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(54) **Household laundry washing and/or drying appliance and relative operating method**

(57) A household appliance (1) comprising an outer casing (2) having inside a laundry storage compartment (4, 10) for housing the clothing to be cleaned, and an ultraviolet light source (3) for illuminating, on command,

said laundry storage compartment (4) to activate the photocatalyst chemical reactions that dissolve organic stains on any fabric stored therein and which has photocatalyst self-cleaning capabilities.

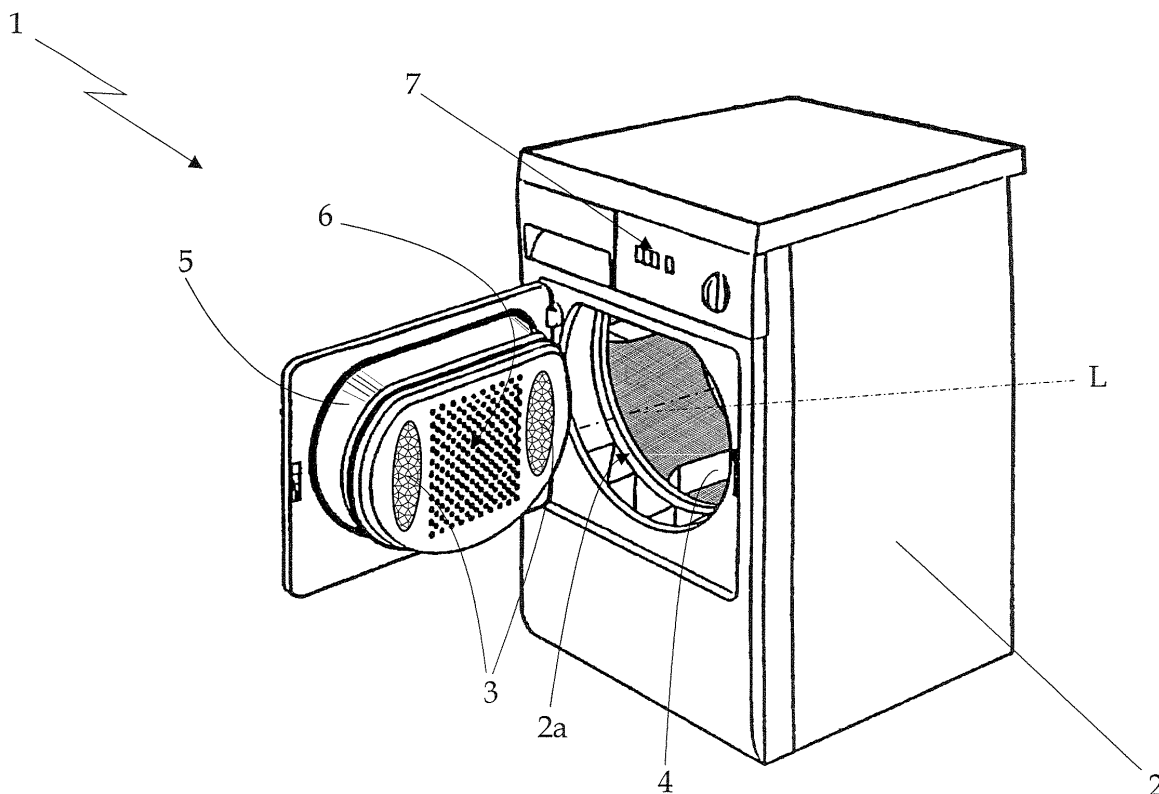


Fig. 1

Description

[0001] The present invention relates to a household laundry washing and/or drying appliance.

[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 usually comprise a substantially parallelepiped-shaped outer casing; a cylindrical bell-shaped drum for housing the laundry to be dried, and which is housed in axially rotating manner inside the casing to rotate about a horizontal longitudinal axis, and 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 casing and the bell-shaped drum; and an electric motor assembly 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 bell-shaped drum a stream of hot air with a low moisture content, and which flows through the bell-shaped drum and over the laundry inside the drum to rapidly dry the laundry.

[0005] It is the aim of the present invention to provide a rotary-drum home laundry drier suitable to be used with recently introduced fabrics having self-cleaning capabilities, such as fabrics coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents able to generate a photocatalyst chemical reaction that dissolve organic stains.

[0006] According to the present invention, there is provided a household appliance as claimed in Claim 1 and preferably, though not necessarily, in any one of the Claims depending directly or indirectly on Claim 1.

[0007] According to the present invention, there is also provided a method of operating a household appliance as claimed in Claim 14.

[0008] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which :

- Figure 1 shows a view in perspective, with parts removed for clarity, of a rotary-drum laundry drier in accordance with the teachings of the present invention; and
- Figure 2 shows a view in perspective, with parts removed for clarity, of a drying cabinet in accordance with the teachings of the present invention.

[0009] With reference to Figure 1, number 1 indicates as a whole a household laundry washing and/or drying appliance suitable to improve self-cleaning capabilities of fabrics coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents.

[0010] Household appliance 1 essentially comprises a outer casing 2 having inside a laundry storage compart-

ment for housing the clothing to be cleaned, and an ultraviolet light source which is housed in casing 2 for lighting up, on command, the laundry storage compartment, so as to activate the photocatalyst chemical reactions that dissolve organic stains on any fabric stored therein and which has photocatalyst self-cleaning capabilities, i.e. on any fabric coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents.

[0011] More specifically, with reference to Figure 1, in the example shown household appliance 1 is a home laundry drier which comprises a preferably, though not necessarily, parallelepiped-shaped outer box-like casing 2; a preferably, though not necessarily, cylindrical bell-shaped revolving drum 4 for housing the laundry to be dried, and which is housed in axially rotating manner inside casing 2 to rotate freely about a preferably, though not necessarily, horizontally-oriented longitudinal axis L, directly facing a laundry loading and unloading opening 2a formed in the front face of casing 2; and a door 5 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 casing 2 and drum 4.

[0012] The laundry storage compartment of household appliance 1 is defined by the empty space inside revolving drum 4.

[0013] Laundry drier 1 also comprises an electric motor assembly (not shown) which, on command, rotates drum 4 about longitudinal axis L inside casing 2; and a closed-circuit, hot-air generator housed inside casing 2 and designed to circulate inside revolving drum 4 a stream of hot air with a low humidity content, and which flows over, to rapidly dry, the laundry inside drum 4.

[0014] More specifically, the hot-air generator provides for gradually drawing air from revolving drum 4; extracting surplus moisture from the hot air drawn from drum 4; heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from revolving drum 4; and feeding the heated, dehumidified air back into revolving drum 4, where it flows over, to rapidly dry, the laundry inside the drum.

[0015] With reference to Figure 1, in particular, in the example shown the hot-air generator draws air from revolving drum 4 (i.e. from the laundry storage compartment of household appliance 1) via an inlet 6 formed in the door 5 inner wall which is faced to the front opening of revolving drum 4 when the latter is in its rest position, and feeds the heated, dehumidified air back into revolving drum 4 (i.e. into the laundry storage compartment of household appliance 1) via an outlet (not shown) coupled in airtight manner directly to the perforated, or at any rate permeable to air, end wall of revolving drum 4.

[0016] Casing 2, revolving drum 4, door 5, the electric motor assembly, and the hot-air generator are commonly known parts in the industry, and therefore not described in detail.

[0017] As regards the ultraviolet light source, with reference to Figure 1, unlike known home laundry driers, door 5 of laundry drier 1 is provided with at least one

electric ultraviolet light lamp 3 which is positioned on the inner wall of door 5 so as to be faced to the end wall of revolving drum 4 when door 5 is in its rest position, and which, on command, is able to light up the inside of drum 4 (i.e. the laundry storage compartment of household appliance 1) with an ultraviolet light having a wavelength or a wavelengths spectrum comprised between 370 nanometers and 10 nanometers (i.e. a wavelength/s within the ultraviolet light spectrum), so as to activate the photocatalyst self-cleaning capabilities of any clothing stored inside revolving drum 4 and made at least partially of fabrics coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents.

[0018] More specifically, the at least one electric ultraviolet light lamp 3 is turned on and off by the electronic central control unit (not shown) of laundry drier 1, according to a user-selected photocatalyst cleaning cycle characterized by a specific switching-on time-limit of the ultraviolet light lamp 3.

[0019] In other words, a given number of different photocatalyst cleaning cycles, each characterized by a specific switching-on time-limit of the ultraviolet light lamp 3, may be stored in the electronic central control unit (not shown) of laundry drier 1, and the user can manually select the desired photocatalyst cleaning cycle, i.e. the desired switching-on time-limit of the ultraviolet light lamp 3, via the external control panel 7 of laundry drier 1.

[0020] With reference to Figure 1, in the example shown laundry drier 1 is provided with two ultraviolet electric lamps 3 preferably, though not necessarily, of fluorescent type, which are recessed on the inner wall of door 5 on both sides of hot-air generator inlet 6.

[0021] Alternatively, the ultraviolet light source may use ultraviolet LED lamps or ultraviolet Semiconductor Light Matrix (SLM) lamps or other types of ultraviolet light lamps belonging to the electric arc lamp family.

[0022] Obviously, providing suitable watertight electrical connections, the ultraviolet light source may comprise a number of ultraviolet light lamps 3, each of which is recessed into a respective longitudinal projecting rib realized on the inner surface of the cylindrical wall of revolving drum 4.

[0023] Preferably, though not necessarily, the ultraviolet light source may also comprise an electronic power control unit (not shown) which drives lamp 3 to control the candlepower of the ultraviolet light emitted by lamp 3. This electronic power control unit, in turn, may be electrically connected to the electronic central control unit (not shown) of laundry drier 1, for allowing said electronic central control unit to control the candlepower of the ultraviolet light emitted by lamp 3 according to the user-selected photocatalyst cleaning cycle.

[0024] In other words, via the laundry drier external control panel 7, the user can manually select the desired switching-on time-limit of the ultraviolet light lamp 3 and the desired or most appropriate candlepower of the ultraviolet light illuminating the inside of revolving drum 4 (i.e. the laundry storage compartment of household ap-

pliance 1), to optimize the photocatalyst self-cleaning capabilities of the particular photocatalyst chemical agents currently inside revolving drum 4.

[0025] In addition to the above, in a much more sophisticated embodiment, electric lamp 3 may be able to emit an ultraviolet light having any wavelength or any wavelengths spectrum comprised between 370 nanometers and 10 nanometers (i.e. any wavelength within the ultraviolet light spectrum), and the electronic power control unit (not shown) which drives lamp 3 also controls the wavelength of the ultraviolet light emitted by lamp 3.

[0026] Also in this embodiment, the electronic power control unit may be electrically connected to the electronic central control unit (not shown) of laundry drier 1, for allowing said electronic central control unit to regulate the wavelength or wavelengths spectrum of the ultraviolet light emitted by lamp 3 according to a user-selected photocatalyst cleaning cycle.

[0027] In other words, via the laundry drier external control panel 7, the user can also manually select the most appropriate wavelength or wavelengths spectrum of the ultraviolet light illuminating the inside of revolving drum 4 (i.e. the laundry storage compartment of household appliance 1) to maximize the photocatalyst self-cleaning capabilities of the particular photocatalyst chemical agents currently inside revolving drum 4.

[0028] General operation of laundry drier 1 is clearly inferable from the above description with no further explanation required, other than to state that, via the laundry drier external control panel 7, the user can request laundry dryer 1 to perform a photocatalyst cleaning cycle comprising the step of switching on the ultraviolet light lamp 3 for a given switching-on time-limit, to illuminate the laundry storage compartment (i.e. the inside of revolving drum 4) for activating the photocatalyst chemical reactions that dissolve organic stains on any fabric stored therein and which has photocatalyst self-cleaning capabilities.

[0029] The presence of the ultraviolet light source 3 has lots of advantages. Laundry drier 1 can be used for both drying moist laundry like known home laundry driers, or activating the photocatalyst self-cleaning capabilities of any fabric coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents on cloudy days.

[0030] If candlepower of the ultraviolet light emitted by lamp 3 is greater than that of the ultraviolet component of direct sunlight, laundry drier 1 can also be used for accelerating the photocatalyst chemical reaction that dissolve organic stains, thus reducing the time requested for self-cleaning to any fabric coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents.

[0031] Clearly, changes may be made to household appliance 1 as described herein without, however, departing from the scope of the present invention.

[0032] For example, household appliance 1 may be a home laundry washing machine. In which case, revolving

drum 4 is housed in axially rotating manner into a watertight, preferably, though not necessarily, substantially bell-shaped washing tub which is suspended horizontally and in floating manner inside casing 2 via a suspension system comprising a number of coil springs combined with one or more vibration dampers.

[0033] More specifically, the front opening of the washing tub is watertight connected to opening 2a on the front face of casing 2 via a cylindrical elastic-deformable bellows, and door 5 is hinged to the front face of casing 2 to rotate to and from a rest position in which door 5 closes opening 2a of casing 2 to watertight seal the washing tub.

[0034] In which case, the ultraviolet light lamp 3 may be located either on the inner wall of door 5 as disclosed above, or into a suitable seat realized on the cylindrical bellows connecting the front opening of the washing tub to the laundry loading and unloading opening 2a on the front face of casing 2.

[0035] Obviously, providing suitable watertight electrical connections, the ultraviolet light source may consist of a number of ultraviolet light lamps 3, each of which is recessed into a respective longitudinal projecting rib realized on the cylindrical wall of revolving drum 4.

[0036] With reference to Figure 2, in a further different embodiment household appliance 1 may be a wardrobe-like drying cabinet preferably, though not necessarily, suitable to be placed on the worktop of a traditional laundry washing machine.

[0037] More specifically, in this embodiment casing 2 consists of a parallelepiped-shaped inner foldable supporting frame comprising a bottom base plate 8 and a top base plate 9 rigidly connected one to the other via a number of foldable vertical uprights (not shown); and of a tubular-shaped external envelop 10 wrapping the inner foldable supporting frame to define on the inside a parallelepiped-shaped laundry storage compartment where to hang the clothing to be cleaned, and which is provided with a vertical zipper 11 allowing the user to manually open envelop 10 to put the clothing in the laundry storage compartment.

[0038] The ultraviolet light source, in turn, comprises one or more electric ultraviolet light lamps 3 housed into, or at least faced to, the parallelepiped-shaped laundry storage compartment for illuminating, on command, the clothing placed therein, so as to activate the photocatalyst self-cleaning capabilities of any fabric coated with nano-particles including titanium dioxide or similar photocatalyst chemical agents.

[0039] More specifically, with reference to Figure 2, to ensure uniform illumination of the clothing hanging inside the parallelepiped-shaped laundry storage compartment, the ultraviolet light source preferably, though not necessarily, comprises a first electric ultraviolet light lamp 3 recessed into bottom base plate 8 for illuminating the clothing from below, and a second electric ultraviolet light lamp 3 recessed into top base plate 9 for illuminating the clothing from top.

[0040] Also in this case, drying cabinet 1 comprises an

electronic central control unit (not shown) which turns on and off the ultraviolet light lamp/s 3 according to a user-selected photocatalyst cleaning cycle.

Claims

1. A household appliance (1) comprising an outer casing (2) having inside a laundry storage compartment (4, 10) for housing the clothing to be cleaned, and **characterized by** also comprising an ultraviolet light source (3) for illuminating, on command, said laundry storage compartment (4) to activate the photocatalyst chemical reactions that dissolve organic stains on any fabric stored therein and which has photocatalyst self-cleaning capabilities.
2. A household appliance as claimed in Claim 1, **characterized by** also comprising an electronic central control unit which turns on and off said ultraviolet light source (3) according to a user-selected photocatalyst cleaning cycle.
3. A household appliance as claimed in Claim 1 or 2, wherein said ultraviolet light source (3) comprises at least one ultraviolet light lamp (3) which is faced to said laundry storage compartment (4, 10) and emits light having a wavelength or a wavelengths spectrum comprised between 370 nanometers and 10 nanometers.
4. A household appliance as claimed in Claim 3, wherein said ultraviolet light source (3) also comprises an electronic power control unit which drives said at least one ultraviolet light lamp (3) to control the candlepower and/or select the wavelength or wavelengths spectrum of the ultraviolet light emitted by said lamp (3).
5. A household appliance as claimed as claimed in anyone of Claims 2 to 4, wherein said electronic central control unit is connected to an external control panel (7) of said household appliance (1) for allowing the user to manually select the switching-on time-limit of the ultraviolet light source (3), and/or the candlepower of the ultraviolet light emitted by said ultraviolet light source (3), and/or the wavelength or wavelengths spectrum of the ultraviolet light emitted by said ultraviolet light source (3).
6. A household appliance as claimed in anyone of the foregoing Claims, **characterized by** also comprising a bell-shaped revolving drum (4) which is housed in axially rotating manner inside the casing (2), directly facing a laundry loading and unloading opening (2a) formed in a main face of said casing (2), and a door (5) hinged to the main face of the casing (2) to rotate to and from a rest position closing said laundry storage compartment.

dry loading and unloading opening (2a) to seal the casing (2) and the revolving drum (4); the space inside the revolving drum (4) defining the laundry storage compartment of the household appliance (1).

7. A household appliance as claimed in Claim 6, **characterized by** also comprising a hot-air generator which is housed inside the casing (2) and is designed to circulate inside the revolving drum (4) a stream of hot air with a low humidity content, and which flows over, to rapidly dry, the laundry inside drum (4).
8. A household appliance as claimed in Claim 6, wherein the revolving drum (4) is housed in axially rotating manner into a substantially bell-shaped washing tub which is suspended in floating manner inside the casing (2); the front opening of said washing tub being watertight connected to said laundry loading and unloading opening (2a) on the main face of the casing (2) via a cylindrical elastic-deformable bellows, and said door (5) being hinged to said main front face of the casing (2) to rotate to and from a rest position in which the door (5) closes said laundry loading and unloading opening (2a) to watertight seal said washing tub.
9. A household appliance as claimed in Claim 6 or 8, wherein said at least one ultraviolet light lamp (3) is recessed in said door (5) so as to be faced to the end wall of said revolving drum (4) when the door (5) is in its rest position.
10. A household appliance as claimed in anyone of Claims 1 to 5, wherein said casing (2) comprises a parallelepiped-shaped inner foldable supporting frame (8, 9) and an external envelop (10) wrapping said inner foldable supporting frame (8, 9) to define on the inside a parallelepiped-shaped laundry storage compartment where to hang the clothing to be cleaned.
11. A household appliance as claimed in Claim 10, wherein said external envelop (10) is provided with a zipper (11) allowing the user to manually open the envelop (10) to put the clothing in the laundry storage compartment.
12. A household appliance as claimed in Claim 10 or 11, wherein said inner foldable supporting frame comprises a bottom base plate (8) and a top base plate (9) rigidly connected one to the other via a number of vertical uprights; said ultraviolet light source (3) comprising at least one ultraviolet light lamp (3) recessed in said bottom base plate (8) and/or in said top base plate (9).
13. A household appliance as claimed in any one of

Claims 3 to 12, wherein said ultraviolet light lamp (3) is an electric arc lamp or a LED lamp or a Semiconductor Light Matrix (SLM) lamp.

- 5 14. Operating method of a household appliance (1) comprising an outer casing (2) having inside a laundry storage compartment (4, 10) for housing the clothing to be cleaned, and an ultraviolet light source (3) for illuminating, on command, the laundry storage compartment (4); said operating method being **characterized by** comprising the step of switching on said ultraviolet light source (3) for a given switching-on time-limit, to activate the photocatalyst chemical reactions that dissolve organic stains on any fabric stored therein and which has photocatalyst self-cleaning capabilities.

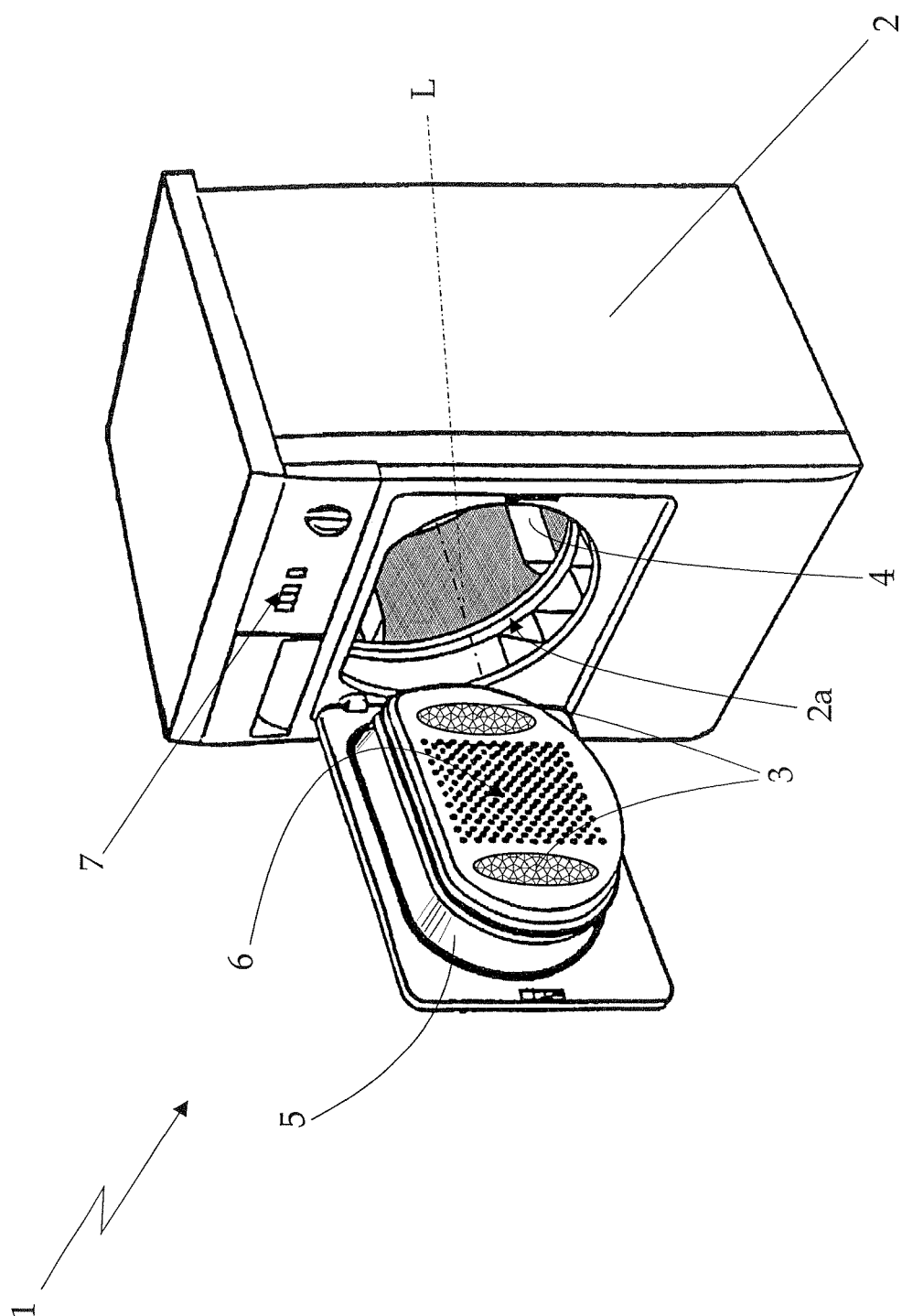


Fig. 1

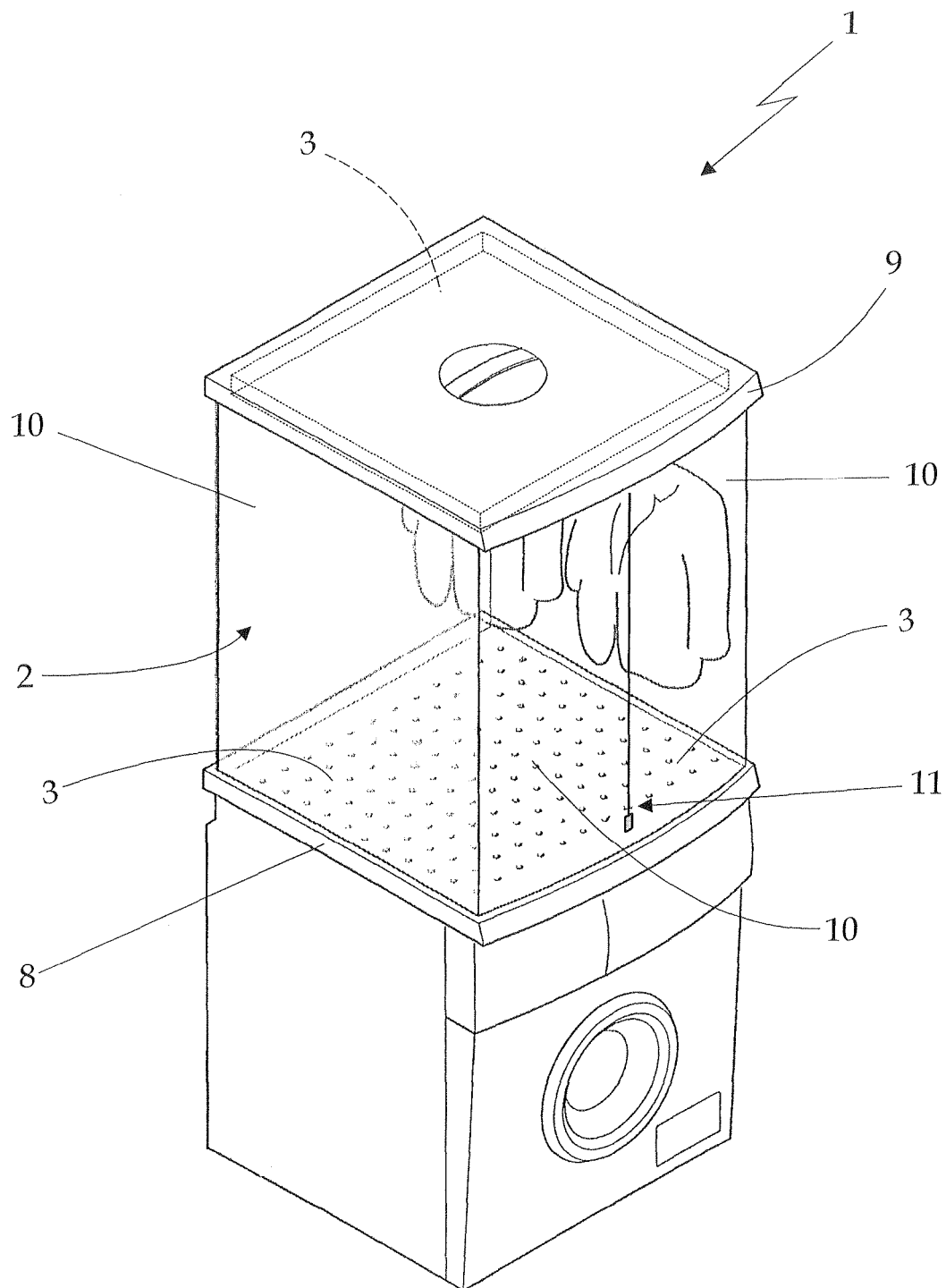


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 08 15 4989

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 October 2008	Examiner Fachin, Fabiano
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	

 3
EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 08 15 4989

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 October 2008	Examiner Fachin, Fabiano
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 (P04C01)



Application Number

EP 08 15 4989

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION
SHEET B

Application Number

EP 08 15 4989

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9,14

Household appliance and operating method of the same using an ultraviolet light source to dissolve organic stains on a fabric having photocatalyst self cleaning capabilities.

2. claims: claims 10-13

Household appliance comprising a foldable supporting frame and an external envelop wrapping said frame.

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

EP 08 15 4989

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.

08-10-2008

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EPO FORM P0459

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