensation outlet conduit for discharging condensation from the combustion chamber, which internal condensation outlet conduit is provided with a siphon and an opening for discharge to an external condensation outlet conduit, wherein said location of the pressure gauge or pressure difference gauge is in the internal condensation outlet conduit or in the siphon such that, when the siphon or the condensation outlet conduit is blocked, the water level in the siphon rises rapidly to above the location of the pressure gauge or pressure difference gauge, and wherein the regulating means are adapted to switch off the heating device at a pressure or pressure difference above a predetermined threshold value.

5. Heating device as claimed in both claims 1 and 4, comprising said pressure gauge as well as said pressure difference gauge.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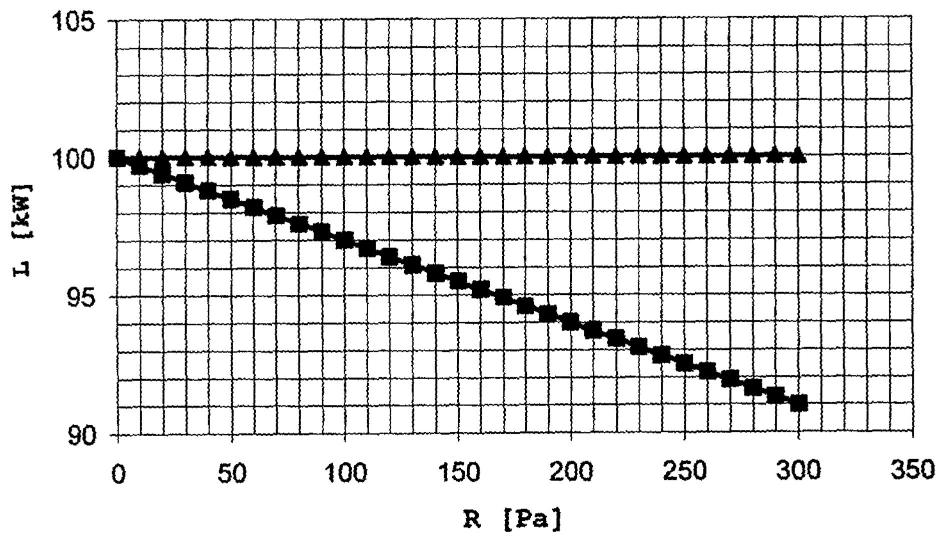
7
6
15
16
14

FIG. 1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95
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100
150
200
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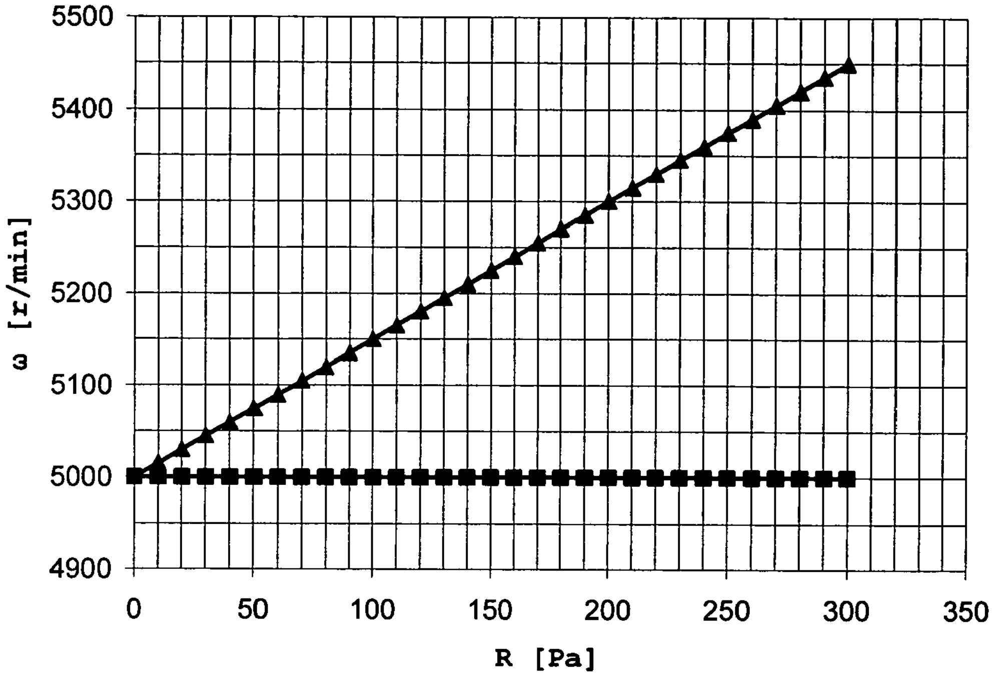
300
350
R [Pa]

FIG. 2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5300
5200
5100
5000
4900
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0
50
100
150
200
250
300
350
R [Pa]

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 07 07 5259

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 July 2007	Coli, Enrico

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