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

(11) EP 2 116 647 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.11.2009 Bulletin 2009/46

(21) Application number: **09159319.4**

(22) Date of filing: **04.05.2009**

(51) Int Cl.:
***D06F 58/02** (2006.01)* ***D06F 58/20** (2006.01)*
***D06F 58/28** (2006.01)*

(84) Designated Contracting States:
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 SE SI SK TR

(30) Priority: **06.05.2008 IT TO20080337**

(71) Applicant: **Indesit Company, S.p.A.**
60044 Fabriano (AN) (IT)

(72) Inventors:
- **Mariotti, Costantino**
06028 Sigillo (PG) (IT)
- **Colucci, Nicola**
60044 Fabriano (AN) (IT)

(74) Representative: **Dini, Roberto et al**
Metroconsult S.r.l.
Via Sestriere 100
10060 None (TO) (IT)

(54) **Laundry dryer or washing/drying machine**

(57) The present invention relates to a method for drying laundry (3) in a ventilation laundry dryer or washing/drying machine (1,10), wherein the laundry is dried in a drum (2) where it is subjected to the action of an air flow that causes the water contained therein to evaporate, wherein a drying cycle comprises at least one closed circuit step, during which an air flow consisting of a single air mass (1,10) makes several passages through the drum (3), and at least one open circuit step, during which the air flow comprises an air mass taken in from the outer environment and then exhausted into the outer environment after having flowed through the drum (2) once, and wherein the air is heated during the closed circuit step.

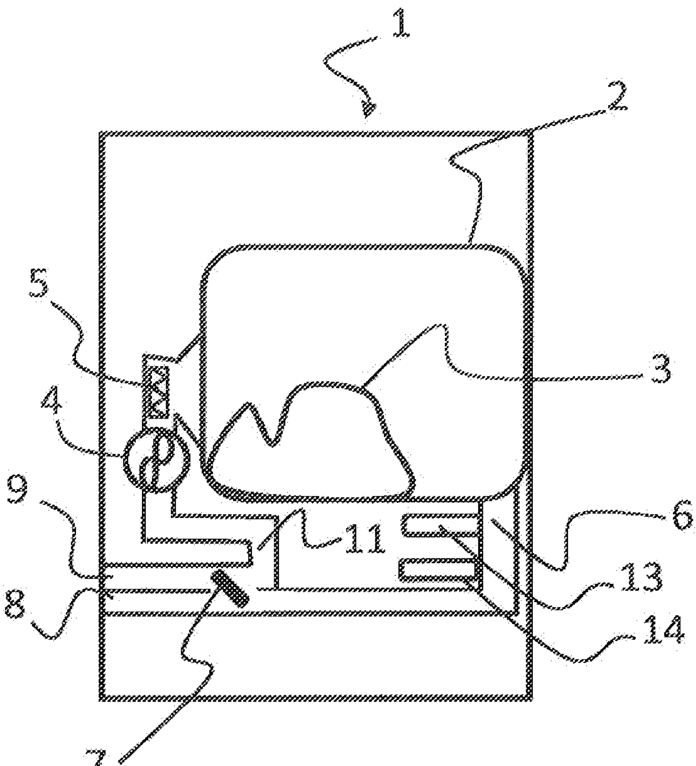

Fig.1

EP 2 116 647 A1

Description

[0001] The present invention relates to a ventilation laundry dryer or washing/drying machine according to the preamble of claim 1.

[0002] These so-called "ventilation" machines stand out from "condensation" machines because they operate according to a different principle: in the former, the damp air is evacuated into the outer environment without condensing inside the machine (unlike the latter); it follows that ventilation machines are simpler because they lack the condenser and all those parts connected thereto (condensed water collection basins and ducts, control systems and components).

[0003] Such machines are usually equipped with a drum in which the laundry is placed to dry under the action of an air flow generated by a fan and heated by an electric resistor.

[0004] An example of such machines is described in patent GB 595,305 to ALBERT VON ROTZ, which relates to a ventilation laundry dryer with two operating steps: during a first step, the air within the machine flows within a closed circuit, thus recirculating several times in the drum containing the laundry to be dried, at each passage subtracting therefrom a certain quantity of moisture. When the air reaches a certain degree of humidity, the circuit opens to the outside during a partialization operating step, wherein a portion of the humid air is exhausted into the environment, while the remaining portion is mixed with fresh air having a low degree of humidity (environmental air).

[0005] The partialization step of mixing the humid air with environmental air takes place with the heater on, so that the air is always kept at a certain temperature for improving the removal of moisture from the laundry.

[0006] Some drawbacks of this solution relate to energy consumption and to establishing when the circuit is to be opened for admitting environmental air and partializing the air recirculating within the machine.

[0007] First of all, in fact, the partialization step goes on until the end of the drying cycle (when the laundry is dry) with the heater constantly on to prevent the air temperature from dropping: if on the one hand this provides a faster drying cycle, on the other hand the continuous operation of the electric heater in the presence of an air volume renewed with low-temperature air causes a high energy consumption.

[0008] Secondly, the determination of the instant at which the cycle should be switched from closed circuit mode to partialization mode as a function of the degree of humidity has proven to be inaccurate: in the initial cycle steps, due to the very humid load, hygrometer readings may have significant deviations, and consequently the start of the partialized cycle may be established at inappropriate times (i.e. when the humidity of the circulating air is still low); of course, very accurate hygrometers are theoretically available which could be suitable for this purpose, but such instruments are so specific and expensive that they cannot be reasonably used in a laundry dryer.

[0009] In this respect, an alternative has been provided by patent GB 2 094 963, which discloses a drying cycle that comprises an initial partialization step and a successive open circuit step: the machine starts drying the laundry by partializing the air volume circulating in the machine, so as to reduce the humidity thereof; subsequently it switches to open circuit operation, wherein the entire air volume circulating in the machine is taken from the outside and is exhausted into the outer environment after having flowed through the drum only once; this step takes place with the heater off in order to let the laundry cool down before removal.

[0010] The switching between the two operating steps (partialization and open circuit) occurs according to a preset time interval or depending on the degree of humidity of the air, detected by a hygrometer.

[0011] However, this solution suffers from drawbacks related to energy consumption and to determining when the operating mode is to be switched: in this case as well, in fact, the heater is kept operating while a fresh air volume is supplied, thus leading to a considerable waste of energy, just like in the case previously described.

[0012] Furthermore, if the switching between the two operating modes is determined according to a preset time interval, the latter will take into account none of the variables involved in the machine (degree of humidity of the laundry, degree of humidity of the air, quantity of laundry items to be dried, etc.), and therefore the switching time cannot be based on the optimal conditions of the machine and of the load; on the other hand, the above-mentioned problems will arise when air humidity is detected in order to determine the switching time.

[0013] The present invention relates to a laundry dryer or washing/drying machine according to claim 1.

[0014] The idea at the basis of the present invention is to provide a ventilation-type laundry drying method wherein each complete laundry drying cycle comprises at least a first closed circuit step, during which the same air volume recirculates in the drum, and a second open circuit step, during which the air circulating in the drum is taken from and exhausted into the outer environment, and wherein during the first step the air is heated.

[0015] In the present description, the term "complete drying cycle" refers to an operating cycle of the machine which starts when the wet laundry is subjected to the action of the machine and ends when the laundry is dry.

[0016] This method offers the advantage that the heater (typically an electric resistor) is only turned on when the machine is operating in closed circuit mode, so that energy consumption is considerably reduced; as can be easily understood, in fact, the thermal energy supplied to the air volume (which is always the same) circulating within a closed circuit in the machine is lower than that which should be supplied if heating were required (as in the prior art) during a partialization or open circuit step.

[0017] The features of the laundry dryer or washing/drying machine according to the invention are set out in the appended claims.

[0018] These features as well as further advantages of the present invention will become apparent from the following description of an embodiment thereof as shown in the annexed drawings, which are supplied by way of non-limiting example, wherein:

Fig. 1 is a sectional view of a laundry dryer or washing/drying machine according to the present invention;
Fig. 2 shows a first recirculation step of the machine of Fig. 1;
Fig. 3 shows a second open circuit step of the machine of Fig. 1;
Fig. 4 shows a detail of the flow diverter in the condition of Fig. 2;
Fig. 5 shows a detail of the flow diverter in the condition of Fig. 3;
Fig. 6 shows a detail of the flow diverter in the partialization condition;
Fig. 7 shows an alternative embodiment of the air intake duct;
Fig. 8 shows an alternative embodiment of the machine of Fig. 1, wherein the flow diverter is replaced by two shutters;
Fig. 9 schematically shows a drying cycle according to the present invention;
Fig. 10 shows a drying cycle which is alternative to the one of Fig. 9;
Fig. 11 illustrates a further variant of the drying cycle of Fig. 9, comprising any number of repetitions of the open circuit step and closed circuit step;
Fig. 12 shows a further alternative embodiment of a flow diverter;
Fig. 13 shows the flow diverter of Fig. 12 in the closed circuit condition;
Fig. 14 shows the flow diverter of Fig. 12 in the open circuit condition.

[0019] Referring now to Fig. 1, a ventilation laundry dryer or washing/drying machine 1 is shown in a simplified form which is useful for understanding how it operates.

[0020] Machine 1 has a rotary drum 2 in which laundry 3 is placed by the user and dried by an air flow generated by fan 4 and heated by electric resistor 5.

[0021] The hot air flow laps laundry 3 (thereby subtracting the water contained therein in the form of moisture) and then flows into duct 6, which is for this purpose in fluidic communication with drum 2.

[0022] Downstream of duct 6, as will be described more in detail below, there is a flow diverter 7 that connects four ducts: return duct 6 for drawing air from the drum, exhaust duct 8 for exhausting air into the outer environment, intake duct 9 for taking air from the outer environment, and feed duct 11 which is routed towards fan 4 and houses resistor 5. By acting upon flow diverter 7, either a closed circuit operation or an open circuit operation will be obtained, as will be described hereafter.

[0023] First of all, it is necessary to observe the position of the flow diverter with respect to four ducts 6, 8, 9, 11: as shown in greater detail in Figs. 4 to 6, it is housed in a chamber 70 to which the four ducts are afferent; more specifically, the ducts connected to chamber 70 are return duct 6 for drawing air from the drum and feed duct 11 on one side of flow diverter 7, and exhaust duct 8 for exhausting air into the outer environment and intake duct 9 for taking air from the outer environment on the opposite side of the diverter. The flow diverter can rotate about its own axis, so as to put in fluidic communication return duct 6 with feed duct 11, and intake duct 9 with exhaust duct 8 (as shown in Fig. 4), or return duct 6 with exhaust duct 8 and intake duct 9 with feed duct 11 (as shown in Fig. 5).

[0024] It should be noted that chamber 70 and the ducts are shaped in a manner such as to minimize load losses while still maintaining a considerable construction simplicity.

[0025] As will be better explained below, flow diverter 7 can also take intermediate positions between the two positions described above, for the purpose of partializing the flows exhausted into the outer environment, those taken in from the outer environment, and those recirculated between duct 6 and duct 11.

[0026] This first part of the description will briefly describe the two operating steps, the alternation of which will be tackled in detail later on.

[0027] During a first operating step of the machine, called closed circuit step (or recirculation step), diverter 7 is in the condition of Fig. 4, thus leading to the same air volume circulating within the machine by following the path indicated by the arrows in Fig. 2: the air heated by resistor 5 is pushed into drum 2 by fan 4 and laps the laundry, thus removing moisture therefrom, to enter then return duct 6; from the latter it flows into chamber 70, where it is conveyed by diverter 7 into feed duct 11 and returns to resistor 5, thus been recirculated.

[0028] In this case, during closed circuit operation resistor 5 is on and quickly heats the circulating air volume, which in turn will increase the temperature of laundry 3 and subtract moisture therefrom.

[0029] During the second operating step, called open circuit step, the diverter is rotated about its own axis, as shown in Fig. 5, so that the air circulates by following the path indicated by the arrows in Fig. 3: the air is taken in from the outside through intake duct 9, which communicates with feed duct 11, and is pushed into drum 2 by fan 4; it then laps the laundry, thus removing moisture therefrom, and enters return duct 6 that communicates with exhaust duct 8, through which it is exhausted into the outer environment.

[0030] In this case, the path followed by the hot air flow is an open circuit, wherein the air is taken in from the outer environment, fed into drum 2, and then exhausted into the outer environment again; it is important to point out that during this second operating step electric resistor

5 is off, as will be discussed in greater detail hereafter.

[0031] It should also be pointed out that machine 1 may comprise a temperature sensor 13 and a humidity sensor 14, the use of which will be described later on.

[0032] It is now possible to discuss the method of operation of the above-described machine.

[0033] According to the operation illustrated diagrammatically in Fig. 9, after laundry 3 has been placed into drum 2 machine 1 is first operated in closed circuit mode, so that the air volume circulating within the machine is heated very quickly, thus warming up the laundry and subtracting moisture therefrom.

[0034] When a certain air temperature threshold has been reached, as detected by temperature sensor 13, flow diverter 7 is controlled in a manner such as to start the second operating step.

[0035] In this regard, it should be noted that the switching from open circuit operation to closed circuit operation based on air temperature overcomes a drawback of the prior art: during this first operating step, in fact, (commercial) hygrometer 14 would provide inaccurate readings due to the high degree of humidity of both the circulating air and the load.

[0036] On the contrary, the detection will be much more accurate when switching from closed circuit to open circuit (and turning off the resistor) as a function of temperature, because thermometer 13 is not of course affected by the degree of humidity of the air, and therefore ensures a very accurate reading.

[0037] Tests carried out have shown that a threshold temperature which may considered to be optimal (in terms of energy consumption and quantity of water subtracted from the laundry) is in the range of 60°C to 80°C, preferably 70°C.

[0038] When the second open circuit step starts, the laundry will have already lost a certain quantity of water and will have reached a certain temperature higher than room temperature (and substantially equal to the threshold temperature); during this operating step, the electric resistor can be turned off, with the air lapping the laundry being at room temperature; it can however subtract moisture from the laundry until the latter is completely dry (i.e. has a natural degree of humidity), thus ending the drying cycle without the electric resistor having to be turned on again, but simply by exploiting the temperature reached by the laundry during the first step and the circulation of air at room temperature, thereby providing considerable energy savings.

[0039] Of course, if drying time is to be privileged, it will be possible to leave the resistor on even during the open circuit step, although this will imply a certain waste of energy, de facto reducing the energy consumption advantages.

[0040] The advantages of the present invention are therefore apparent: during the first step, the air mass heated by the resistor keeps circulating within the closed circuit of the machine until it reaches a desired temperature; when the laundry has warmed up sufficiently (i.e. when the threshold temperature has been reached), the resistor is turned off and the cycle goes on by using unheated environmental air, thus lowering the energy consumption; the temperature reached by the laundry, in fact, is sufficient to obtain that the environmental air circulating around it removes any residual moisture, thus ending the drying cycle.

[0041] The basic operation described above may be subject to many changes without departing from the scope of the present invention.

[0042] According to a first variant, the recirculating air flow is mixed with a fresh air flow from the outside, so that a portion of the hot and damp air flow coming from duct 6 is exhausted into the outer environment; this operating step, which may be called "partialization step", corresponds to a condition of the flow diverter like the one shown in Fig. 6, wherein it is rotated in a manner such that the flow running in duct 6 is divided into two parts, one of which is exhausted through exhaust duct 8, and the other one, i.e. the "recirculating" part, is delivered again into feed duct 11; of course, this implies that an air flow equal to the exhausted flow enters through intake duct 9 and is mixed with the recirculating flow.

[0043] This operating step with partialization allows (especially when the air flow exchanged with the outer environment is kept small with respect to the air volume circulating in the machine) to prevent an excessive cooling of the laundry and of the air circulating in the machine, while at the same time reducing the degree of humidity thereof, thus providing additional extraction of water from the laundry.

[0044] Unlike prior-art solutions, according to the teachings of the present invention during this partialization step the electric resistor can be turned off (advantageously in terms of energy consumption), thus avoiding any waste of energy.

[0045] A further method variant which is particularly advantageous in terms of energy consumption, as shown schematically in Fig. 10, comprises four steps: a first step with the circuit closed and the resistor on, a second step with the circuit open and the resistor off, a third step again with the circuit closed and the resistor on, and a fourth cooling step with the circuit open and the resistor off.

[0046] Analyzing more in detail the transition instants between the four steps, it is appropriate to point out that they are determined on the basis of temperature or humidity readings: more specifically, the instant of transition between the first step and the second step is established as a function of a threshold temperature, just as previously described and for the very same reasons that lead to avoid using humidity readings as a reference.

[0047] Conversely, the instant of transition between the second step and the third step is established as a function of a certain degree of humidity of the air, which in the example described herein is a threshold value between 90% and 95% of humidity of the air in the duct: in this case, a more accurate measurement of the laundry drying state is provided by the hygrometer, which in this operation mode of the machine has very good sensitivity characteristics.

[0048] The transition between the third step and the fourth step is established again as a function of a temperature threshold, just like the first transition, but for different reasons: in this case, in fact, the laundry has a lower degree of humidity and therefore tends to dry and overheat very quickly during the drying process, thus being at risk of damage; for this reason, it is preferable to use a temperature threshold value between 60°C and 80°C (preferably 70°C) at which the resistor is turned off and the circuit is opened, so that the last small water percentage can be exhausted into the outer environment and the laundry can cool down before being removed by the user.

[0049] An alternative to this solution, which is particularly effective when the laundry is much imbibed with water (e.g. because of the thickness or type of fabric thereof) is shown schematically in Fig. 11: the closed circuit and open circuit steps are repeated several times until the laundry is dry (the three dots in the figure mean that there may be any number of repetitions).

[0050] The number of repetitions may advantageously be chosen depending on the duration of the closed circuit step at each repetition: its duration in fact becomes shorter as the quantity of water in the laundry decreases, because the less water there is in the laundry, the faster the air will reach the threshold temperature; it is therefore possible to set a minimum threshold duration of the closed circuit step (e.g. about 30 seconds) at the end of which it is assumed that the laundry is dry.

[0051] In this regard, it can be stated that the duration of the closed circuit step is used as a parameter based on which the laundry drying degree is measured. The machine described above may of course be subject to many changes as well; in particular, although intake duct 9 and exhaust duct 8 are shown in the drawings as being adjacent, they may open into the outer environment at a distance from each other, as shown by way of example in Fig. 7, so that fresher air can be taken in.

[0052] Likewise, the man skilled in the art may of course adopt different arrangements for flow diverter 7 and chamber 70, so that they allow for the above-described operating steps to take place.

[0053] For example, in the laundry dryer or washing/drying machine 10 according to the alternative solution shown in Fig. 8, intake duct 9 and exhaust duct 8, instead of being afferent to flow diverter 7 and chamber 70, are both directly afferent to the fan and are each fitted with a shutter 7A, 7B: the first operating step is therefore obtained when shutters 7A and 7B close intake duct 9 and exhaust duct 8, respectively; the second operating step is obtained when shutter 7A opens exhaust duct 8 and closes feed duct 11, while shutter 7B opens intake duct 9.

[0054] In this case it is also possible to obtain the above-described partialization step by appropriately adjusting shutters 7A, 7B.

[0055] A further variant, which is extremely simple from a construction viewpoint and therefore advantageous, is represented by the flow diverter shown in Fig. 12; said flow diverter is also shown in Figs. 13 and 14 in the positions corresponding to the conditions of closed circuit and open circuit.

[0056] In this case, intake duct 90 and exhaust duct 80 simply open into rear wall 81 of the machine through a single aperture 100; in the closed circuit position, flow diverter 70 simply connects return duct 6 to feed duct 11, while at the same time closing aperture 100.

[0057] In the open circuit condition shown in Fig. 14, flow diverter 70 is rotated about its own median axis, thus forming one of the walls of intake duct 90 and exhaust duct 80; in particular, it forms the common wall between the two ducts, thus dividing single aperture 100 into two ducts 80 and 90.

[0058] This solution advantageously allows for a very simple implementation of the invention.

[0059] The electric resistor may alternatively be replaced with a gas heater or the like.

[0060] Of course, the machine according to the present invention will be equipped with a control unit receiving signals from (temperature or humidity) sensor 13 and controlling the flow diverter or the shutters so as to select the most appropriate operating step; to this end, the flow diverter or the shutters will be actuated by a dedicated electric motor controlled by the control unit.

[0061] Of course the machine will also comprise, in addition to the parts described above for the purpose of illustrating the invention, all those parts which are usually found in machines of this kind, such as an electric motor for rotating the drum, a user interface and, in the case of a washing/drying machine, also all those parts which are typically required for the laundry washing function.

Claims

1. Method for drying laundry (3) in a ventilation laundry dryer or washing/drying machine (1,10), wherein the laundry is placed to dry in a drum (2) where it is subjected to the action of an air flow that causes the water contained therein to evaporate,
characterized in that
a drying cycle comprises at least one closed circuit step, wherein an air flow consisting of a single air mass (1,10) makes several passages through the drum (2), and at least one open circuit step, wherein the air flow comprises an air mass taken in from the outer environment and exhausted into the outer environment after having flowed through the drum (2) once, and wherein the air is heated during the closed circuit step.

2. Method according to claim 1, wherein the air is not heated during the open circuit step.

3. Method according to claim 1 or 2, wherein the switch-

ing between the closed circuit step and the open circuit step is determined as a function of air temperature, in particular the temperature threshold value that determines the switching between closed circuit and open circuit being in the range of 60°C to 80°C, preferably 70°C.

4. Method according to claim 1, comprising four consecutive steps:

- a first step with the circuit closed and the air heated;
- a second step with the circuit open and the air not heated;
- a third step with the circuit closed and the air heated;
- a fourth step with the circuit open and the air not heated, in particular the switching between the first step and the second step being established as a function of a first air temperature threshold, the first temperature threshold value being preferably substantially 70°C, the switching between the second and third steps is established as a function of an air humidity threshold, the humidity threshold value of the air flowing out of the drum being preferably between 90% and 95%, and the switching between the third and fourth steps is established as a function of a second air temperature threshold, the second temperature threshold value being preferably substantially 70°C.

5. Method according to claim 1, comprising the consecutive repetition for a preferred number of times of:

- a first step with the circuit closed and the air heated;
- a second step with the circuit open, in particular said open circuit step taking place without the air being heated.

6. Method according to claim 5, wherein the number of repetitions of the first and second steps is established as a function of the duration of the closed circuit step.

7. Method according to claim 5 or 6, wherein the switching between the first step and the second step is established as a function of a first air temperature threshold, and the switching between the second step and the next step is established as a function of an air humidity threshold, in particular the temperature threshold value being in the range of 60°C to 80°C, preferably 70°C, and the humidity threshold value of the air flowing out of the drum being between 90% and 95%.

8. Method according to any of the preceding claims, further comprising a partialization step, wherein a portion of the air mass circulating in the machine (1,10) is replaced with an equal quantity of environmental air, and wherein the air is not heated.

9. Laundry dryer or washing/drying machine (1,10), of the type comprising: a drum (2) in which the laundry (3) is placed to dry, a heater (5) for heating an air flow generated by a fan (4), which air flow flows through the drum (2) and laps the laundry contained therein, thus subtracting moisture therefrom, which air flow is conveyed from and to the drum (2) through respective return (6) and feed (11,11A,11B) ducts, further comprising an exhaust duct (8,80) for exhausting the air into the outer environment and an intake duct (9,90) for taking in environmental air,
characterized in that
it also comprises a flow diverter (7,7A,7B,70) adapted to alternately put in fluidic communication the return duct (6) with the feed duct (11) and the intake duct (9,90) with the exhaust duct (8,80), or the return duct (6) with the exhaust duct (8,80) and the intake duct (9,90) with the feed duct (11), so as to open or close the circuit followed by the air flowing through the drum (2).

10. Machine (1,10) according to claim 9, wherein the flow diverter (7) is housed in a chamber (70), the air return duct (6) and feed duct (11) being afferent to said chamber on one side of the diverter (7), and the air exhaust duct (8) and intake duct (9) being afferent to the chamber (70) on the opposite side of the diverter (7), and wherein the flow diverter (7) can rotate about its own axis, thus opening or closing the circuit followed by the air flowing through the drum (2).

11. Machine (1,10) according to claim 9, wherein the intake and exhaust ducts (90,80) open into a single aperture (100) in the rear wall of the machine, and wherein in the closed circuit condition the flow diverter (70) is adapted to connect the return duct (6) to the feed duct (11) while at the same time closing the aperture (100), and in the open circuit condition the flow diverter (70) is rotated about its median axis and divides the aperture (100) into the two exhaust and intake ducts (80,90) by forming a common wall therebetween.

12. Machine (1,10) according to any of claims 9 to 11, wherein, when the circuit followed by the air flowing through the drum (2) is a closed circuit, the heater (5) is on, whereas when the circuit followed by the air flowing through the drum (2) is an open circuit, the heater (5) is off.

13. Machine (1,10) according to any of claims 9 to 12, wherein the flow diverter (7,70) can be set to intermediate positions in order to partialize the air flows exiting through the return duct (6) and conveyed into the exhaust duct (8,80) with equivalent environmental air flows taken in through the intake duct (9,90) and conveyed into the feed duct (11).

14. Machine (1,10) according to one or more of claims 9 to 13, comprising a temperature sensor (13) and a humidity sensor (14) for detecting the temperature or the degree of humidity of the air flow circulating within the drum.

15. Machine (1,10) according to one or more of claims 9 to 14, **characterized in that** it implements the method according to one or more of claims 1 to 8.

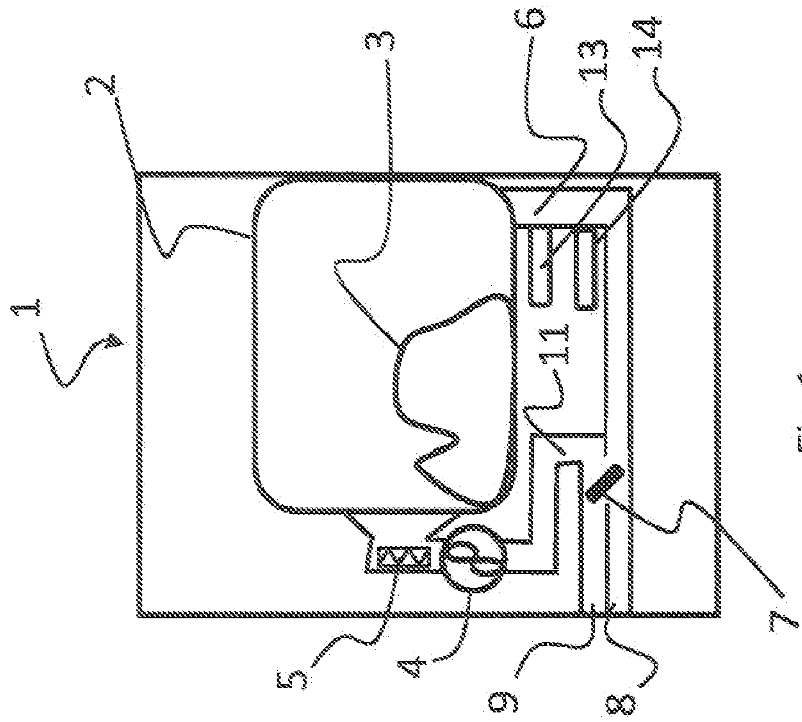

Fig.1

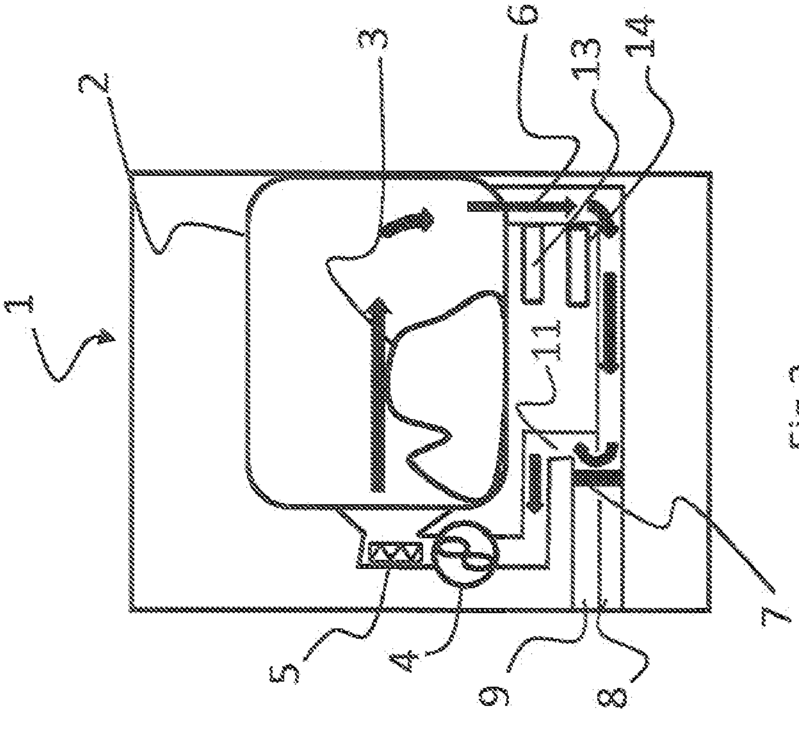

Fig.2

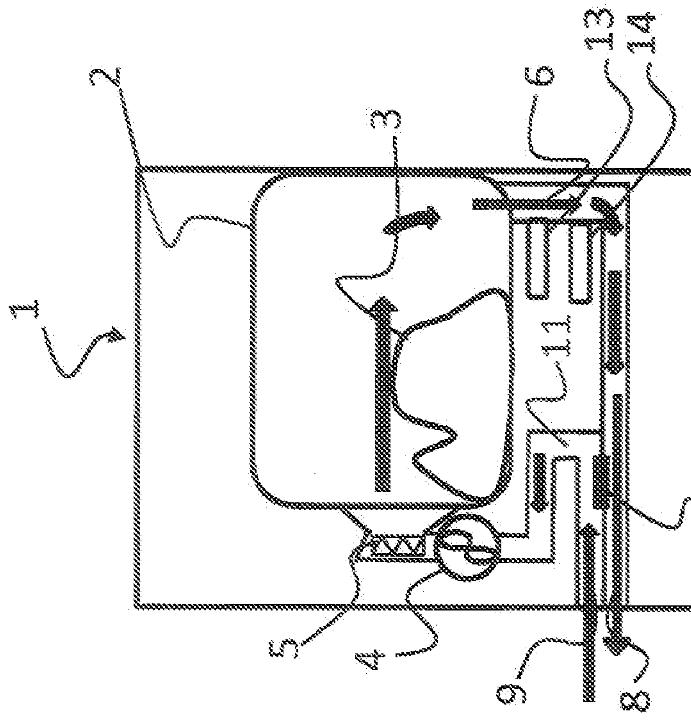

Fig.3

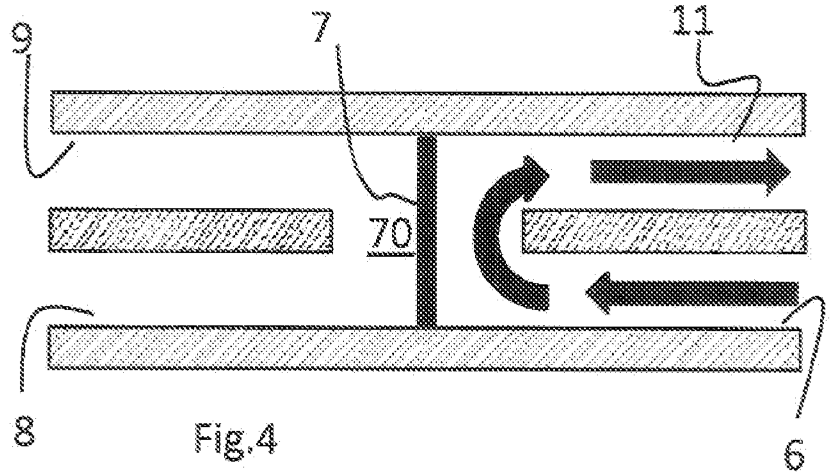

Fig.4

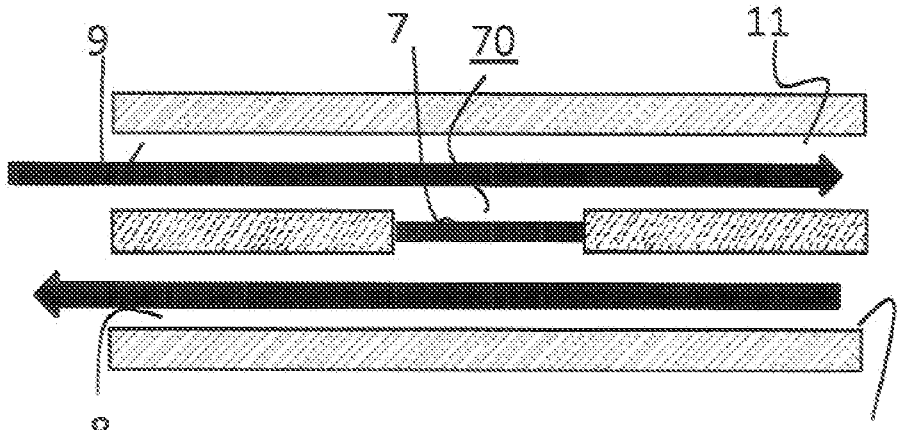

Fig.5

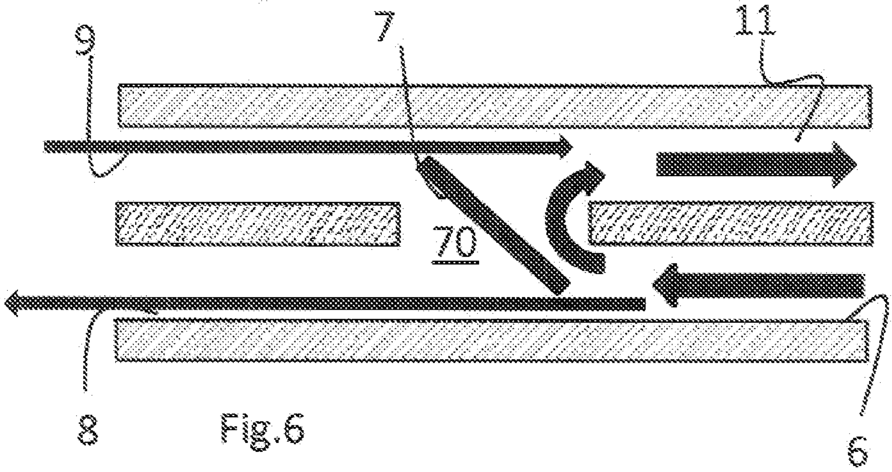

Fig.6

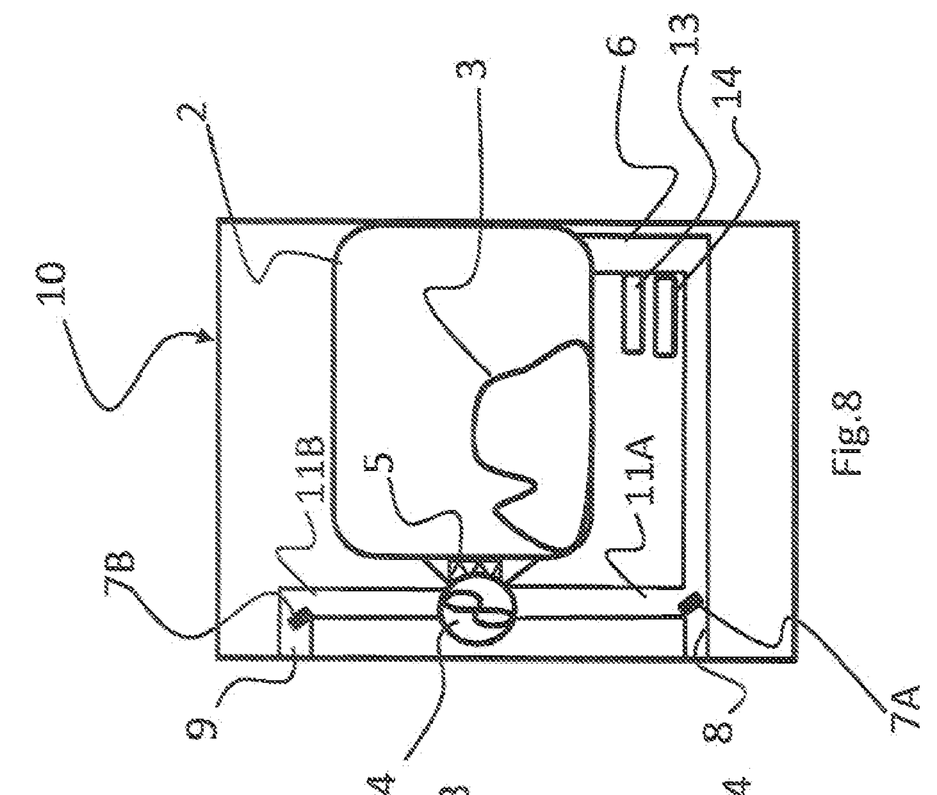

Fig.8

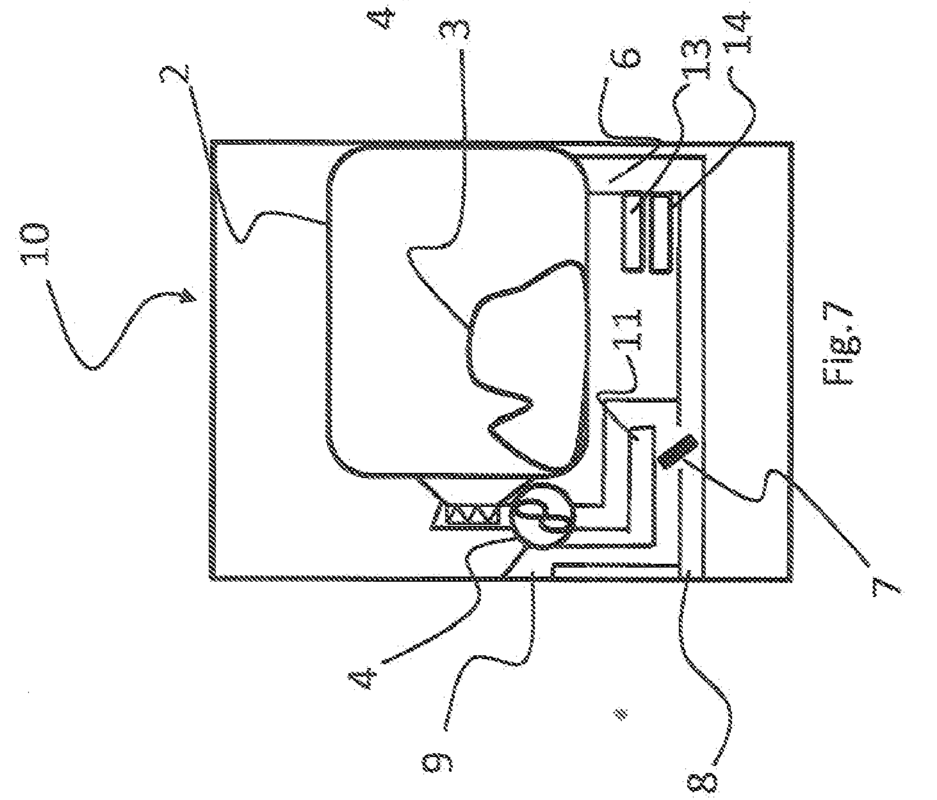

Fig.7

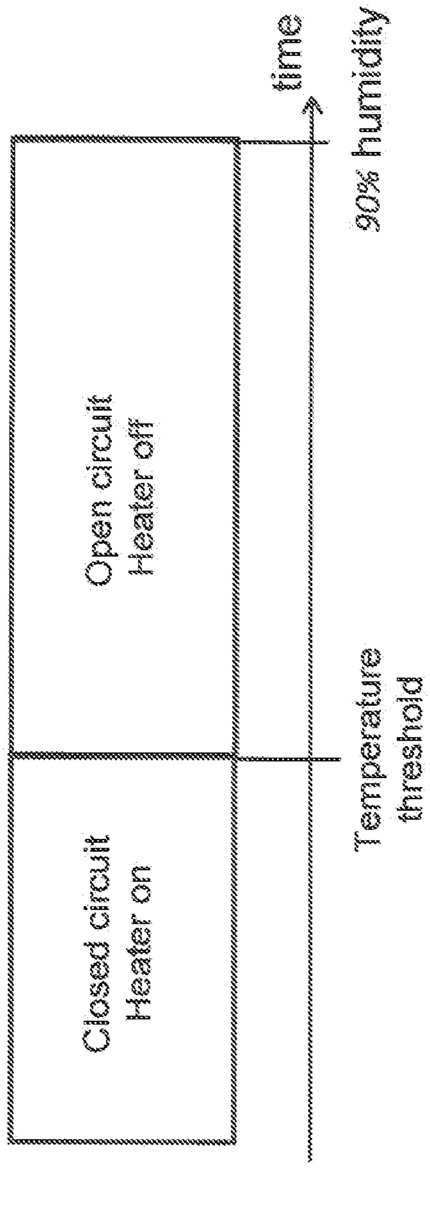
Closed circuit
Heater on
Open circuit
Heater off
Temperature
threshold
90% humidity
time

Fig.9

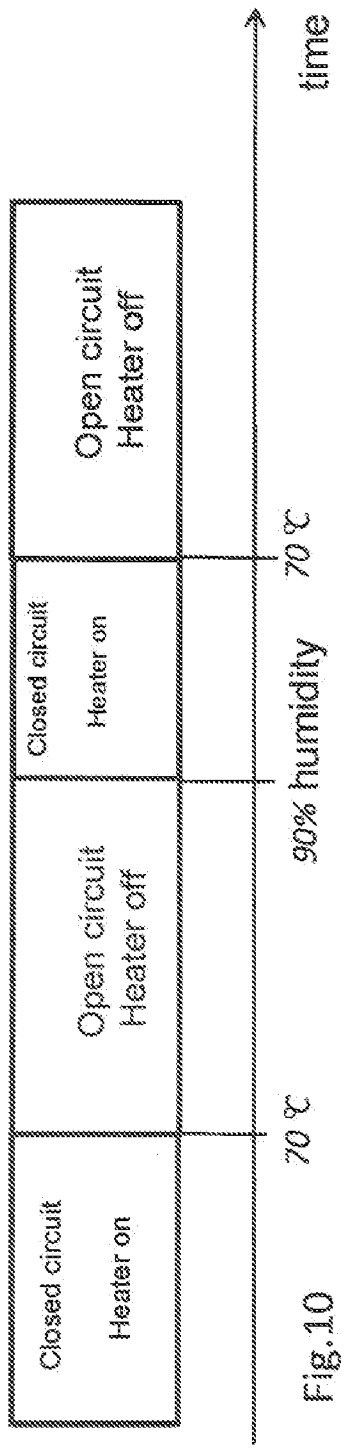
Closed circuit
Heater on
70 °C
Open circuit
Heater off
90% humidity
Closed circuit
Heater on
70 °C
Open circuit
Heater off
time

Fig.10

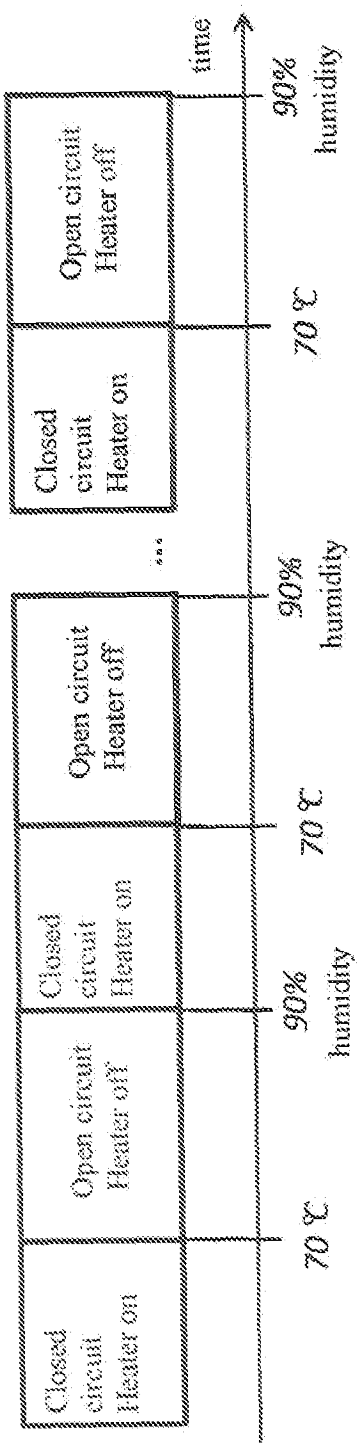

Fig.11

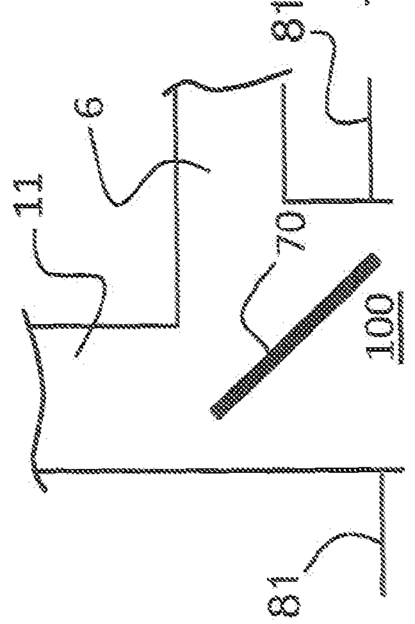

Fig.12

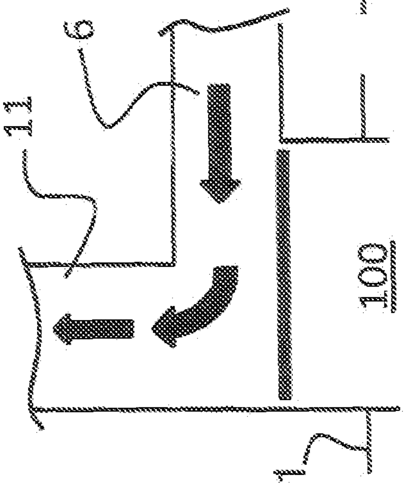

Fig.13
closed circuit

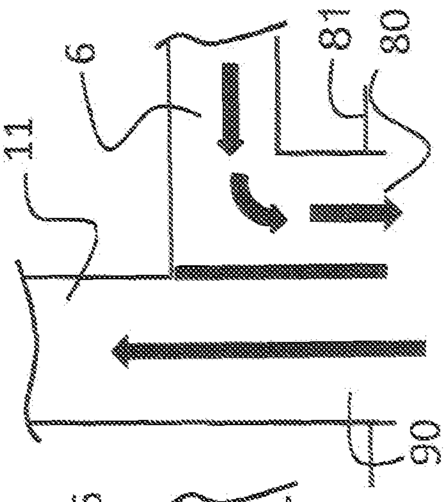

Fig.14
open circuit

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 15 9319

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 519 145 A (MANDEL SHELDON W [US]) 28 May 1985 (1985-05-28) * column 2, line 65 - column 3, line 17; figure 1 *	1,9,10, 15	INV. D06F58/02 D06F58/20 D06F58/28
X	US 4 549 362 A (HARIED JOHN C [US]) 29 October 1985 (1985-10-29) * column 5, line 26 - line 53; figure 1 *	1,9,10, 13-15	
X	FR 2 539 153 A (THOMSON BRANDT [FR]) 13 July 1984 (1984-07-13) * figures 2-4 *	1,9,10, 15	
X	FR 2 517 040 A (SETAN ETUDES ANALYSES [FR]) 27 May 1983 (1983-05-27) * claim 7; figure 1 *	1,9,14, 15	
X	DE 22 20 425 A1 (LICENTIA GMBH) 15 November 1973 (1973-11-15) * page 4 - page 5; claims 1,2,5; figures *	1,9,15	
X	EP 1 291 597 A (ESSWEIN SA [FR] BRANDT IND [FR]) 12 March 2003 (2003-03-12) * the whole document *	1-3,5,9, 10,12,15	TECHNICAL FIELDS SEARCHED (IPC) D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 September 2009	Diaz y Diaz-Caneja

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

EPO FORM 1503 03.82 (P04C01)

2

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 15 9319

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.

17-09-2009

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 4519145	A	28-05-1985	NONE			
US 4549362	A	29-10-1985	NONE			
FR 2539153	A	13-07-1984	NONE			
FR 2517040	A	27-05-1983	NONE			
DE 2220425	A1	15-11-1973	NL	7305757	A	30-10-1973
EP 1291597	A	12-03-2003	DE	60219112	T2	06-12-2007
			ES	2282383	T3	16-10-2007
			FR	2829231	A1	07-03-2003

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- GB 595305 A, ALBERT VON ROTZ **[0004]**
- GB 2094963 A **[0009]**