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(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 MT NL NO PL PT RO SE SI SK TR Designated Extension States: AL BA MK RS (71) Applicant: Electrolux Home Products Corporation N.V. 1930 Zaventem (BE)	(72) Inventors: • Cimetta, Silvano 33100 Treviso (IT) • Mazzocco, Roberto 33170 Pordenone (IT) • Olivaro, Paolo 31010 Orsago (Treviso) (IT) (74) Representative: Nardoni, Andrea Electrolux Italia S.p.A. Corso Lino Zanussi, 30 33080 Porcia (PN) (IT)
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(54) **Washer dryer with integrated condenser to the washing group**

(57) Combined laundry washing and drying machine comprising a rotating drum, a tub containing said drum, a detergent drawer, first water conduits controlled by respective electro-valves and able of conveying into said detergent draw a controlled liquid flow from the mains, second water conduits able of conveying said water from said drawer into said tub, an air drying path comprising , linked in series and connected each other, a suction mouth able of intaking air and water and opened in the lower part of said tub, a condenser for moisture condensing from the air flow passing into it, a channel conveying said air flow at the outlet of said condenser to a suitable fan, water admission means able of introducing a flow of water into said condenser, wherein said water being apt of realizing the cold means for the condensation, wherein

said second water conduits comprise a single conduit able of conveying said water flow from said detergent drawer straight into said condenser; it is extended from said suction mouth substantially upwards, so as said suction mouth forms the lower end of said condenser, and in that the admitting opening of said single conduit into said condenser is placed in an intermediate position in the upper portion of said condenser; preferably said single conduit is continuously descending from said detergent drawer towards said condenser.

During at least a time-interval of the drying cycle said fan is operated in at least two different rotation speeds, one of which allows a part of the water (B), introduced into said condenser from said single conduit, to be drawn towards the portion of said condenser downstream said intermediate position of said condenser.

PROPOSAL

C Inlet Condensation Hose
1 Washing Group
2 Detergent dispenser
3 Water tap
4 Inlet Valve
5 Intake hole
6 Condenser
7 Hose connection
8 Fan Unit
9 Heating Element
10 Inlet hose without siphon
11 Entry condenser

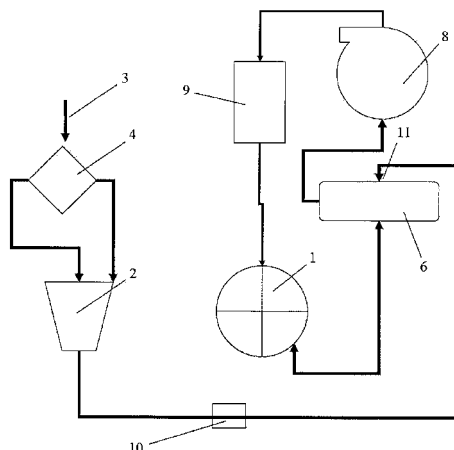


FIG. 2

Description

[0001] The present invention relates to an improved, preferably household combined washing-drying machine, provided with a condenser for the condensation of the moisture collected by a hot air-flow which crosses the washing drum and therefore takes the moisture away from the wet clothes which are contained in said drum.

[0002] Combined laundry washing and drying machines, provided with a condenser for the drying air, are well known; in said machines the hot drying air is made to circulate in a closed loop across the drum in which the laundry to be washed and dried is contained.

[0003] Said machines are generally represented in the patents EP 1 302 586 and EP 1 199 397; they are generally produced as a conventional washing machine, provided with a tub, a drum rotating inside it, a detergent drawer to contain the detergent and other substances used for the washing, a conduit, comprising a siphon, which allows a flow of water which carries with it said detergent/substances from said drawer into said tub, and further operating and control devices which are generally known in se.

[0004] In order to implement the drying function too, said machine is added also with a hot drying air path comprising a condenser with a suction mouth which opens on the tub side wall, and a fan which sucks the air from said condenser and which blows it in a proper heating unit, wherefrom the air-flow is again being introduced into the drum, generally across the same opening for the laundry loading.

[0005] It is also known that the purpose of condensing the moisture, contained in the drying air flow which is intaken from said suction mouth and which runs said condenser and blown by said fan, is achieved by injecting into the condenser a spray of cold water, normally taken by the water supply devices of the machine itself, controlled by respective electro-valves, and which are connected to the water mains.

[0006] Such spray of cold water injected into the condenser will cross in counter-current to with the moisture-laden hot air-flow which is sucked by the fan from inside the tub.

[0007] Due to the remarkable temperature difference between the water which is sprayed and the hot and moisture-laden air-flow, the moisture is condensed and falls down, together with the sprayed water, on the condenser bottom and from there, across said mouth, into the tub.

[0008] Such type of machine, though effective, shows the well known drawback that the lint and other rests, released by the laundry in the course of a washing cycle, leave a deposit and stick during a following drying cycle on the condenser inner walls, causing a clogging in the long term, and also generating a serious fire risk, in the case such lint would overcome the condenser and the fan and would contact the electric heating resistors, which work at high temperature.

[0009] Anyway the cleaning of such lint/rests is being

partially implemented during a washing cycle, when the level of the washing bath on the wash bottom is higher than the level of such sucking mouth; in the facts in such a case a part of the washing bath penetrates into the lower part of the condenser and licks it, so removing and taking away from its inner surface said lints, which afterwards are discharged outside during a discharge step of the same bath.

[0010] However such ability of washing the condenser shows two problems:

- first of all, in the last years the water amount which is used in a washing cycle has progressively reduced, due to well known and general requirement of energy and water saving; therefore the bath level on the tub bottom is correspondently and progressively lower and lower, which renders no more sufficient to wash the condenser bottom, which generally is placed slightly above the level of the wash bottom;
- moreover, even if the washing of the lower part of the condenser is implemented as just described, all the same the lint of the higher portion of the condenser is positively not removed, which maintains the above described drawbacks, even if in a reduced amount.

[0011] Further to said problem, the more general problem of the increased cost of such kind of machine still remains; as a matter of facts, over the drying air-flow conduits which have to be added to the machine, a specific water supply circuit relevant to the cold water condensing spray must be added.

[0012] Such additional water circuit obviously requires at least a proper water supply conduit and a related electro-valve with the relevant man-hour costs for the mounting operations; such additional costs appear to be particularly burdensome, as in the facts said machine must include also the devices which are used in the washing cycles only, i.e. the siphon conduit conveying the water from the detergent drawer down into the tub, and the electro-valves to control the water flow from the mains into the detergent drawer.

[0013] It would therefore be desirable, and is actually a main purpose of the present invention, to provide a combined laundry washing and drying machine of the condensing type, provided with means able to implement the washing from lint of the whole condenser inner surface, even if the bath level on the tub bottom is really low.

[0014] Moreover said machine has to be produced with well known techniques and first of all without any additional cost or burden, but on the contrary by implementing a cost reduction with respect to the prior art machines.

[0015] According to the present invention, this and further aims are reached in a combined washing and drying machine of the condensing type, incorporating the characteristics as recited in the appended claims and includ-

ing such operating means as described below by mere way of non-limiting example with reference to the accompanying drawings, in which:

- Fig. 1 is a schematic view of the water circuit and of the drying air-flow path of a combined washing and drying machine according to the prior art,
- Fig. 2 is view similar to the fig. 1 view, but describing a combined machine according to the instant invention,
- Fig. 3 is an outer view of the rear side of the tub in a combined washing and drying machine according to the invention,
- Fig. 4 show a simplified and symbolic view of an improved operating mode of a machine according to the invention.

[0016] A combined washing and drying machine according to the prior art comprises:

- a rotating drum to contain, wash and dry the laundry, not shown,
- a tub 1 lodging into it said drum,
- a detergent drawer 2 wherein various compartments are defined for pouring and storing the detergent and further substances to be introduced into said tub during the washing and drying process,
- at least a water conduit 3, controlled by a related electro-valve 4, able of introducing from the water mains into said drawer a controlled water flow,
- a suction mouth 5 placed on a lower portion of a side wall of said tub, through which separate flows of water and air can be sucked into a condenser 6, able of condensing the moisture contained in the air flow passing along it,
- a channel 7 conveying said air flow, going out from said condenser, to a proper fan 8, wherefrom said air-flow is being blown into a container 9 lodging one or more electric heating resistors, not shown,
- conveying means able of circulating the drying air flow across said drum and tub, not shown in a specific way as generally known in se and not relevant to the instant invention.

[0017] Up to now a generally know machine according to the prior art has been described.

[0018] According to the invention, the conduit connecting the detergent drawer to the tub, and which is normally provided with a siphon, and the small pipe injecting water

into said condenser, which according to the prior art are two separate devices, are instead here unified as a single conduit 10, which:

- starts from said drawer 2, (like the conduit which according to the prior art connects the drawer to the tub),
- and which admits into said condenser 6, in a proper intermediate position 11 of it.

[0019] It will be already from now apparent that across said single conduit 10 it is possible of pouring a water flow mixed with the detergent and with further substances towards and into the tub, said water flow being first introduced into the condenser, from whose lower portion it passes across said suction mouth 5 to admit into the tub and on the bottom side of it.

[0020] Moreover during a drying cycle said single conduit 10 is also able of supplying a water flow for the condensation process into the condenser 6 in a fully controllable way, as ruled by the electro-valve 4.

[0021] With such solution the first and most important benefit of the invention will be apparent; as a matter of facts the admission of a water flow into the condenser during a washing or rinsing step implements the washing of most of the condenser inner wall, so causing the lint removal, as the intermediate position 11 is determined after such a condenser length portion so as to assure the washing effect of the water flowing down by gravity on the condenser inner wall, then licking and cleaning most of it.

[0022] The just explained invention allows a number of further profitable improvements:

a) it will be indeed understood that the simple water pouring into the condenser is generally not sufficient to wash the whole condenser, as the water obviously goes down licking only the lower portion of the condenser inner wall.

However the specific selected embodiment allows a first but essential improvement: in the facts during a washing cycle the fan 8 is activated into sucking at a proper speed so as the water flow which runs inside the condenser 6, as soon as poured from said single conduit 10, is hindered by the air-flow drawn by the fan; caused by said opposition between the water flow, which goes down, and the air flow which goes up, the water flow is turned into a spray of very small drops licking the condenser upper portion, downstream said intermediate position 11.

Such small drops then make to essentially lap the whole condenser inner wall, and then the there deposited lint is removed.

Moreover it is soon apparent that it is possible to gain some remarkable cost saving in the machine manufacturing, as the conduit admitting the water into the condenser during the drying process, the related

electro-valve, the respective air-break, and the mounting devices are spared.

b) the second improvement consists in placing said suction mouth 5 in the tub lower portion, in orienting the condenser 6 vertically and upwards, in determining said intermediate admitting position 11 of the conduit 10 in an upper portion of the condenser, so that the water flow by gravity goes out from the conduit 10 into the condenser 6 licking and washing most of its inner wall.

c) the third improvement consists in forming said single conduit 10 with a shape and orientation continuously descending towards the condenser 6; so the siphon is spared, as during the drying process the produced steam, which in the prior art machines escaped from the tub even through the path running across the conduit for the water loading and the detergent drawer, in the instant invention is practically intercepted and condensed inside the condenser; therefore the small part of the steam flow which is not condensed is automatically drawn by the fan. As a result the problem of steam emission into the environment during the drying process is wholly avoid.

[0023] Such a feature is furthermore favored in that the just described tub shows only two opening to outside, which are:

- the lower opening , not shown, for letting out the washing or rinsing bath,
- said suction mouth 5 connecting the tub to the condenser 6.

[0024] Therefore a machine, on which such a tub is mounted, results obviously simpler, cheaper and in particular it intrinsically avoids the steam emission outside.

d) with ref. to fig. 4, the fourth improvement consists in that during the drying cycle, and while the water is injected into the condenser 6, the fan 8 is activated at two different rotation speeds, wherein a first and lower speed, which can also be zero, i.e. the fan is stopped, allows the descent of the sprayed water "A" down into the condenser 6, while the second and higher speed draws the portion "B" of the water introduced into the condenser and sucks it in the opposite sense, so that also the portion downstream of said admitting position 11 of the condenser is properly run by the air flow containing sprayed water; as a final result this portion too is being carefully washed.

e) a fifth improvement consists in that these two different rotating speeds are activated in alternate way

and with a changing frequency which has to be high enough, so as to allow the fan to be only a little involved by the air- and waterflow.

f) a sixth improvement regards the initial time interval of a drying cycle; in the facts in said initial interval the laundry load is very wet and still quit cold; therefore in such a time interval the moisture taken from the laundry is still very low, and so there is no need to circulate an high amount of drying air flow.

The improvement consists in that, during said initial time interval, said fan 8 is made to operate at a properly reduced speed, what obviously generates a corresponding energy saving, without however suffering a remarkable worsening of the drying performances.

g) a seventh improvement is closely linked to the previous one; in the facts said decrease in the fan 8 rotating speed during the starting drying step is not implemented in the same way for any kind of laundry load, but it is adjusted, as "tylored", for any specific kind of laundry, in order to further optimize the energy saving.

Of course such selection of the time-length relevant to any starting step may be associated to any drying cycle through well known and not discussed command and control means.

h) the eighth improvement consists in that said machine, in order to let the water into said drawer 2, wherefrom it is poured by gravity into the single conduit 10, uses the same means employed to pour the water into the drawer 2 during a washing cycle, and particularly use the same valve 4 and the same water conduit 3 which from the water mains leads to said valve 4.

Such operation is obviously carried out by command and control means in se known, and allows to achieve a further cost reduction in the construction, as the valve and the related air-break to convey the water into the condenser during a drying step can be saved.

i) with ref. to fig. 3, the ninth improvement is carried out based on the following simple considerations:

- the more the condenser is long, the more it condensates the moisture,
- it has to begin from the bottom, and must end close to the fan. i.e. on the top,
- to pass on said two extremes and in the same time to be long enough, it has to show a curved shape, close to the tub, and therefore it has to follow the same tub outer profile.

[0025] All that considered, it seems to be apparent that the optimum condenser shape is that one of a sickle, with the suction mouth 5 placed on the bottom and with the upper end placed in correspondence to the tub upper part; moreover said "sickle" shape and the size of the condenser must be such as to conform and follow the outer circular profile of the tub itself.

l) again with ref. to fig. 3, it turns to be preferable that, in order to maximize the useful length of the condenser, said intermediate admitting position 11 of the conduit 10 is selected and pick in the condenser 6 upper position; in the facts, said position 11 provides both a proper length of the condenser working stretch, and the possibility of orienting vertically said useful length of the condenser, what is essential to assure an actual counter-current effect between the sprayed water flow coming from said conduit 10, and the drying air flow sucked by the fan and coming from the tub across said suction mouth 5.

m) an even further improvement regards again the control means of the described machine; as a matter of facts it was experienced as profitable that during a washing or rinsing cycle, and preferably the latter, the fan 8 is made to operate ad an high rotating speed; as the tub bottom is covered with water, so said suction mouth 5 is obviously closed by said water cap; then no air flow can be sucked across it.

[0026] However the depression caused by the fan itself inside the condenser causes a consequent motion upwards of the bath from the tub bottom into and along the condenser, with a further washing effect on its wall.

[0027] Moreover it will be advantageous that such suction step be activated during one of the rinsing steps, as in these case the water is more plentiful and, most of all, much cleaner.

[0028] This description is ended pointing out that the invention is best implemented and achieves the most important advantages if a fan is used whose speed be controllable even at a speed higher than the speed which is normally used for the drying step according to the prior art; however such types of fans and the relevant command and control means are well known in se.

[0029] A further improvement refers a specific machine working mode; to this regard it is remembered that for most of the users it is more and more appreciated and preferred the possibility of making the machine to work also during the night time; in the facts in such a time period the energy cost is less, and moreover during this time period it is normal that the user is at home, while it is not always true in the day time.

[0030] However the machine working in the night time may raise the well known noise problem, that can be too loud and then annoying; in order to decrease such a problem, it is here proposed to make the fan to work at a controllable, and therefore very low, speed.

[0031] Such possibility, preferably when associated to a reduced power supply on the heating resistors, causes the machine overall working at a generally reduced rate, and especially at a low fan speed; as a matter of facts it is known that the machine noise when it works as a dryer, is mainly caused by the fan and by the drying air flow.

[0032] In order to achieve the possibility of activating the nightly working, according to the instant improvement a specific "night cycle" cycle program, is designed and implemented, wherein the machine working is generally reduced and slowed-down, and which comprises not only a fan speed reduction, but in the case and also a drum rotation speed slowing down, and a decrease of the average power supplied on the heating resistors; such possibility may be given either by a reduction of the power supply voltage, or by a fully rated but intermittent power supply voltage, with a suitable and pre-selectable duty-cycle.

Claims

1. Combined laundry washing and drying machine, particularly for household use, comprising:

- a rotating drum for the laundry containment, washing and drying,
- a tub (1) containing inside it said drum,
- a detergent drawer (2) for the storing of the products and substances to be introduced into said tub during the washing and drying cycle of said laundry,
- first water conduits (3), controlled by respective electro-valves (4) able of conveying into said detergent drawer (2) a controlled liquid flow, preferably water from the mains,
- second water conduits able of conveying said water from said drawer (2) into said tub (1),
- an air drying path comprising , linked in series and connected each other,
- a suction mouth (5) able of intaking air and water and opened in the lower part of said tub,
- a condenser (6) able of condensing the moisture from the air flow passing into it,
- a channel (7) conveying said air flow at the outlet of said condenser on a suitable fan (8), and from here to a successive device (9) for the air heating,
- water admission means able of introducing into said condenser, wherein said water is apt of realizing the cold means for the condensation,
- ventilation means able of circulate a drying air flow into and across said drum,

characterized in that said second water conduits comprise a single conduit (10) able of conveying said water from said drawer (2) straight into said condenser (6).

2. Washing and drying machine according to claim 1, **characterized in that** said condenser (6) is extended from said suction mouth (5) substantially upwards, so as said suction mouth forms the lower end of said condenser, and **in that** the admitting opening of said single conduit (10) into said condenser is placed in an intermediate position (11) in the upper portion of said condenser. 5
3. Washing and drying machine according to claims 1 or 2, **characterized in that** said single conduit (10) shows a continuously descending orientation from said detergent drawer (2) towards and into said condenser (6). 10
4. Machine according to claim 2 or 3, **characterized in that** during at least a time-interval of the drying cycle said fan (8) is operated at least two different rotation speeds, wherein during one of said different speeds a part of the water (B), introduced into said condenser from said single conduit (10), is drawn towards the portion of said condenser downstream said intermediate position (11) of said condenser. 15 20
5. Machine according to claim 4, **characterized in that** said different rotation speeds are generated alternatively a plurality of times. 25
6. Machine according to any previous claims, **characterized in that** it is provided with control means able of selectively reducing the speed of said fan during the drying initial step. 30
7. Machine according to claim 6, **characterized in that** said control means are able of automatically reducing the rotation speed of said fan during the drying initial step according to stored instructions linked to the respectively selected drying cycle. 35
8. Machine according to any previous claim, **characterized in that** it is provided with control means able of making said electro-valve (4) to control the water flow in said first water conduit (3), so as to allow that said water flow is admitted from said first water conduit (3) into said drawer (2), from it into said single conduit (10), and from it into said condenser according to stored instruction linked to the respectively selected drying cycle. 40 45
9. Machine according to any previous claim, **characterized in that** said condenser shows the partially circular shape of a sickle, 50
 - whose bottom end is placed in correspondence to said suction mouth (5), 55
 - whose top end is arranged in correspondence to the upper portion of said tub,
 - and so shaped and sized to conform to the
- outer circular profile of the rear side of said tub (1).
10. Machine according to claim 9, **characterized in that** the position (11) of the admitting opening of said single conduit (10) into said condenser is arranged on the upper portion of said condenser (6).
11. Machine according to any previous claims, **characterized in that** it is provided with control means able of selectively operate said fan (8) during a pre-selected time-interval of a washing cycle, and preferably during a pre-selected time-interval of a rinsing step.
12. Machine according to any previous claims, **characterized in that** it is provided with control means able of activating the fan at a reduced speed, preferably together with a reduction of the average power supply delivered to the air heating resistors.

CURRENT

- C Inlet Condensation Hose
- 1 Washing Group
- 2 Detergent dispenser
- 3 Water tap
- 4 Inlet Valve
- 5 Intake hole
- 6 Condenser
- 7 Hose connection
- 8 Fan Unit
- 9 Heating Element
- 12 Inlet hose with siphon

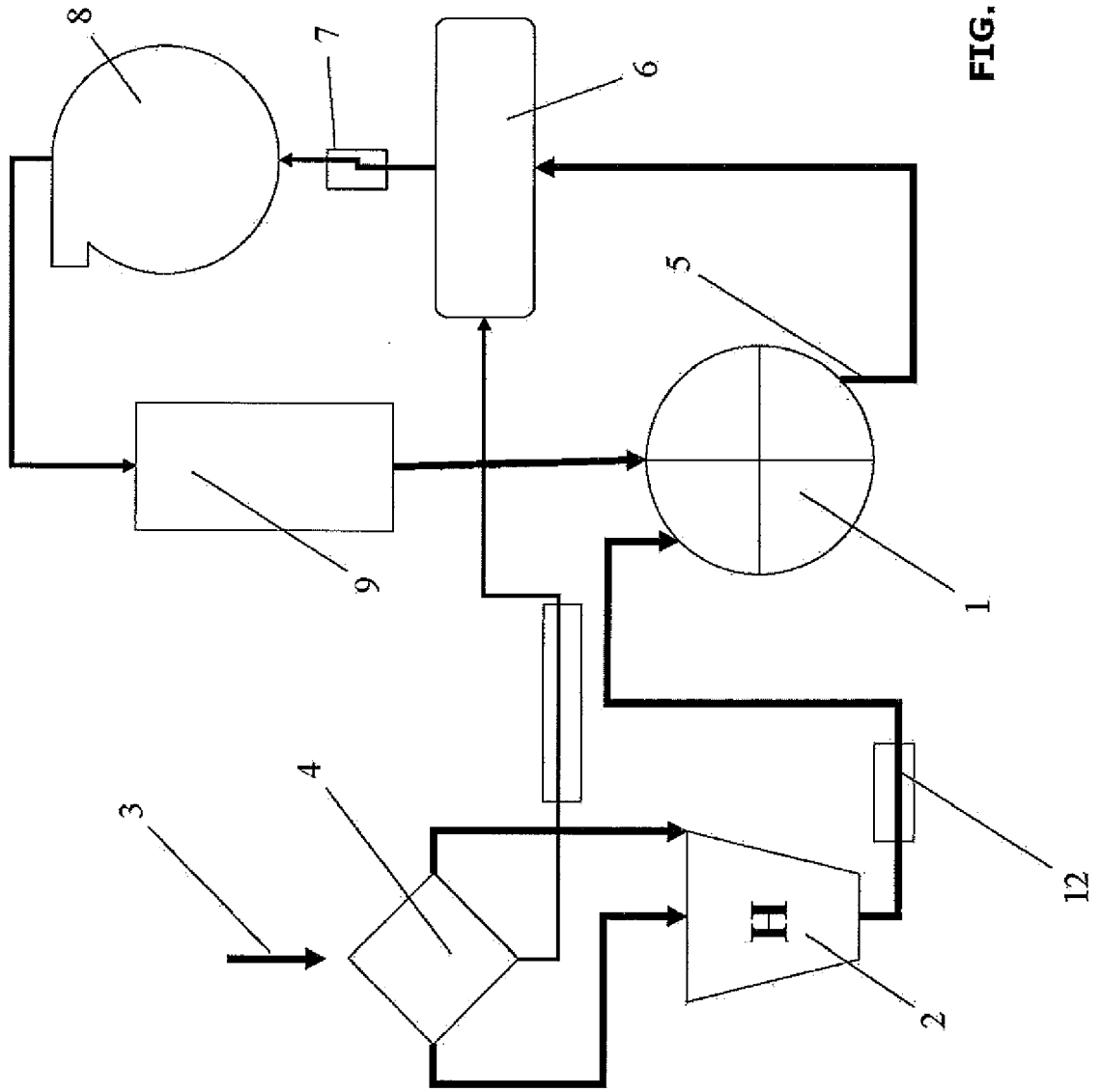


FIG. 1

PROPOSAL

- C Inlet Condensation Hose
- 1 Washing Group
- 2 Detergent dispenser
- 3 Water tap
- 4 Inlet Valve
- 5 Intake hole
- 6 Condenser
- 7 Hose connection
- 8 Fan Unit
- 9 Heating Element
- 10 Inlet hose without siphon
- 11 Entry condenser

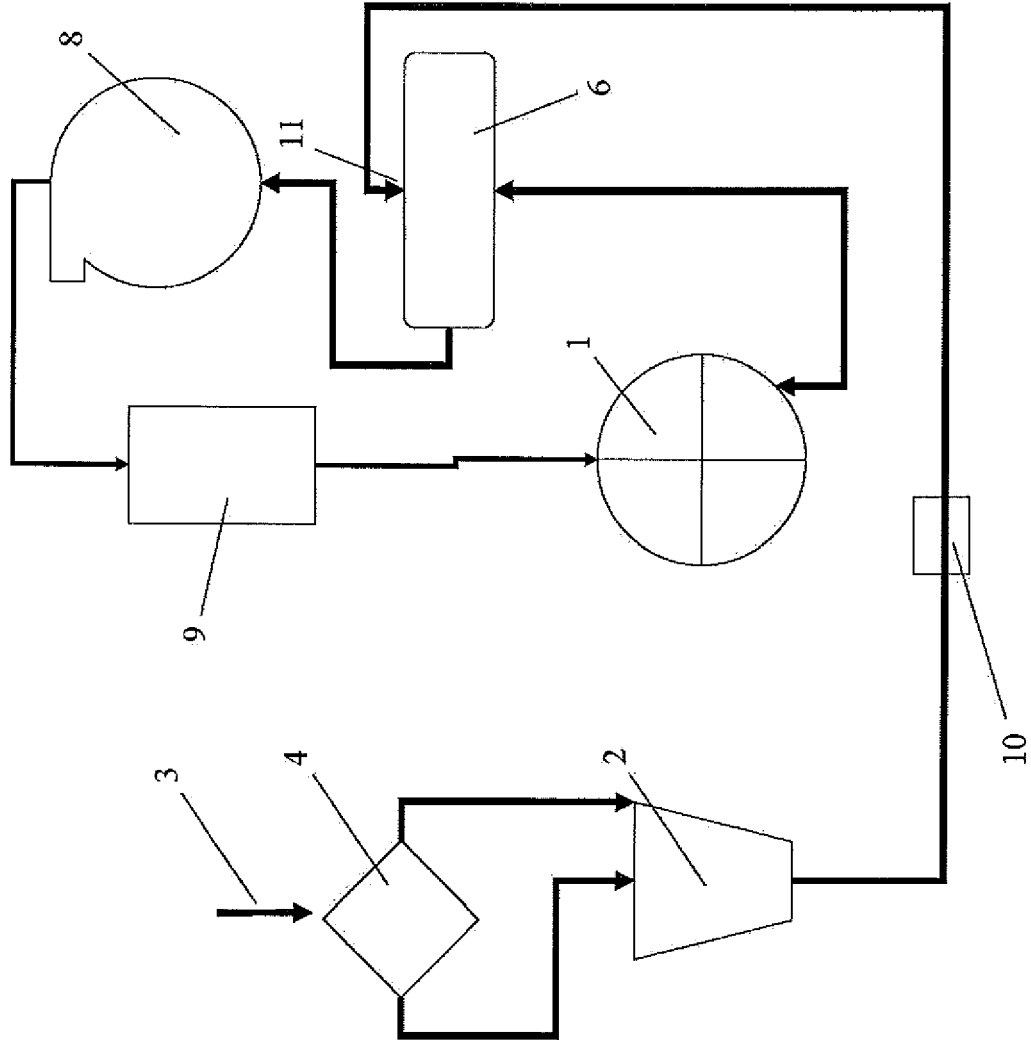
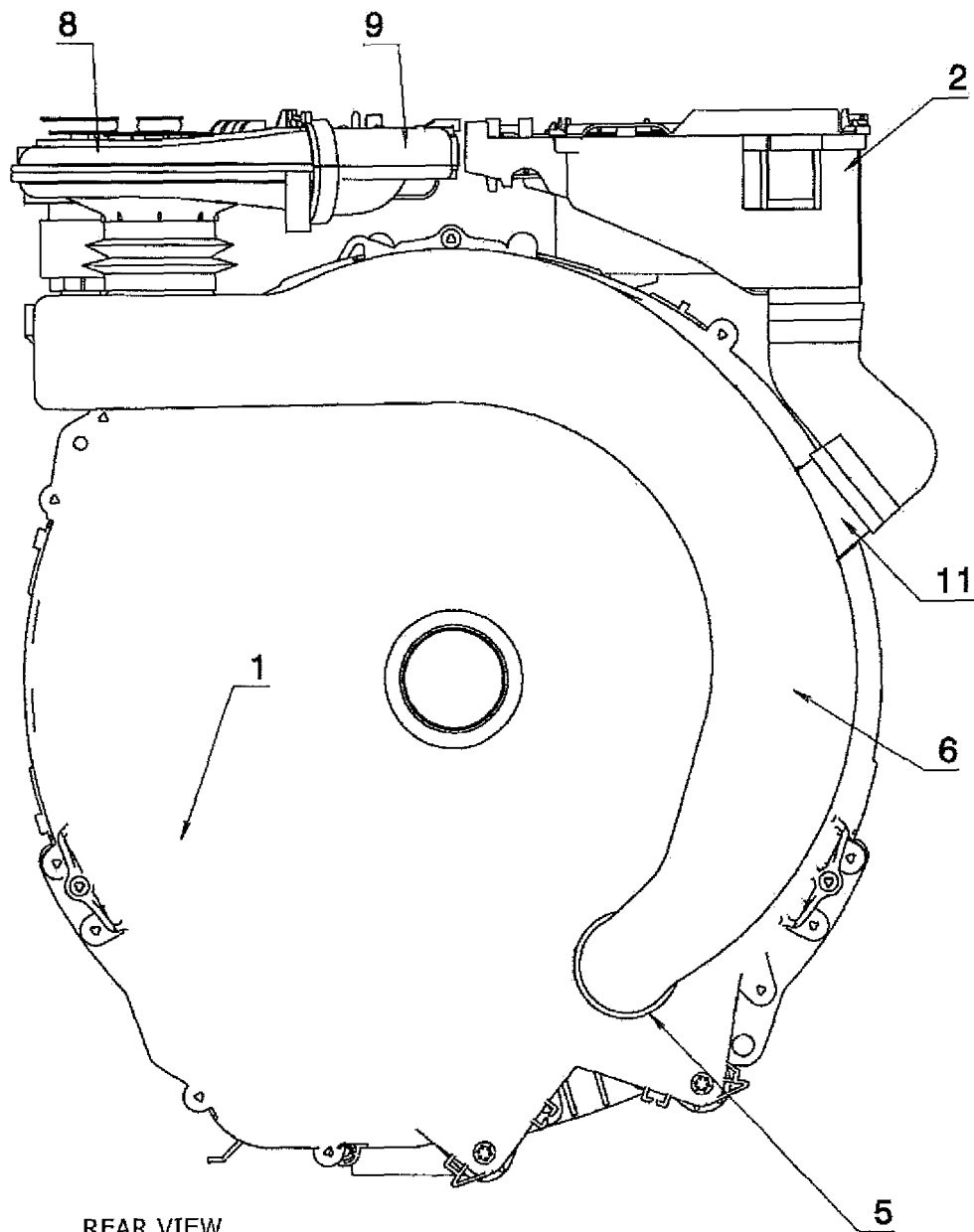
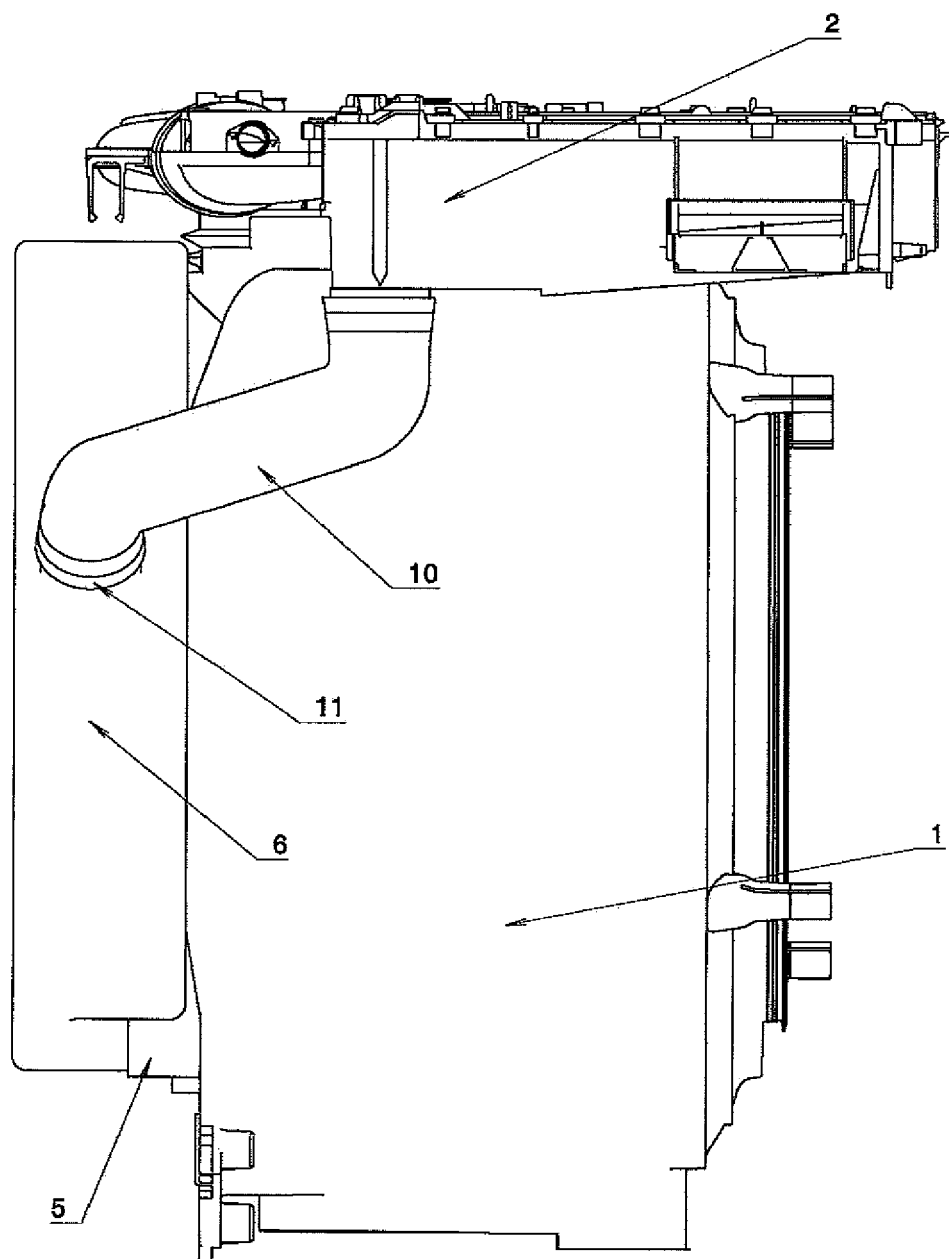


FIG. 2



REAR VIEW

FIG. 3



SIDE VIEW

FIG. 3a

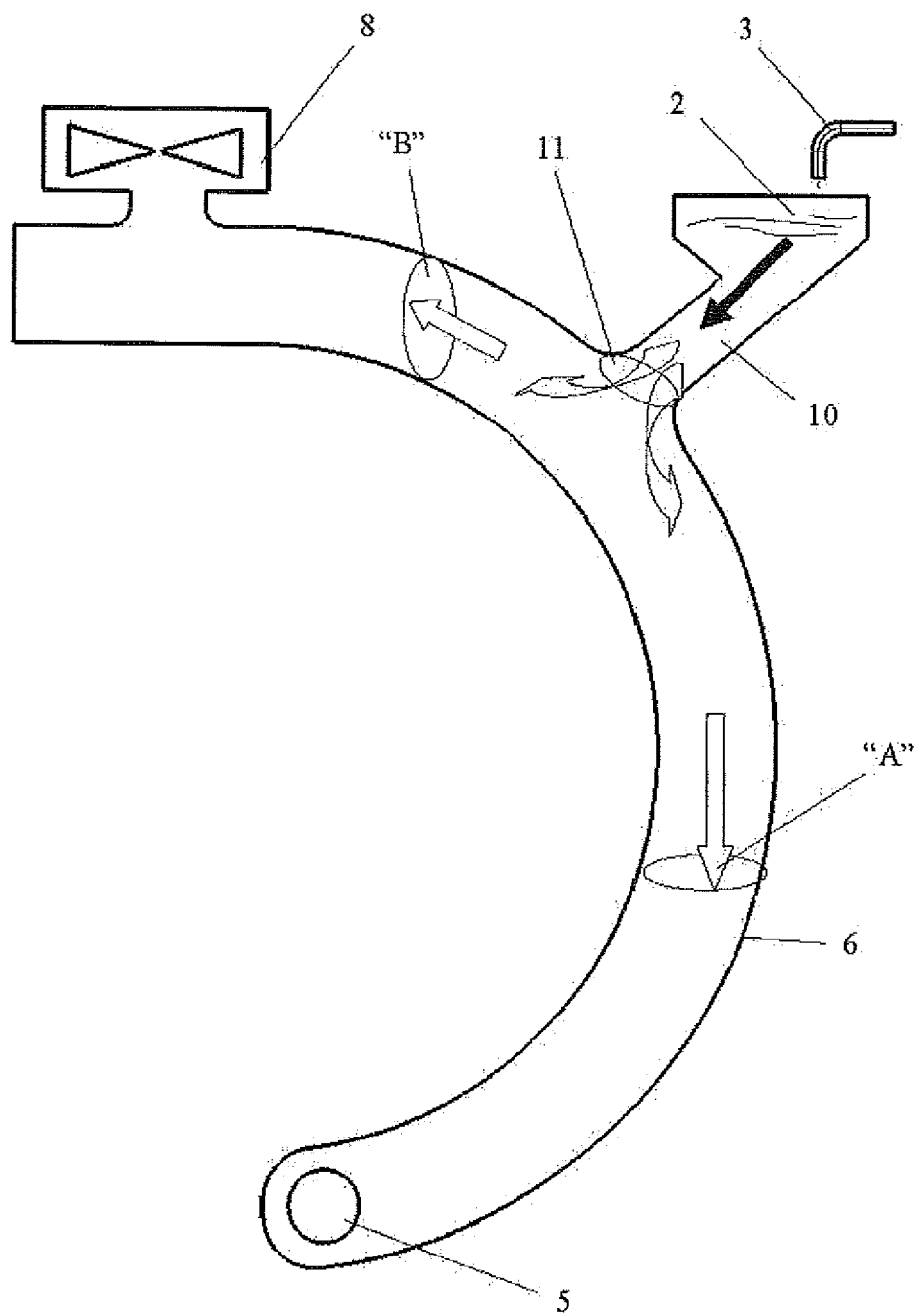


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 08 10 4942

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	GB 2 291 891 A (BOSCH SIEMENS HAUSGERAETE [DE]) 7 February 1996 (1996-02-07) * claim 1; figure 1 *	1-12	INV. D06F58/24 D06F39/02
X	DE 40 12 172 A1 (LICENTIA GMBH [DE]) 5 December 1991 (1991-12-05) * claim 1; figure 1 *	1-12	
X	EP 0 499 029 A (BOSCH SIEMENS HAUSGERAETE [DE]) 19 August 1992 (1992-08-19) * claim 1; figure 1 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 January 2009	Examiner Dupuis, Jean-Luc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (F04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 10 4942

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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23-01-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2291891	A	07-02-1996	AT 407264 B 26-02-2001
			CN 1133369 A 16-10-1996
			CZ 9502660 A3 17-04-1996
			DE 4436673 A1 18-04-1996
			FR 2725735 A1 19-04-1996
			HK 177096 A 27-09-1996
			IN 187989 A1 03-08-2002
			PL 310876 A1 15-04-1996
			RU 2144104 C1 10-01-2000
			TR 960250 A2 21-06-1996
			US 5588313 A 31-12-1996
DE 4012172	A1	05-12-1991	NONE
EP 0499029	A	19-08-1992	DE 4104760 A1 20-08-1992

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1302586 A [0003]
- EP 1199397 A [0003]