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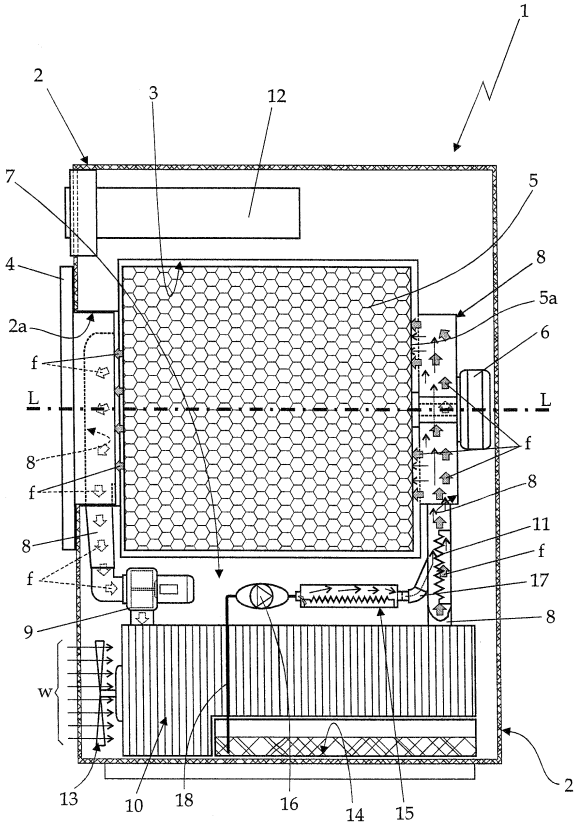
(54) **Home laundry drier**

(57) A home laundry drier (1) provided with a laundry oontainer (3,5) for housing the laundry to be dried, and with a hot-air generator (7) for circulating a stream of hot air into the laundry container (3,5); the hot-air generator (7) comprising an air recirculating conduit (8) connected at both ends to the laundry container (3,5), and a heat exchanger (10) located along the recirculating conduit (8) to cool the airflow (f) from the laundry container (3,5) and condense the surplus moisture in the airflow (f) ; the heat exchanger (10) being provided with a water canister (14) which collects the distilled water produced by condensation of the surplus moisture in the airflow (f) from the laundry container (3,5), with an in-pressure electric boiler (15) located above the heat exchanger (10) and connected to the recirculating conduit (8), with a electric pump (16) located above the water canister (14) and capable to suck the distilled water from the water canister (14) and to pipe it to the electric-boiler (15), and with a central control unit (12) which determines the flow rate of the steam coming out from the electric boiler (15) and controls the electric pump (16) so as that the flow rate of the water supplied to the electric boiler (15) is almost equal to the flow rate of the steam coming out from the electric boiler (15).



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Description

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

[0002] More specifically, the present invention relates to a rotary-drum home laundry drier, to which the following description refers purely by way of example.

[0003] As is known, rotary-drum laundry driers substantially comprise a substantially parallelepiped-shaped outer box casing; a cylindrical laundry 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 laundry drum; and an electric motor for rotating the laundry 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 laundry drum a stream of hot air with a low moisture content and which flows through the laundry 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 laundry drum, on opposite sides of the latter. The air/air heat exchanger provides for rapidly cooling the airflow from the laundry 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 laundry 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 laundry 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 laundry drum to eliminate or at least greatly reduce creasing of the fabrics during the drying cycle.

[0007] Unfortunately, the steam generators currently used in driers have substantially the same structure as ordinary irons with a separate boiler, and so have all the drawbacks typically associated with them : first and foremost, compulsory use of demineralized water in the boiler to prevent the formation of lime scale, which could impair operation of the steam generator.

[0008] More in details, currently used steam generators comprises a demineralized water reservoir which is located in the highest portion of the household appliance so as to facilitate manual refilling of demineralized water; and a steam generation electric boiler which is usually located below the demineralized water reservoir and is in communication with the latter via a connecting pipe. Water flows into the electric boiler for gravity.

[0009] Though highly efficient, today's laundry drier with steam generator consumes a lot of demineralized water during steam cycles, thus requiring high capacity water reservoirs or frequent refilling of the water reservoirs.

[0010] It is an object of the present invention to provide a home laundry drier designed to eliminate the aforementioned drawbacks.

[0011] 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 Claims depending directly or indirectly on Claim 1.

[0012] 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.

[0013] Number 1 in the attached drawing indicates as a whole a home laundry drier substantially comprising a preferably, though not necessarily, parallelepiped-shaped outer box casing 2; an airtight, preferably, though not necessarily, cylindrical laundry drying tub or chamber 3 for housing the laundry to be dried, and which is fixed substantially horizontally inside casing 2, directly facing a laundry loading and unloading opening 2a formed in the front face of casing 2; a door 4 hinged to the front face of casing 2 for rotating to and from a rest position closing opening 2a in the front face to seal the laundry drying tub 3; and a preferably, though not necessarily, cylindrical laundry drum 5 for housing the laundry to be dried, and which is housed in axially rotating manner and preferably, though not necessarily, horizontally inside the drying tub 3.

[0014] More specifically, with reference to the attached drawing, laundry drum 5 is provided with an end wall 5a and possibly a cylindrical lateral wall perforated, or at any rate permeable to air, to permit airflow into the drum 5; and it is mounted for rotation about its longitudinal axis L which, in the example shown, coincides with the longitudinal axis of the drying tub 3.

[0015] Laundry drier 1 also comprises an electric motor 6 or similar, which, on command, rotates laundry drum 5 about longitudinal axis L inside drying tub 3; and a closed-circuit, hot-air generator 7 housed inside casing 2 and designed to circulate through laundry drum 5 a stream of hot air having a low moisture level, and which flows over and rapidly dries the laundry inside drum 5.

[0016] Casing 2, drying tub 3, door 4, laundry drum 5, and electric motor 6 are commonly known parts in the industry, and therefore not described in detail.

[0017] With reference to the attached drawing, closed-circuit, hot-air generator 7 provides for gradually drawing air from drying tub 3; extracting surplus moisture from the hot air drawn from drying tub 3; heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from drying tub 3; and feeding the heated, dehumidified air back into drying tub 3, where it flows over, to rapidly dry, the laundry inside the tub.

[0018] 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 latter, and substantially comprises:

an air recirculating conduit 8, the two ends of which are connected to drying tub 3 preferably, though not necessarily, on opposite sides of laundry drum 5;

an electric 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 tub 3 and over the laundry inside the 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 tub 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 tub 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 tub 3, so that the air flowing into drying tub 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 tub 3.

[0019] More specifically, in the example shown, the intake end of recirculating conduit 8 is integrated in door 4, and the exhaust end of recirculating conduit 8 is coupled directly to drying tub 3, in front of end wall 5a of laundry drum 5.

[0020] Like any other recently marketed electric household appliance, drier 1 also comprises an electronic central control unit 12, which controls electric motor 6, fan 9, heat exchanger 10 (or, rather, the cooling fan 13 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.

[0021] 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 14 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 14 is located in the bottom of heat exchanger 10.

[0022] Unlike known hot-air generators, hot-air generator 7 also comprises an instant in-pressure electric boiler 15 designed to receive a given quantity of water and immediately convert said water into a stream of low-pressure steam whose pressure is slightly higher than external pressure; an electric pump 16 which, on command, sucks the distilled water from water canister 14 and feeds it to electric boiler 15; and a steam exhaust manifold 17 connecting the outlet of electric boiler 15 to recirculating conduit 8 preferably, though not necessarily, upstream from heater 11, to feed the low-pressure steam produced in electric boiler 15 directly to drying tub 3 and laundry drum 5 via the end portion of recirculating conduit 8.

[0023] More specifically, instant in-pressure electric boiler 15 is housed inside casing 2, immediately over heat exchanger 10, and substantially consists of an airtight container housing a resistor dimensioned to immediately vaporize water fed into the airtight container. Next to connection to steam exhaust manifold 17, i.e. next to the outlet of electric boiler 15, the airtight container has a calibrated hole or opening which is dimensioned to slow down steam spillage and increase the pressure of the steam inside the airtight container to above external pressure.

[0024] Likewise electric boiler 15, electric pump 16 is housed inside casing 2 immediately over heat exchanger 10, or at least over water canister 14, and preferably, though not necessarily, side by side to electric boiler 15, and it is structured to suck the distilled water from beneath water canister 14, via an intake pipe 18 connecting the inlet of electric pump 16 to the bottom of water canister 14 across heat exchanger 10.

[0025] In other words, electric pump 16 is dimensioned to produce an inlet suction pressure capable of sucking the distilled water from water canister 14 up to electric boiler 15. More in details, in the example shown electric pump 16 is a self-priming volumetric pump, namely a membrane pump.

[0026] Electric boiler 15 and membrane pump 16 are commonly known parts in the industry, and therefore not described in detail.

[0027] Electronic central control unit 12 obviously controls electric boiler 15, electric pump 16 and the other component parts of hot-air generator 7, such as fan 9 and/or fan 13 of heat exchanger 10, so as to feed steam into drying tub 3 and drum 5 according to the selected drying cycle, and also to feed, when required, a stream of low-pressure steam into drying tub 3 and drum 5.

[0028] As concern membrane electric pump 16 and electric boiler 15, central control unit 12 calculates the instant flow rate of the low-pressure steam coming out from electric boiler 15 according to the electric power supplied to the resistor of electric boiler 15, and to the temperature inside the airtight container of electric boiler 15; and controls electric pump 16 so as that the instant flow rate of the distilled water supplied to electric boiler 15 is almost equal to the instant flow rate of low-pressure steam coming out from electric boiler 15.

[0029] In the example shown, the instant temperature inside the airtight container of electric boiler 15 is determined via a temperature sensor of known type (not shown) housed inside the airtight container.

[0030] In addition to the above, central control unit 12 switches on and off electric boiler 15 according to the selected drying cycle until there is distilled water into wa-

ter canister 14.

[0031] Preferably, though not necessarily, hot-air generator 7 also has a water drain circuit for draining surplus of distilled water from water canister 14. Water drain circuit comprises a manually-removable waste-water tank (not shown) housed in easily removable manner inside casing 2, preferably, though not necessarily, near the top of the casing; and a second electric pump (not shown) which, on command, sucks the distilled water from water canister 14 and feeds it to the waste-water tank.

[0032] More specifically, the second electric pump is switched on in known manner by a floater (not shown) housed in water canister 14, when the water-level in water canister 14 exceeds a given upper threshold value.

[0033] Operation of drier 1 will be clear from the above description, with no further explanation required.

[0034] Integration of steam generator in hot-air generator 7 has lots of advantages: first and foremost, the availability of a large amount of distilled water for steam production, thus saving the user the inconvenience of periodically filling steam generator with distilled/demineralized water.

[0035] Moreover the removal of the demineralized water reservoir on the top of the household appliance makes it possible to reduce household overall dimensions and/or makes more free space available for other devices inside casing 2.

[0036] Clearly, changes may be made to laundry drier 1 as described herein without, however, departing from the scope of the present invention.

[0037] For example, steam exhaust manifold 17 may connect the outlet of electric boiler 15 directly to drying tub 3 and laundry drum 5, bypassing the end portion of recirculating conduit 8.

[0038] In a different embodiment, laundry drier 1 may not have the laundry drying tub or chamber 3, and laundry drum 5 may be mounted in axially rotating manner directly inside casing 2. In which case, only end wall 5a of laundry drum 5 is perforated or permeable to air, and the exhaust end of recirculating conduit 8 is coupled in airtight manner directly to end wall 5a. Moreover the front opening of laundry drum 5 directly faces laundry loading and unloading opening 2a in the front face of casing 2, and door 3, when placed in its rest position, seals in airtight manner directly the front opening of laundry drum 5.

[0039] Furthermore, in a more sophisticated embodiment, hot-air generator 7 may be provided also with a water level sensor (not shown) which is housed inside the airtight container of electric boiler 15 for determining the instant water-level inside the airtight container, and central control unit 12 calculates the instant flow rate of the low-pressure steam coming out from electric boiler 15 according to the signals received form said water level sensor (not shown).

Claims

1. A home laundry drier (1) comprising an outer box casing (2) and inside the latter a laundry container (3, 5) for housing the laundry to be dried, and a hot-air generator (7) for circulating a stream of hot air into the laundry container (3, 5); the hot-air generator (4) comprising an air recirculating conduit (8) connected at both ends to said laundry container (3, 5), and a heat exchanger (10) located along said recirculating conduit (8) to cool the airflow (f) from the laundry container (3, 5) and condense the surplus moisture in said airflow (f); said heat exchanger (10) being provided with a water canister (14) which collects the liquid distilled water produced inside the heat exchanger (10) by condensation of the surplus moisture in the airflow (f) from the laundry container (3, 5); said laundry drier being **characterized in that** the hot-air generator (7) also comprises

- an electric boiler (15) which is located above said heat exchanger (10), and is designed to receive water and convert said water into steam;
- an electric pump (16) which is located above said water canister (14), and is designed to suck, on command, the distilled water from the water canister (14) and to pipe it to said electric boiler (15);
- a steam exhaust manifold (17) for channeling the steam coming out from said electric boiler (15) into the laundry container (3, 5); and
- a central control unit (12) which determines the flow rate of the steam coming out from the electric boiler (15), and controls the electric pump (16) so as that the flow rate of the water supplied to said electric boiler (15) is almost equal to the flow rate of the steam coming out from said electric boiler (15).

2. A home laundry drier as claimed in Claim 1, **characterized in that** said electric boiler (15) is an instant in-pressure electric boiler (15).

3. A home laundry drier as claimed in Claim 1 or 2, **characterized in that** said electric pump (16) is a volumetric pump (16) dimensioned to suck water from said water canister (14) via an intake pipe (18) connecting the inlet of electric pump (16) to the bottom of the water canister (14).

4. A home laundry drier as claimed in Claim 3, **characterized in that** said electric pump (16) is a membrane pump.

5. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said electric pump (16) is located above said heat exchanger (10).

6. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said central control unit (12) calculates the flow rate of the steam coming out from the electric boiler (15) according to electric power supplied to said electric boiler (15), and to the temperature inside said electric boiler (15).

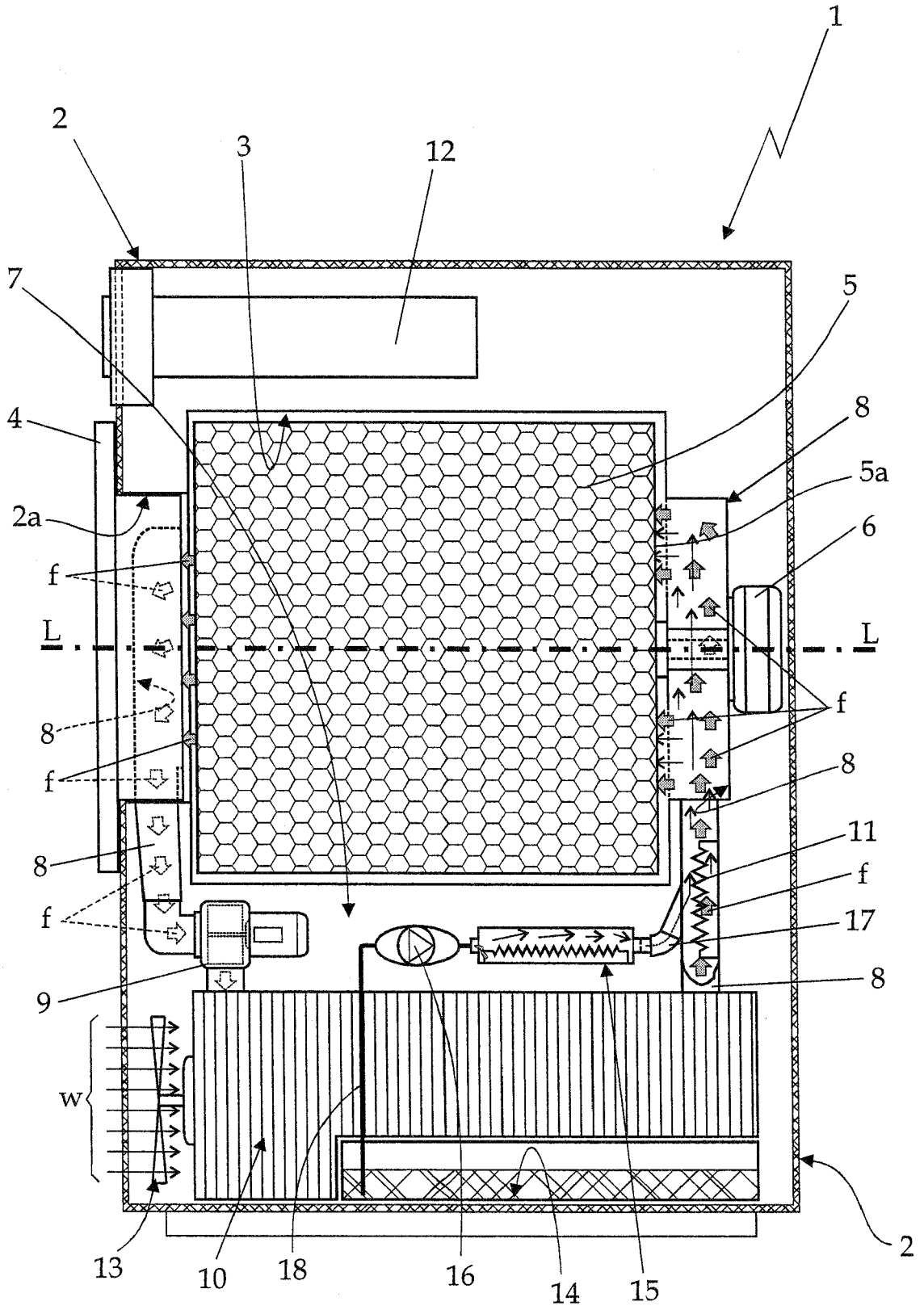
7. A home laundry drier as claimed in any one of Claims 1 to 4, **characterized in that** said hot-air generator (7) is also provided with a water level sensor which determines the water-level inside the electric boiler (15), and said central control unit (12) calculates the flow rate of the steam coming out from said electric boiler (15) according to the signals received form said water level sensor.

8. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said hot-air generator (7) also comprises first heating means (11) located along said recirculating conduit (8) to heat, on command, the airflow (f) flowing out of the heat exchanger (10) and back into the laundry container (3, 5).

9. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said heat exchanger (10) is placed on the bottom of the outer box casing (2), and that said water canister (14) is located in the bottom of said heat exchanger (10).

10. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said laundry container (3, 5) comprises a rotary drum (5) for housing the laundry to be dried, and which is mounted for rotation about its longitudinal axis (L) inside said box casing (2); the laundry drier being also provided with a engine unit (6) for rotating, on command, said drum (5) about its longitudinal axis (L).

11. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said steam exhaust manifold (17) connects said electric boiler (15) to said recirculating conduit (8) to feed the steam produced in said electric boiler (15) into the laundry container (3, 5) via the end portion of said recirculating conduit (8).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EUROPEAN SEARCH REPORT

Application Number
EP 07 11 2495

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	EP 1 441 059 A (ELECTROLUX HOME PROD CORP [BE]) 28 July 2004 (2004-07-28) * the whole document * -----	1-6,8-11	INV. D06F58/20
A	US 2007/006484 A1 (MOSCHUETZ HARALD [DE] ET AL) 11 January 2007 (2007-01-11) * paragraph [0010] - paragraph [0040] * -----	1-5,8-11	
A	US 3 869 815 A (BULLOCK NORMAN J) 11 March 1975 (1975-03-11) * column 2, line 57 - column 2, line 68 * * column 6, line 44 - column 8, line 34 * -----	1-3,6	
A	US 4 519 145 A (MANDEL SHELDON W [US]) 28 May 1985 (1985-05-28) * figure 1 * -----	1,9-11	
			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
The Hague	22 February 2008	Jezierski, Krzysztof

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 11 2495

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