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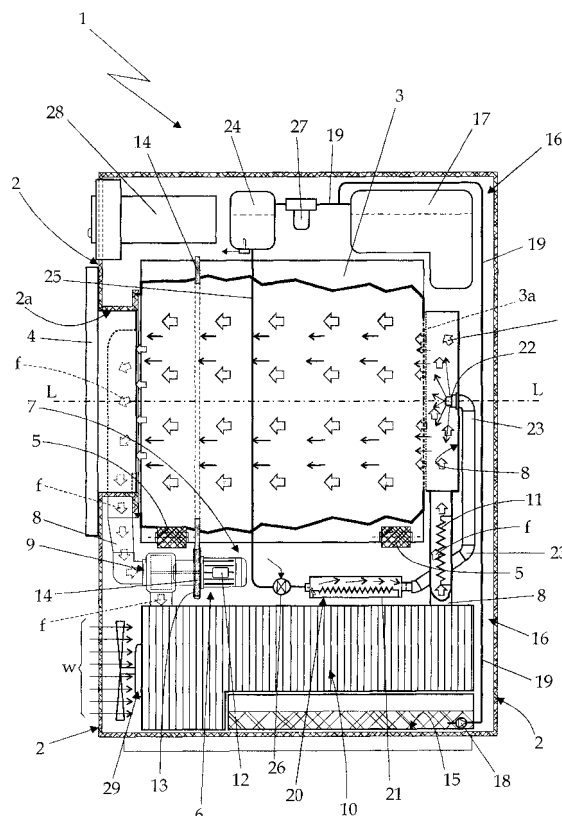
(71) Applicant: **Electrolux Home Products Corporation N.V.**
1930 Zaventem (BE)

(72) Inventors:
• **Favret, Ugo**
33072, CASARSA (IT)
• **Noviello, Flavio**
33081, AVIANO (IT)

(74) Representative: **Baumgartl, Gerhard Willi et al**
AEG Hausgeräte GmbH
Group Intellectual Property
90327 Nürnberg (DE)

(54) **Home laundry drier with steam generator**

(57) A home laundry drier (1) having an outer box casing (2) and, inside the casing (2), a drying drum (3) for housing the laundry to be dried, a hot-air generator (7) for circulating a stream of hot air inside the drying drum (3), and a steam generator (20) for feeding steam into the drying drum (3); the drying drum (3) being fixed inside the casing (2) for rotating about its longitudinal axis (L), the end wall (3a) of the drying drum (3) being permeable to air, and the hot-air generator (7) comprising an air recirculating conduit (8) coupled to the end wall (3a) of the drying drum (3), and ventilating means (9) to produce an airflow (f) entering in the drying drum (3) via its end wall (3a); the steam generator (20) feeding the steam into the drying drum (3) via nozzle (22), and the driving means (6) comprising an electric motor (12) which rotates the drying drum (3) and also drives the ventilating means (9).



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Description

[0001] The present invention relates to a home laundry drier with steam generator.

[0002] More specifically, the present invention relates to a rotary-drum home laundry drier with steam generator.

[0003] As is known, rotary-drum laundry driers substantially comprise a substantially parallelepiped-shaped outer box casing; a cylindrical laundry drying drum housed in axially rotating manner inside the box casing, directly facing a laundry loading and unloading opening formed in the front face of the casing; a door hinged to the front face of the casing to rotate to and from a rest position closing the opening in the front face of the casing to seal the drying drum; and an electric motor for rotating the drying drum about its longitudinal axis inside the casing.

[0004] Rotary-drum laundry driers of the above type also comprise a closed-circuit, hot-air generator designed to circulate inside the drying drum a stream of hot air with a low moisture content, and which flows through the drying drum and over the laundry inside the drum to < rapidly dry the laundry.

[0005] In the most widely marketed driers, the closed-circuit, hot-air generator comprises an air/air heat exchanger and an electric heater located one after the other along an air recirculating conduit, the two ends of which are connected to the drying drum, on opposite sides of the latter; and an electric centrifugal fan or similar located along recirculating conduit to produce, inside the recirculating conduit, an airflow which flows through the drying drum. The air/air heat exchanger provides for rapidly cooling the airflow from the drying drum to condense the surplus moisture in the airflow; and the heater provides for rapidly heating the airflow from the heat exchanger back to the drying drum, so that the air flowing into the drum is heated rapidly to a temperature higher than or equal to that of the same air flowing out of the drying drum.

[0006] Some more recently marketed rotary-drum driers also feature a pressurized-steam generator which, at the end of the drying cycle, feeds a jet of steam into the drying drum to eliminate or at least greatly reduce wrinkling of the fabrics produced during the drying cycle.

[0007] Currently used steam generators feed the jets of steam into the drying drum by means of a nozzle located inside the casing, in the collar connecting the front opening of the drying drum to the laundry loading and unloading opening in the front face of the casing, and generally comprise a demineralized-water reservoir housed in the highest part of the household appliance casing for easy manual refill with distilled/demineralized water; and an electric steam generating boiler normally located below the demineralized-water reservoir and connected to it by a connecting pipe. Water flows by gravity into the electric boiler under control of an electrovalve or similar placed along the connecting pipe.

[0008] To perform an optimal steam de-wrinkling of the

fabrics in the drum, at the end of the drying cycle the electronic central control unit of the drier stops the electric centrifugal fan of the hot-air generator to discontinue the air circulation, and activates the pressurized-steam generator to feed a sequence of jets of steam into the drying drum while the electric motor repeatedly changes the rotating direction of the drying drum.

[0009] The stop of air circulation avoids the hot-air generator to immediately such the steam out of the drying drum, thus preventing the steam to reach the laundry. The intake of the air recirculating conduit of the hot-air generator, in fact, is integrated in the door, immediately beneath the steam nozzle.

[0010] Since optimal fabrics steam de-wrinkling requires the continuous movement of the fabrics in a steam saturated atmosphere, today's rotary-drum home laundry driers with steam generator are all provided with two independent electric motors, each of which is driven by the electronic central control unit separately from the other.

[0011] It is the object of the present invention to provide a rotary-drum home laundry drier with fabrics steam de-wrinkling functions, which is cheaper than those currently on the market.

[0012] According to the present invention, there is provided a home laundry drier, as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0013] The present invention will be described with reference to the attached drawing, which shows a side view, with parts in section and parts removed for clarity, of a home laundry drier in accordance with the teachings of the present invention.

[0014] Number 1 in the attached drawing indicates as a whole a home laundry drier comprising a preferably, though not necessarily, parallelepiped-shaped outer box casing 2; a preferably, though not necessarily, cylindrical bell-shaped laundry drying drum 3 for housing the laundry to be dried, and which is fixed in axially rotating manner inside casing 2, directly facing a laundry loading and unloading opening 2a formed in the front face of casing 2; and a door 4 hinged to the front face of casing 2 to rotate to and from a rest position closing opening 2a in the front face to seal laundry drum 3.

[0015] More specifically, in the example shown drying drum 3 rests horizontally inside casing 2 on a number of horizontal supporting rollers 5 which are fitted to casing 2 to let drying drum 3 freely rotate about its longitudinal axis L.

[0016] Casing 2, drying drum 3, door 4 and supporting rollers 5 are commonly known parts in the industry, and therefore not described in detail.

[0017] With reference to the attached drawing, laundry drier 1 also comprises a motor assembly 6 for rotating, on command, drying drum 3 about its longitudinal axis L inside casing 2; and a closed-circuit, hot-air generator 7 housed inside casing 2 and designed to circulate through drying drum 3 a stream of hot air having a low moisture level, and which flows over and rapidly dries the laundry

inside drum 3.

[0018] More specifically, closed-circuit, hot-air generator 7 provides for gradually drawing air from drying drum 3; extracting surplus moisture from the hot air drawn from drying drum 3; heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from drying drum 3; and feeding the heated, dehumidified air back into drying drum 3, where it flows over, to rapidly dry, the laundry inside the drum.

[0019] In other words, hot-air generator 7 provides for continually dehumidifying and heating the air circulating inside drum 5 to rapidly dry the laundry inside the drum, and substantially comprises:

an air recirculating conduit 8, the two ends of which are connected to drying drum 3 on opposite sides of drum 3;

a centrifugal fan 9, or other type of air circulating pump, located along recirculating conduit 8 to produce, inside recirculating conduit 8, an airflow f, which flows into drying drum 3 and over the laundry inside drum 5;

an air/air heat exchanger 10 or similar - commonly referred to as a condenser - which is located along recirculating conduit 8 so that the airflow f from drying drum 3 and a cold airflow w from outside casing 2 flow through it simultaneously, and which is designed so that the cold airflow w rapidly cools the airflow f from drying drum 3 to condense the surplus moisture inside airflow f; and

an electric heater 11 (in the example shown, a resistor) located along recirculating conduit 8, downstream from heat exchanger 10, and which provides for rapidly heating the airflow f from heat exchanger 10 back to drying drum 3, so that the air flowing into drying drum 3 is heated rapidly to a temperature preferably, though not necessarily, higher than or equal to that of the same air flowing out of drying drum 3.

[0020] With reference to the attached drawing, the intake end of recirculating conduit 8 is integrated in door 4, and is faced to the front opening of drying drum 3; the end wall 3a of drying drum 3 is perforated, or at any rate permeable to air, to permit air entry into drum 3; and the exhaust end of recirculating conduit 8 is coupled in airtight manner directly to the end wall 3a of drying drum 3.

[0021] As regards centrifugal fan 9, it is mechanically coupled to motor assembly 6 so as to be driven together with drying drum 3, and is structured to produce an airflow f flowing, along recirculating conduit 8, from the intake end of recirculating conduit 8, i.e. door 4, to the exhaust end of recirculating conduit 8, i.e. perforated end wall 3a of drying drum 3.

[0022] More specifically, motor assembly 6 consists of an electric motor 12 fixed inside casing 2 below drying drum 3, of a pulley 13 fitted to the output shaft of electric motor 12, and of a drive belt 14 looped about drying drum 3 and pulley 13; and centrifugal fan 9 is directly coupled

to electric motor 12 so that the impeller/rotor of centrifugal fan 9 is directly driven by the output shaft of electric motor 12.

[0023] In other words, electric motor 12 drives both drying drum 3 and centrifugal fan 9.

[0024] With reference to the attached drawing, given its large dimensions, heat exchanger 10 is located at the bottom of casing 2, and it is also provided with a condensed-water canister 15 which collects the liquid distilled water produced, when the drier is running, inside heat exchanger 10 by condensation of the surplus moisture in airflow f arriving from drying tub 3. Obviously condensed-water canister 15 is located in the bottom of heat exchanger 10.

[0025] Since the capacity of condensed-water canister 15 is preferably, though not necessarily, sufficient to store the distilled water produced during a single drying cycle, hot-air generator 7 is also provided with a water drain circuit 16 for draining the distilled water from canister 15.

[0026] Preferably, though not necessarily, water drain circuit 16 comprises a high-capacity manually-removable waste-water tank 17 housed in easily removable manner inside casing 2, preferably, though not necessarily, near the top of the casing; and an electric pump 18, which, on command, sucks the distilled water from condensed-water canister 15 and feeds it to waste-water tank 17 via a connecting pipe 19.

[0027] More specifically, in the example shown, electric pump 18 is a submerged electric pump 18 located at the bottom of condensed-water canister 15 and it is switched on in known manner when the water level in canister 15 exceeds a given upper threshold value.

[0028] Like some recently marketed laundry driers, laundry drier 1 also comprises a pressurized-steam generator 20, which, on command, produces and feeds a jet of steam into drying drum 3 to eliminate or at least greatly reduce wrinkling of the fabrics produced during the drying cycle.

[0029] With reference to the attached drawing, pressurized-steam generator 20 comprises an instant in-pressure electric boiler 21 designed to receive a given quantity of water and immediately convert it into a stream of low-pressure steam whose pressure is slightly higher than external pressure; a steam injection nozzle 22 faced to the perforated end wall 3a of drying drum 3, outside of the drum, and structured for projecting jets of low-pressure steam through end wall 3a, inside drying drum 3; and a steam exhaust manifold 23 connecting the outlet of electric boiler 21 to the steam injection nozzle 22 for feeding the low-pressure steam produced by electric boiler 21 directly to nozzle 22.

[0030] More specifically, in the example shown steam exhaust manifold 23 extends outside of recirculating conduit 8, whereas steam injection nozzle 22 is housed in the exhaust end of recirculating conduit 8. Obviously, in a different embodiment steam injection nozzle 22 could be located outside of the exhaust end of recirculating conduit 8, but anyway facing the perforated end wall 3a

of drying drum 3.

[0031] Finally pressurized-steam generator 20 is provided with a demineralized-water reservoir 24 which is housed inside casing 2, over electric boiler 21, and is connected to electric boiler 21 by a connecting pipe 25; and with an electrovalve 26 or similar which is located along connecting pipe 25 to control the outflow of water from water reservoir 24 to electric boiler 21.

[0032] Obviously, water flows by gravity from water reservoir 24 to electric boiler 21.

[0033] In-pressure electric boiler 21, steam injection nozzle 22, steam exhaust manifold 23, demineralized-water reservoir 24 and electrovalve 26 are commonly known parts in the industry, and therefore not described in detail.

[0034] With reference to the attached drawing, to avoid or greatly reduce manual refilling with demineralized water, water reservoir 24 of pressurized-steam generator 20 is preferably, though not necessarily, connected to water drain circuit 16 of hot-air generator 7, to receive part of the distilled water drained from water canister 15.

[0035] More specifically, in the example shown water reservoir 24 is connected to water drain circuit 16 of hot-air generator 7, namely connecting pipe 19, via a manually-removable filter 27 structured to keep fluff and/or lint particles out of water reservoir 23.

[0036] Like any other recently marketed electric household appliance, laundry drier 1 also comprises an electronic central control unit 28, which controls electric motor 12, heat exchanger 10 (or, rather, the cooling fan 29 of heat exchanger 10, which generates cold airflow w through the exchanger), and heater 11 in predetermined manner, as memorized inside it, to perform the user-selected drying cycle.

[0037] In addition to the above, control unit 28 also controls steam generator 20 (i.e. electric boiler 21 and electrovalve 26) in predetermined manner, as memorized inside it, to feed jets of low-pressure steam into drying drum 3 through its perforated end wall 3a when required by the user-selected drying cycle.

[0038] General operation of drier 1 is clearly inferable from the above description, with no further explanation required.

[0039] Positioning the steam injection nozzle 22 in front of the perforated end wall 3a of drying drum 3 has lots of advantages: first and foremost, the possibility to use a single electric motor - i.e. electric motor 12 - for driving both drying drum 3 and centrifugal fan 9, thus drastically reducing manufacturing costs.

[0040] In fact, unlike known laundry driers with steam generator, in laundry drier 1 the steam jets are taken into the drying drum 3 by the stream of hot air entering in drying drum 3 via the perforated end wall 3a, thus performing a "drift" steam de-wrinkling of the fabrics in drum 3.

[0041] In other words, the air circulation generated by hot-air generator 7 helps in performing an optimal steam de-wrinkling of the fabrics in drum 3, and should not be

discontinue during rotation of drying drum 3 in both rotating direction.

[0042] In fact, likewise centrifugal fans used in known laundry driers, centrifugal fan 9 is structured to produce an airflow f flowing from the intake end of recirculating conduit 8 to the exhaust end of recirculating conduit 8 irrespective of the rotating direction of the impeller/rotor of the fan.

[0043] Clearly, changes may be made to home laundry drier 1 as described herein without, however, departing from the scope of the present invention.

[0044] For example, electric motor 12 of motor assembly 6 may be mechanically coupled also to cooling fan 29 of heat exchanger 10. In which case, therefore, electric motor 12 drives at the same time drying drum 3, centrifugal fan 9 and cooling fan 29.

[0045] In a further not-shown embodiment, steam exhaust manifold 23 may extend up to steam injection nozzle 22 inside the end portion of recirculating conduit 8.

Claims

1. A home laundry drier (1) comprising an outer box casing (2) and, inside the casing, a drying drum (3) for housing the laundry to be dried, a hot-air generator (7) for circulating a stream of hot air inside said drying drum (3), and a steam generator (20) for feeding steam into said drying drum (3); the drying drum (3) being fixed inside the casing (2) for rotating about its longitudinal axis (L), and said laundry drier (1) being provided with driving means (6) for rotating, on command, the drying drum (3) about its longitudinal axis (L); the end wall (3a) of the drying drum (3) being permeable to air to permit air entry into the drum (3), and the hot-air generator (7) comprising an air recirculating conduit (8) having its exhaust end coupled to the end wall (3a) of said drying drum (3), and ventilating means (9) to produce, along said recirculating conduit (8), an airflow (f) entering in the drying drum (3) via its end wall (3a); the driving means (6) comprising an electric motor (12) mechanically coupled to the drying drum (3) for rotating, on command, the latter about its longitudinal axis (L), and said laundry drier (1) being **characterized in that** said electric motor (12) also drives said ventilating means (9), and that said steam generator (20) feeds steam into the drying drum (3) via nozzle (22) faced to the end wall (3a) of said drying drum (3).
2. A home laundry drier as claimed in Claim 1, **characterized in that** said hot-air generator (7) also comprises a heat exchanger (10) located along said recirculating conduit (8) to cool the airflow (f) from the drying drum (3) and condense the surplus moisture in said airflow (f), and heating means (11) located along said recirculating conduit (8) to heat, on command, the airflow (f) flowing out of the heat ex-

changer (10) and back into the drying drum (3).

means (29) for driving them.

3. A home laundry drier as claimed in Claim 1 or 2,
characterized in that said steam generator (20)
comprises electric boiler (21) designed to receive 5
water and immediately convert it into a stream of
low-pressure steam, and a steam exhaust manifold
(23) connecting the outlet of said electric boiler (21)
to said steam nozzle (22) for feeding the low-pres-
sure steam produced by the electric boiler (21) di- 10
rectly to said nozzle (22).

4. A home laundry drier as claimed in Claim 3,
characterized in that said steam generator (20) al-
so comprises a water reservoir (24) communicating 15
with said electric boiler (21).

5. A home laundry drier as claimed in any one of Claims
2-4, **characterized in that** said heat exchanger (10)
is provided with a water canister (15) which collects 20
the liquid distilled water produced inside the heat ex-
changer (10) by condensation of the surplus mois-
ture in the airflow (f) from the drying drum (3), and
with a water drain circuit (16) for draining the distilled
water from said water canister (15). 25

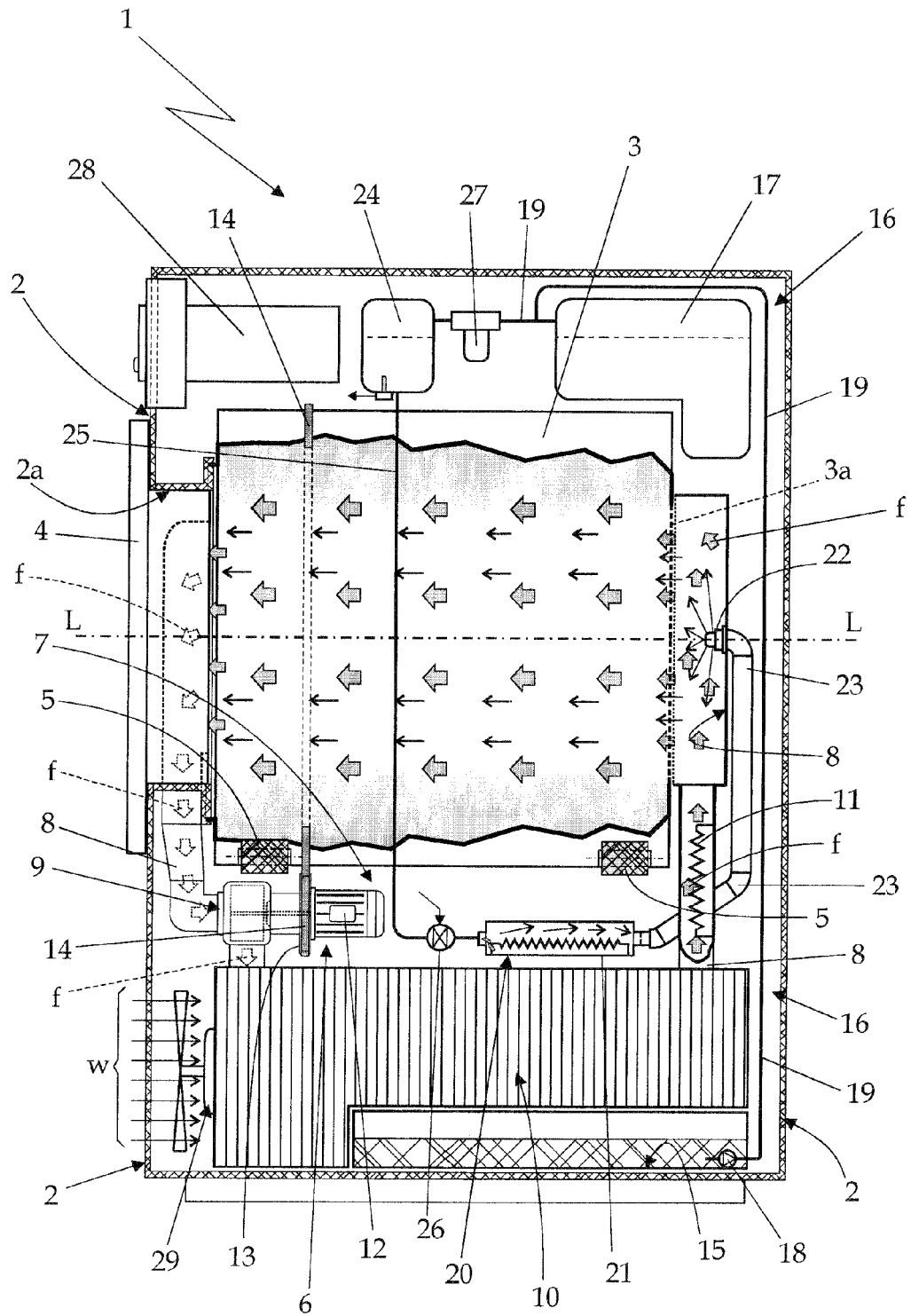
6. A home laundry drier as claimed in Claims 4 and 5,
characterized in that said water reservoir (24) is
connected to the water drain circuit (16) of said hot-
air generator (7), to receive part of the distilled water 30
drained from the water canister (15) of the heat ex-
changer (10).

7. A home laundry drier as claimed in any one of the
foregoing Claims, **characterized in that** the steam 35
nozzle (22) of said steam generator (20) is housed
inside the exhaust end of the air recirculating conduit
(8) of said hot-air generator (7).

8. A home laundry drier as claimed in any one of the 40
foregoing Claims, **characterized in that** the end wall
(3a) of said drying drum (3) is a perforated wall.

9. A home laundry drier as claimed in any one of the 45
foregoing Claims, **characterized in that** said drying
drum (3) is a substantially cylindrical, bell-shaped
drum (3).

10. A home laundry drier as claimed in any one of Claims
2-9, **characterized in that** said heat exchanger (10) 50
is air/air heat exchanger (10) located along said re-
circulating conduit (8) so that the airflow (f) from dry-
ing drum (3) and a second cold airflow (w) from out-
side the casing (2) flow through it simultaneously;
said air/air heat exchanger (10) being provided with 55
second ventilating means (29) which generates said
cold airflow (w), and said electric motor (12) being
mechanically coupled also to said second ventilating





European Patent
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EUROPEAN SEARCH REPORT

Application Number
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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