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

(11) **EP 2 466 240 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.06.2012 Bulletin 2012/25

(51) Int Cl.:
F27B 17/00 *(2006.01)* ***F27D 1/16*** *(2006.01)*
F27D 1/18 *(2006.01)*

(21) Application number: **11191029.5**

(22) Date of filing: **28.11.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **17.12.2010 FI 20100422**

(71) Applicant: **Termorak Oy**
33880 Lempäälä (FI)

(72) Inventor: **Pitkänen, Seppo**
33300 Tampere (FI)

(74) Representative: **Gritschneder, Martin et al**
Abitz & Partner - Patentanwälte
Hörselbergstrasse 5
81677 München (DE)

(54) **Dry heating method of refractory ceramic construction**

(57) The object of this invention is a drying heating method of a high temperature proof i.e. refractory ceramic lining. With the help of this method, the moisture of a refractory material construction is removed in a controlled way so that it does not damage the constructions when coming out- Likewise, by this method the temperature of a ceramic construction is raised so high that the temporary bonds of the construction, i.e. hydraulic bonds are removed in a controlled way and instead the final bonds i.e. ceramic bonds of the construction are formed. In this method, the lining (102) of the subject matter (100) is heated by electric resistances (5) that are controlled by a computer (10) and control unit (7) following a certain temperature diagram until the moisture gets out and the bonds are formed.

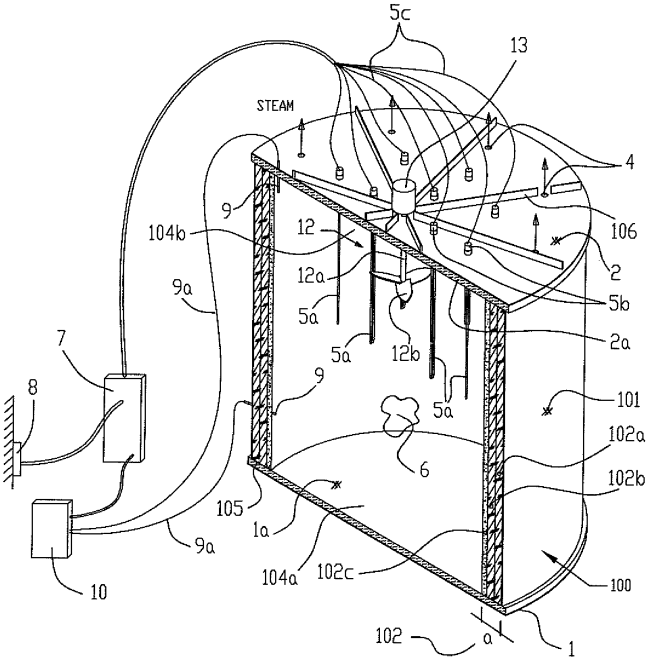

FIG 4

EP 2 466 240 A1

Description

[0001] The object of this invention is a drying heating method of a high temperature proof i.e. refractory ceramic lining. With the help of this method, the moisture of a refractory material construction is removed in a controlled way so that it does not damage the constructions when coming out. Likewise, by this method the temperature of a ceramic construction is raised so high that the temporary bonds of the construction, i.e. hydraulic bonds are removed in a controlled way and instead the final bonds i.e. ceramic bonds of the construction are formed. So by using the method, the moisture is removed from the ceramic lining and the temporary bonds change into permanent bonds in such a way that the lining is not damaged.

[0002] The term "drying heating" is generally in use when speaking of the preparation of taking in use of the equipment including refractory constructions. It is also used in the documents of this application and it includes the raising of the temperature of the construction to about 550 - 600°C. The first phase is to raise the temperature slowly to about 110 - 120°C and keeping it there so long there essentially that all the so called free water in the construction evaporates and comes out from the construction in the form of steam. In the second phase, the temperature is raised in a controlled way and sufficiently slowly so high that the ceramic bonds of the construction are formed instead of the essentially out coming temporary hydraulic bonds. In this phase, the changes and structure of so called crystal water gets the greatest part of the final strength when the ceramic bonds are formed.

[0003] The before mentioned constructions are typically used in the industry boilers, gasifyer plants, industry kilns and corresponding plants. The parts that contain most water after the installation are made at the installation site of the refractory castable material that is made by mixing ceramic powder and water. The ceramic powder is typically made mainly of base material and bond material and can include also finer filler material. Alumina cement is used very often as a bond material. The material that is in the form that it can be casted of shaped is installed for example into molds where the hydraulic bond is formed when the water reacts with lime and the material hardens. After the molds have been removed and the air drying has taken place the before mentioned drying heating is made for the construction before it is taken into use.

[0004] The making of the ceramic construction in the before mentioned equipments is performed either to the equipment that has been installed in the final placement location or in the parts of this equipment in a workshop before transporting them to the final location. The latter method is known to be the better way to install refractory linings but it is not always possible because for instance it is sometimes very expensive and challenging to divide the pressurized body into certain sections. On the other hand, the plate frames like for instance bio gasifiers, this is in many cases the more advantageous way to build the plants that have been refractory lined because a great part of the production can then be made in the advantageous workshop conditions and only the parts are put together at the installation site. And because of what has been said before, the drying heating must sometimes be done in the workshop or tent where the parts are produced and in some other cases at the installation site.

[0005] The before mentioned drying heating is performed nowadays in different ways depending on the conditions. The drying heating at the final place of the equipment especially in big plants is often performed using the own oil or gas burners of the plant burning them intermittently. The burner or burners like for instance the start-up burners of the fluidized bed boilers are used intermittently so that the inside temperature of the plant can be raised following as accurately as possible the temperature diagram for the drying heating. The process cannot be very accurate because it is not possible to fine tune using the burners. In fig 1 there is a typical temperature diagram for the drying heating of boilers or gasifiers, where the temperature is show as a function of time. There it can be seen that the temperature is first raised from the room temperature (20°C) to about 115 - 120°C with the speed of 20°C per hour. There are temperature detectors inside the lining or at the surface of it and they show when the lining is at this temperature all the way through and from that point on the temperature is kept for 8 hour, as the diagram says. Thereafter the burner efficiency is raised so that the raising speed of the temperature of the inside space or of the refractory lining is max 50°C per hour. It is advanced with this speed until the temperature of about 550°C has been reached which in turn is kept for 12 hours. The drying heating is now ready and the ceramic linings of the plant are ready to be taken into use. As an extension of the drying heating in a ready plant, the actual start-up run can be performed where the temperature of the plant is raised to the temperature of about 850 - 900°C.

[0006] The drying heating of smaller plants and plants to be made in parts is performed by prior-art technique by installing heating equipments to these plants and parts of plants. For instance the drying heating of the before mentioned bio gasifiers parts is made using the prior-art technique so that the open openings of the part are closed using things that are coated with ceramic fibre and the oil or the gas burner is put to and opening leading inside this package. The opening can be a part of the construction and then it can be for example a man hole of so or it can be done to parts that close the before mentioned openings. It is also taken care that there is an opening for out coming flue gas and steam. The power of the heating burner is regulated by hand and the temperature is monitored carefully during the whole process. When it is the question about for example a bio gasifier reactor section the outside diameter being 4 m, height 4 m and the thickness of the lining totaling 0.3 m, the section is put on the floor either on its side or upright and its open

ends are equipped with before mentioned blocking things (Fig 2). In one end a hole is made to the blocking thing for the boiler and to the other end blocking thing a hole is made for the flue gas and steam. As there is an isolating lining behind the cylinder surface lining, the cylinder itself does not need more lining for the drying heating. The burner like oil burner is put on and the own isolation of the section and the isolations in the blocking things keep the warmth mainly inside the object and thus the inside temperature and the temperature of the lining start to rise. The flue gas goes out through the hole at the other end and it remains in the boiler house or is led out from it using canals. When the temperature of the lining has risen to 100°C the forming steam starts to get out together with the flue gas through the same hole. The power of the burner is increased during the drying heating within the limits of the drying diagram and the supervisor of the drying monitors all the time the temperatures and that the equipment function properly and removes and places new fuel vessels, like oil barrels or gas bottles.

[0007] The before described prior-art technique is used in the production of the applicant and its competitors.

[0008] The greatest disadvantages of the methods of the prior-art technique are the great costs it causes and it is impractical due to many reasons and low reliability of operation. In the drying heating of a section mentioned before the highest value of heating power is about 100 kW, the costs for the fuel according to today's price level is estimated about 5000 € and the cost for supervising the process is about 1500 - 2000 € (35 - 45 h). When the flue gas that contains a lot of energy is led out of the object and usually also out of the building where the drying heating is being done, means a big uneconomic factor. It is also uneconomic that the process must be monitored all the time for instance because of regulating the temperature and the fuel service and additionally there is a risk of fire and further there is necessity to eliminate malfunction of the equipment. A central factor that decreases the good function is the formation of steam inside the boiler house because this makes the air feeding to the boiler more difficult, the burning process becomes less sure and the burner is in danger to turn off by itself. Due to all this, it is difficult to follow the drying heating diagram and the heating schedule is drawn out easily. All this causes more energy and workforce costs. The process is more impractical because the lined parts get sooty and the flue gas comes into the boiler house.

[0009] This invention has as its objective to introduce such a drying heating method for ceramic linings that flaws in the prior-art technique can be avoided. The solution according to the invention is characterized in that what is presented in the patent claim 1 characterizing part.

[0010] The greatest advantages of the method according to the invention in comparison with the prior-art technique can be considered to be the method according to the invention spares a lot economical resources and the second point is that it is operational with great security. It is superiorly more practical in comparison with the prior-art technique. When the drying heating has been started it operates quite automatically without continuous monitoring and fuel service. In the method, no flue gases are formed as so the air inside the object can be directed to the inside circulation and saving also thus a considerable amount of energy. The energy that is used in the process can now all in all be used more efficiently than what is possible in the prior-art technique applications. The method according to the invention is very clean and it does not cause sooty or otherwise unclean plant sections.

[0011] The invention is described more closely in the enclosed drawings, where:

Fig 1 presents one temperature diagram used in the drying heating, where the temperature is presented as a function of time;

Fig 2 presents a drying heating method with its equipments by the prior-art technique used in drying heating a gasifier section;

Fig 3 presents a section of the before mentioned bio gasifier in upright position equipped with equipments according to the invention of the drying heating system;

Fig 4 presents a cross section of the object of the previous fig 3 in the place marked in fig 3 A-A;

Fig 5 presents the blocking part like cover seen from the top;

Fig 6 presents the cross section of the before mentioned lid in the place B-B in fig 5, that is cut in the place of one electric resistance;

Fig 7 presents the down part of the temperature diagram where the principle of raising the temperature is shown using the method according to the invention when performing the drying heating.

[0012] Now follows a description of an application of drying heating that is advantageous for the invention with the help of an example referring to figs that have been mentioned before.

[0013] In fig 3 there is a lined bio gasifier section placed in upright position on the floor of an industry hall. This position is also the final position of the section in the gasifier. The section is the subject matter 100 of the drying heating. The outside diameter d of the subject matter is about 4 m and the height h also is about 4 m. Its shell 101 is bent steel sheet of 10 mm and inside it, a refractory ceramic lining 102 (fig 4) has been installed, and its total thickness is 300 mm. So the lining 102 has the shape of cylinder ring and it contains the outmost rings of isolating

material 102a, 102b and the innermost ring 102c that is of tight refractory material casted at site. The rings 102a and 102b have been made of isolating sheet that has been cut to the shape of wedge and these pieces have been put together with mortar and the whole lining 102 has been anchored to the shell 101 using special anchors and it is supported downwards with a lining support shell 105. In this example, the isolation layers contain very little moisture because only the mortar that has been used in the installation contains a little water and the sheets itself are dry and thus their humidity is only what is caused by the humidity of the air. The innermost layer 102c in turn contains about 4 weight percent water. In this example, the thickness of the innermost layer 102c is 70 mm and the density of the material is 2,3 kg/dm^3, so the ceramic lining 102 of this object matter has received about 300 l water during the installation. A part of this water is free water that is removed in the form of steam during the drying heating and a part is crystal water in the gratings of the salts of the ceramic construction.

[0014] The drying heating system according to the invention operates in the before mentioned situation so that on the floor 103 of the hall, a platelike blocking thing 1 is placed that has been lined with 100 mm of high temperature resistant isolating fibre layer. The fibre is on top and upon it, a refractory lined subject matter section 100 is lifted using a crane and thus the opening that is downwards, the first opening 104a is gotten closed. On top of the subject matter a lid is lifted, that is the second blocking thing 2 and the surface of it that is towards the subject matter 100 has been lined 100 mm thick using ceramic fibre layer 2a that is high temperature resistant and isolating and thus the upwards opening of the subject matter, that is the second opening 104b gets closed. The second blocking thing 2 is placed to its place so that the joint between the subject matter 100 and the fibre layer of the second blocking thing 2 is tight. In the second blocking thing 2 and its fibre layer 2a there are many holes with diameters about 60 - 70 mm. A part of the holes that is the first holes 3 (fig 5) are located in the middle section of the second blocking thing 2 and a part of the holes that is holes 4 are in the edge area of the second blocking thing 2. The second blocking thing 2 consists of steel stiffeners 106 so that it is possible to work standing on it. There are total 12 first location holes 3 in an object matter of the size of this example and an electric resistance 5 is installed in every one of them. The electric resistance is presented in more detail in fig 6. The electric resistance 5 consists of about 2 meters long oblong loop 5a, base 5b and connection cable 5c. The loop 5a consists of a tube like surface part and inside it there is a resistance wire. The material of it is for instance acid proof or fire proof steel and the material of the resistance wire is for instance the material that has the product name "cantal". The base 5b consists of an aluminium base and an isolation material that separates the base and the resistance wire so that there cannot occur a short circuit. The resistance wires 3 have been placed into the first holes 3 so that the loops 5a are located in the inside space 6 of the subject matter 100 reaching about half of its height h and the bases 5b are in the first holes 3 leaning with their down side to the collars 3a that there are in these holes. In the second blocking thing 2 there are round the first holes 3 controller sleeves 3b that center the basis 5b of the electric resistances 5 to the middle of the first holes 3 so that the loops 5a have space to penetrate through the first holes 3 to the inside space 6 of the subject matter 100. The bases 5b serve at the same time as the blockers of the first holes 3. The connection cables 5c of the electric resistances 5 are connected to the control unit 7 that has been connected to the electric net 8. Inside 6 the subject matter or near the lining inside the subject matter, at least one temperature detector 9 has been installed and it/they are connected using cable 9a of cable free technique to the computer 10. The computer 10 has been connected to the control unit 7 and the computer has a software program that makes it possible that the computer is capable of receiving information from temperature detector 9 and comparing this information with the drying heating plan of the subject matter 100 that has been fed to the computer, that is to say the temperature diagram (Fig 1), where the inside 6 temperature of the subject matter 100 or the surface temperature of the lining where the temperature is expressed as the function of time, and the computer is capable of sending information to the control unit 7 whereby the control unit 7 controls the length of the periods of feeding electric power so that the electric energy that is fed to the inside space 6 and that is measured by the temperature detectors 9 follows substantially during the whole drying heating period the temperature diagram of the computer and so that the raising speed of the temperature does not go over and the temperature keeping periods do not go under more than what is accepted in the tolerances, but the process should be as fast as possible. In other words, the lowest temperature value y that the computer receives defines the temperature raising trend t (fig 7) and the temperature keeping start moment x with the condition that at certain moment the highest temperature value z that the computer uses does not go over constant upper margin m what has been set for it in the time axis to be constant for a certain period of time. It can be said about the fig 7 that in the example it shows the length of the first raising period of the temperature is 1½ h longer than the preliminary temperature diagram.

[0015] When the drying heating is started the computer is switched on and the control unit 7 is switched on. The temperature diagram shows that the inside 6 lining surface 102c temperature ought to rise with the speed of 20°C per hour until it reaches the temperature of 120°C and on the other hand when the computer receives the information from the temperature detector 9 that at that moment the temperature is constant about 20°C the computer 10 controls with the help of its software program the control unit 7 to connect the electricity to the electric resistances 5. When the temperature that has been reg-

istered by the temperature detectors and transmitted to the computer rises faster than what is indicated in the temperature diagram, the control unit cuts the electricity when the margin m has been reached, cuts the electricity from the electric resistances 5 by the command of the computer 10. On and off periods of the electricity follow each other under the cooperation of the computer following the temperature diagram and receiving values from the temperature detectors 9 and the control unit 7 and the temperature of the subject matter 100 inside and the lining layer 102c rises within certain limits following the temperature diagram or more slowly until the desired temperature of 120°C. The raise of the temperature is in practice stepwise but its deviations from the values stated in the temperature diagram are in certain accepted limits. If necessary, the computer program is capable of adding time to the temperature raising periods and their keeping periods, that is to slow down the raising speed of the temperature and to lengthen the keeping periods if the information from some temperature detector means that the lining 102 cannot in all its parts follow the temperature diagram values. Thus we can say that the temperature diagram used in the system is preliminary and the computer software program takes into account all the necessary temperatures of the lining in all moments so that the highest raising temperature is not exceeded and the shortest keeping period of the temperature is not gone under in any part of the lining 102 during the whole drying heating process.

[0016] When the inside space 6 of the subject matter and consequently the surface 102c temperature of the lining goes over the 100°C limit the water of the lining starts to evaporate. The temperature is kept in the previous told way sufficiently long at about 120°C and thus all the free water of the construction comes out as steam and further from the inside space 6 through the other holes 4. The system continues its planned operation with the maximum speed defined in the temperature diagram until the highest temperature of the drying heating (in this example about 550°C) has been reached in all the parts of the surface lining and kept the defined period of time. After this, the system cuts the electricity of the electric resistances 5 and the lining 102 of the subject matter 100 cools down slowly back to the temperature of the surrounding.

[0017] The before described raising and keeping of the temperature can also be done so that instead of turning on and of the electricity or in addition to it the amount of the energy fed inside 6 is regulated by change of the power. In this case, a unit that is capable of regulating the power, like for instance a thyristor. One way to reach the same end result is to divide the electric resistances 5 into periods in a different way, a part of the electric resistances can even be turn completely off during the process. The smaller amount of electric resistances are used in the process the longer the periods they are on and the greater the steps to follow the temperature diagram.

[0018] In the example that has been described before 12 pcs of 8 kW electric resistances are used and thus the greatest capacity of the process is 96 kW. This capacity is sufficient to obtain the optimum end result. In the system according to the invention the shape of the electric resistance loop 5a can be different than the example e.g. a spiral or some other advantageous shape. In the documents of this application when speaking about the shapes of the electric resistance loops all types of resistance element shapes and constructions are understood. To mention some examples: direct loop, spiral loop and pleat loop.

[0019] When making the software program or building the control unit 7 for the system according to this invention very many solutions of the prior-art technique can be applied to attain an advantageous result.

[0020] Other advantageous equipments where the system according to this invention can be used are in addition to the previously presented equipment parts and other different parts are whole boilers, kilns, gasifiers, channels, and other equipments containing refractory and isolating ceramic constructions. For instance the drying heating of a boiler furnace or the furnace and cyclone can be performed using the method according to this invention. In that case, the electric resistances would be put into burner openings, man holes or fuel feeding openings. The electric resistances can be placed in different sides of the plant to obtain a more even process. All the other openings are closed with different kind and size of closing things and the gas leaking from the subject matter is eliminated for instance by closing the damper plate. Sufficient paths are arranged for the steam to go out and if possible a closed air circulation is arranged inside the subject matter. It is also possible to arrange a closed air circulation in the previous example inside the subject matter 100. In this case, a hole 11 is made in the middle of the second blocking thing 2 before its installation and into this hole 11 an air ventilator 12 axis 12a is installed. To the outside surface of the second blocking thing 2, an electric motor 13 is installed and this motor rotates the air ventilator axis 12a. At the other end of the axis 12a, a propeller 12b is installed and its rotation and the propeller blade angle cause a certain type of air circulation in the inside space 6. With this arrangement it is possible to make more effective the process of the inside temperature to become even for example so that the air near the electric resistances 5 is pushed to the fringes of the inside space 6 and thus the air from the fringes moves closer the electric resistances in the cetre of the inside space.

[0021] When the object of the drying heating is an equipment or its part where the lining of high temperature resistance includes a backside layer or a part thereof made of the castable material and the drying heating must also be performed for this area because of the amount of water it contains the temperature detector 9 or a number of them is/are placed also so that the system gets information also from this part of the construction.

The temperature detector is placed exactly to that position in the thickness direction from which position the temperature is desired to be compared to the temperature diagram. In these drying heating processes where there is an isolating castable the processes are self evidently longer than the drying heating of one layer because that background layer tells the speed of the drying heating. In cases like this, the dislocations of the margins m in the time axis can be very big. It is worth noticing that it is not always possible to remove even all the free water from the isolating layer and in those cases one must take it into account when placing the temperature detectors. As an example of this kind of case let's mention a lining the utmost isolation layer of which has been done using isolation castable and the shell around the lining 101 has the highest acceptable temperature of less than 100°C in the operation conditions of the plant. Using the system according to the invention it is possible to attain very close the shortest lead-time of the process, because the computer 10 and the control unit 7 run the feed of energy into the inside space 6 without a delay that is always present in hand driven systems.

[0022] It is possible to connect to the system according to the invention an automatic alarm system that can tell the end of the process or something else worth noticing.

[0023] In those cases where the ceramic lining 102 does not include an isolating material layer an isolation is installed to the outside surface of the shell 101 of the subject matter 100 in order to minimize the flow of energy through the shell 101 and thus save energy. One material that is typically very suitable for this purpose is rock wool.

[0024] It is worth noticing that even though this explanation has kept to one type of example that is advantageous for the system according to the invention the intention is not to limit in any way the use of the invention for only this type of example but many variations are possible within the frames of ideas of the patent claims.

Claims

1. A method of drying heating of ceramic refractory construction, according to which method:

- The openings of the subject matter (100) to be drying heated like an inside lined boiler, kiln, gasifier or corresponding equipment, the openings like the first opening 104a and the second opening 104b are closed using blocking things that have high temperature proof ceramic surface lids or corresponding blocking things (1,2) to obtain a closed inside space (6) inside the subject matter (100),
- the shell (101) of the subject matter (100) is isolated outside using isolation material to prevent the loss of energy if the inside lining (102) does not have an isolating layer and if the subject matter does not have an isolation outside,
- at least one hole is made to lead inside the subject matter for a heating device, this hole is made to the blocking thing (1,2) or by forming an opening in the subject matter using filler material like for instance ceramic fibre so that the opening is of suitable size,
- at least one hole is made to lead inside the subject matter for the steam to come out by making it to the lid, stopper or corresponding blocking thing or forming an opening in the construction to a suitable size using filler material like for instance ceramic fibre,
- at least one heat producing device is installed into an opening made for it or through it into the inside space (6) to heat it for the drying heating of the lining (102) of the subject matter,
- at least one temperature detector (9) is installed to the subject matter (100) inside space with the help of this/these detector(s) the inside space (6) lining (102) temperature is monitored during the process of the drying heating,
- the air in the inside space (6) and thus also the lining (102) is heated substantially according to a certain temperature diagram (Fig 1) in order to get the moisture out of the construction and that the final bonds of the lining can be formed,

characterized in that:

- at least one heating device is an electric resistance (5) the loop (5a) of which is pushed through a hole (3) or is installed in some other way in the inside space (6) of the subject matter so that substantially the whole loop (5a) is inside the inside space (6) and the base (5b) of the electric resistance is outside the inside space,
- at least one cable (5c) of the electric resistances (5) is connected to the control unit (7) in order to get the necessary energy for the drying heating from the electrical network (8) via the control unit,
- the temperature detector(s) (9) like for instance a detecting element is/are connected by cable or wireless connection to the computer (10) to get the temperature values of the inside space (6) and/or the lining (102) to the computer,
- the software program of the computer (10) is started and the program:
  - o compares the values that come from the temperature detector(s) with the values of the temperature diagram,
  - o regulates the control unit (7) to increase or decrease the amount of electrical energy to the electric resistances 5 in such a way that the temperature values indicated by the detector(s) in

the inside space 6/the lining remain during the whole process as defined by the preliminary temperature diagram (Fig 1) following the raising trends and that the keeping periods are not under more than the defined tolerance, but in any case so that the drying heating process is performed in so fast a period of time than the lowest temperature values (y, fig 7) allow.

2. The method according to claim 1 **characterized in that** an air ventilator (12) is installed in the inside space (6) like for instance a devise consisting of a motor (13), an axis (12a) and a propeller (12b) and this propeller (12b) moves the inside air farther from the electric resistances (5) and thus air from the other parts of the inside space (6) move to the vacuum close the electric resistances

3. The method according to claim 1 or 2 **characterized in that** the amount of the electric power fed to the electric resistance(s) by the control unit (7) is regulated by a thyristor or other corresponding device.

4. The method according to one of the claims 1 to 3 **characterized in that** the electric resistance (5) loop (5a) has an oblong shape.

5. The method according to one of the claims 1 to 4 **characterized in that** an alarm system is connected to it to express that a certain phase has started or ended or something expected or unexpected has happened.

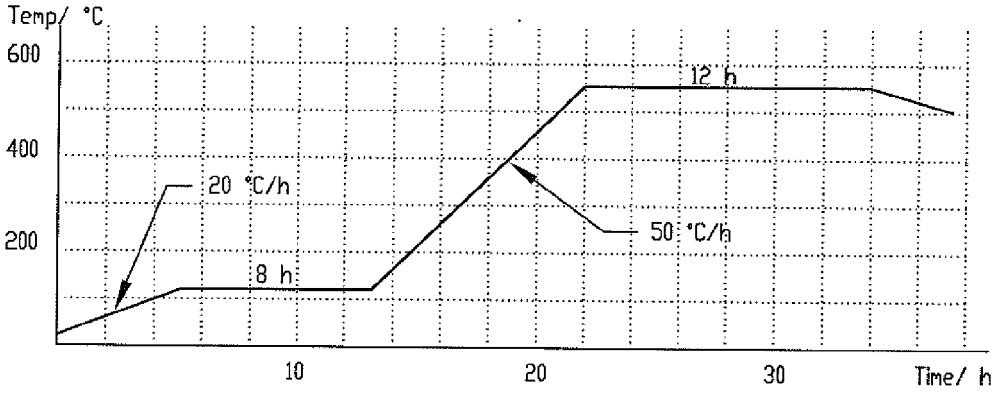

FIG 1

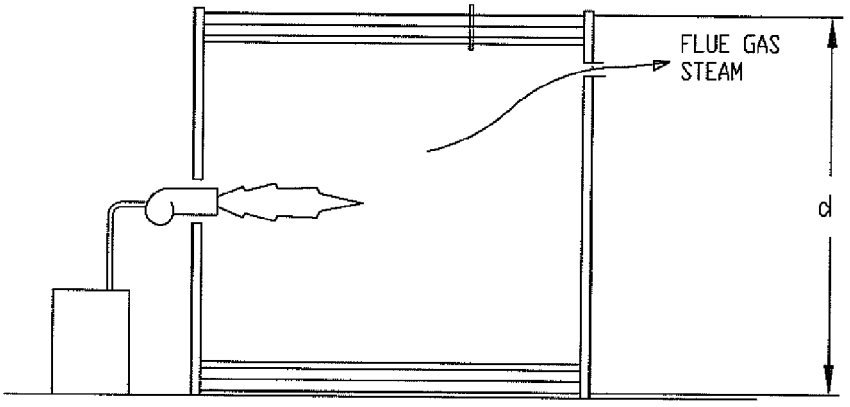

FIG 2

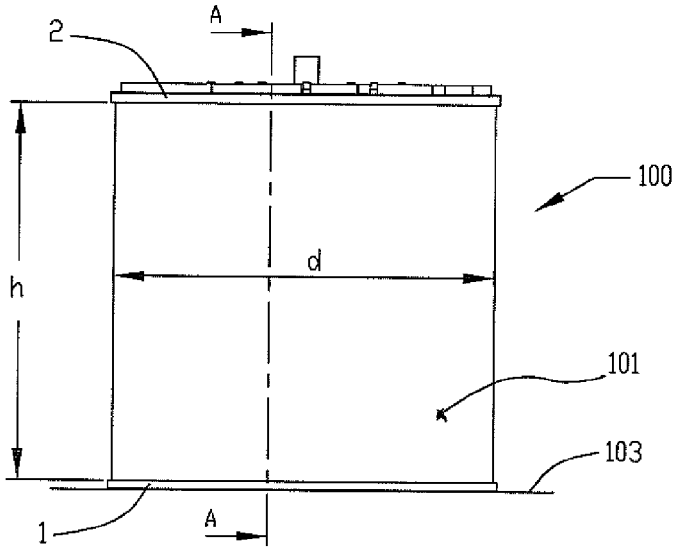

FIG 3

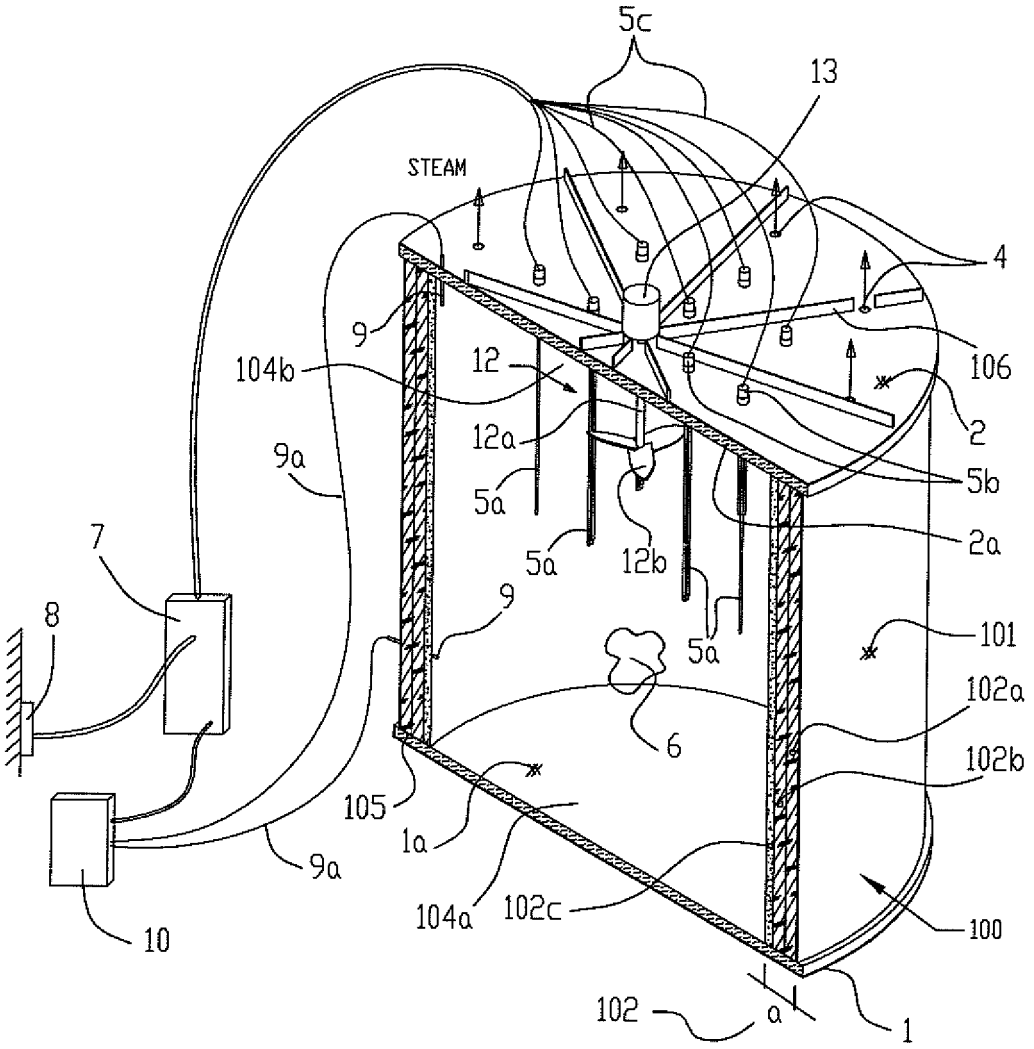
5c
13
STEAM
4
9
104b
12
106
12a
2
9a
5a
5b
7
5a
12b
2a
8
9
101
5a
102a
6
102b
105
1a
9a
104a
102c
100
10
102
a
1

FIG 4

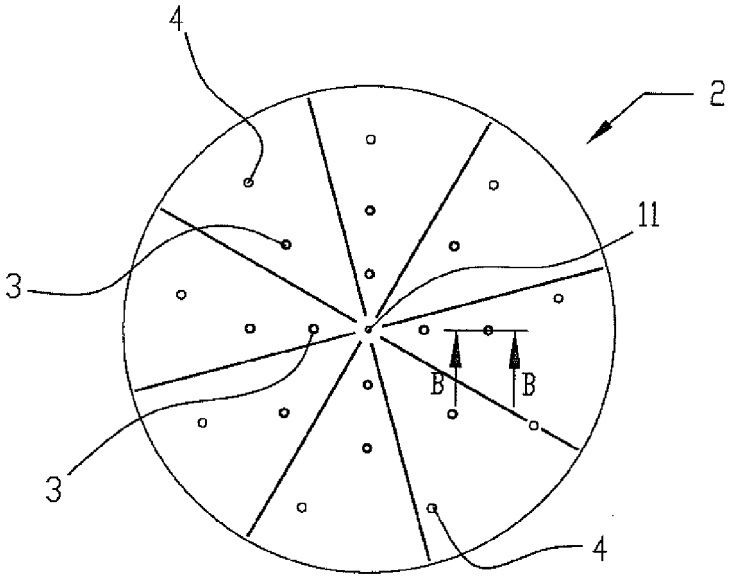

FIG 5

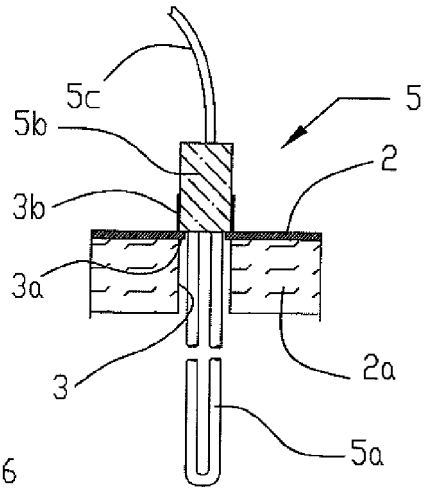

FIG 6

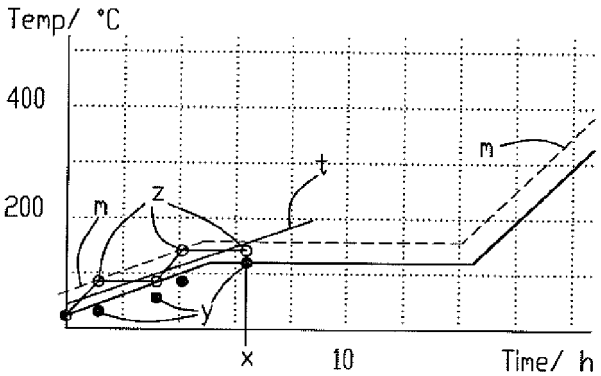

FIG 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 19 1029

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 4 304 986 A (OLSON WILLIAM E) 8 December 1981 (1981-12-08) * column 1, line 7 - line 12 * * column 3, line 8 - line 16 * * column 5, line 10 - line 25 * * figures 7,8 * -----	1-5	INV. F27B17/00 F27D1/16 F27D1/18

TECHNICAL FIELDS SEARCHED (IPC)

F27D
F27B
B22D
H05B
F23G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 March 2012	Peis, Stefano

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

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 19 1029

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-03-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4304986 A	08-12-1981	JP 57032871 A	22-02-1982
		JP 60136862 U	11-09-1985
		US 4304986 A	08-12-1981

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82