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(54) **CLOTHES DRYER**

(57) A clothes dryer includes an inner tub (2, 200 for accommodating clothes and an outer tub (3, 300) arranged around the inner tub. An inner tub wall (21) has first holes (22) in dense distribution to be in spatial communication with the outer tub. A cooling water supply device (8, 801) is connected with an outer tub wall (31, 320) to supply cooling water required for a drying process to an inner surface (30, 3002) of the outer tub wall. The cooling water supply device includes a water outlet region. The inner surface of the outer tub wall has a hydrophilically treated region below the water outlet region (810, 8100), and the rest is a hydrophobic region, such that the cooling water is dispersed and flows in the hydrophilically treated region to form a water film, increasing a heat exchange area.

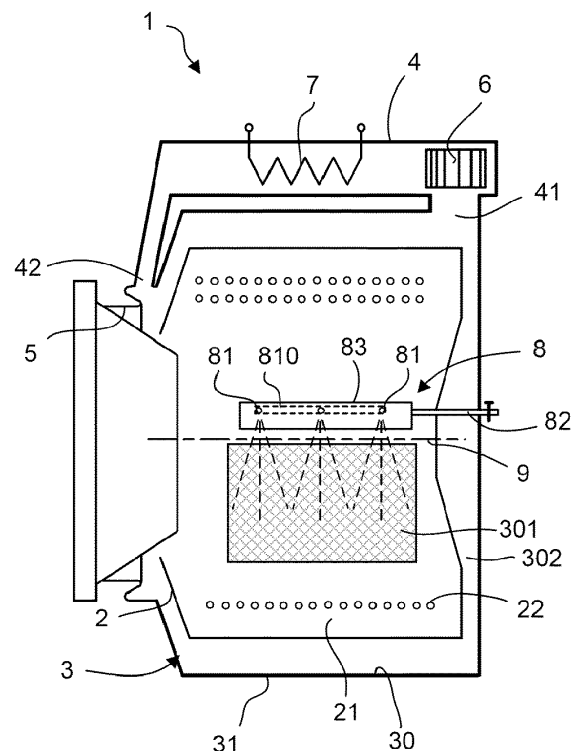


FIG. 1

Description

[0001] The present invention relates to a clothes dryer, including an inner tub for accommodating clothes and an outer tub arranged around the inner tub. An inner tub wall has first holes in dense distribution to be in spatial communication with the outer tub. A cooling water supply device is connected with an outer tub wall to supply cooling water required for a drying process to an inner surface of the outer tub wall. The cooling water supply device includes a water outlet region.

A U.S. invention patent with the publication patent No. of US 6,279,357 B1 discloses a washer dryer. The washer dryer has a drum installed in an outer tub through a spider. A rear wall of the outer tub has recesses. Water flows to the rear wall of the outer tub from a water inlet device. In a drying mode, the drum rotates, and moist air leaves the drum and is agitated under the rotation of the drum. The flowing water is in contact with the moist air, so as to improve the condensing effect on the air before the air is heated and returns back to the drum along a circulation path.

The present invention aims to make a clothes dryer have a relatively high heat exchange efficiency. The present invention provides a clothes dryer, including an inner tub for accommodating clothes and an outer tub arranged around the inner tub. An inner tub wall has first holes in dense distribution to be in spatial communication with the outer tub. A cooling water supply device is connected with an outer tub wall to supply cooling water required for a drying process to an inner surface of the outer tub wall. The cooling water supply device includes a water outlet region. The inner surface of the outer tub wall has a hydrophilically treated first region below the water outlet region, and the rest of the inner surface of the outer tub wall is a hydrophobic second region. A relatively large portion of an inner surface of an inner tub wall is hydrophobic to reduce residues of foam and washing water, and meanwhile, facilitate cleaning, thus being more sanitary. However, after falling onto the surface of the hydrophobic inner tub wall, cooling water may flow in a cylindrical trickle form, which leads to a small contact area with process air involved in drying, resulting in low heat exchange efficiency. After the first region is hydrophilically treated, the cooling water flows out of the water outlet region and flows down along the first region. In this case, water flow spreads along the inner surface of the outer tub wall to form a water film so as to have a relatively large contact area with the process air, and the heat exchange efficiency is also increased accordingly.

[0002] Hydrophilic treatment may include at least one of electrical spark etching, laser etching, spraying hydrophilic coating, and plasma treatment.

[0003] As one of embodiments, the water outlet region includes a group of second holes located on the outer tub wall, and the second holes are horizontally or obliquely arranged. The cooling water flows out of the second holes and forms a plurality of rows of water flow after

contacting with the inner surface of the outer tub wall. The plurality of rows of water flow spreads transversely while flowing down along the first region to form a large-area water film, so as to better exchange heat with the process air, condensing moisture in the process air.

[0004] As one of the embodiments, the hydrophilic first region is located on an inclined or curved surface facing upwards.

[0005] The cooling water supply device may be connected with a cylindrical side wall of the outer tub, and the first region is located on the inner surface of the side wall of the outer tub.

[0006] The first region may be located at a lower position relative to a central axis of the outer tub.

The clothes dryer further includes a fan associated with the outer tub to propel the process air in the outer tub to flow, and a heating device associated with the outer tub to heat the process air.

[0007] An inlet and an outlet of an air passage are in fluid connection with a rear portion of the outer tub and a front portion of the outer tub, respectively, and the fan and the heating device are located in the air passage. The fluid connection may be referred to as that a wall of the air passage is directly or indirectly connected with the outer tub, such that the air passage is in spatial connection with the outer tub to form a fluid loop.

[0008] Specific embodiments of the present invention will be exemplified below with reference to the accompanying drawings.

FIG. 1 is a side view showing main functional components of a clothes dryer according to Embodiment 1;

FIG. 2 is a partial view of a side wall of an outer tub; and

FIG. 3 is a side view showing main functional components of a clothes dryer according to Embodiment 2.

As shown in FIG. 1, the clothes dryer 1 according to Embodiment 1 has a rotatable inner tub 2 for accommodating clothes and an outer tub 3 arranged around the inner tub 2. The inner tub 2 and the outer tub 3 are substantially coaxially arranged, and axially substantially horizontal. An inner tub wall 21 has first holes 22 in dense distribution to be in spatial communication with the outer tub 3. A rear end of the outer tub 3 is connected to an inlet 41 of an air passage 4. An outlet 42 of the air passage 4 is connected with a sealing ring 5 installed on a front portion of the outer tub 3, such that the air passage 4 and the outer tub 3 form a communicating space. A fan 6 and a heating device 7 are arranged in the air passage 4.

A cooling water supply device 8 is connected with a cylindrical side wall 31 of the outer tub 3. The cooling water supply device 8 has a group of second holes 81 horizontally arranged on the side wall 31 of the outer tub. The

cooling water supply device 8 further includes a supply pipeline 82 and a water distribution device 83 connected to the supply pipeline 82. Cooling water enters the water distribution device 83 from the supply pipeline 82 to be buffered, and then enters the outer tub 3 through the second holes 81.

[0009] As shown in FIG. 1 and FIG. 2, an entire inner surface 30 of the outer tub 3 is prefabricated to be hydrophobic, and then hydrophilically treated below a water outlet region 810 where the second holes 81 are located, such that a hydrophilically treated first region 301 is formed on the inner surface 30 of the side wall 31 of the outer tub below the water outlet region, and the rest of the inner surface 30 of the outer tub 3 is a hydrophobic second region 302.

[0010] Hydrophilic treatment includes at least one of electrical spark etching, laser etching, spraying hydrophilic coating, and plasma treatment.

[0011] The first region 301 is located at a lower position relative to a central axis 9 of the outer tub 3. At this position, the hydrophilic first region 301 is curved upwards. The cooling water supply device 8 is close to a horizontal plane where the central axis 9 is located. The cooling water flows out of the second holes 81 and then flows to the hydrophilic first region 301 under the action of gravity to form a water film.

[0012] In a drying process, the fan 6 is started to circulate process air for drying between the air passage 4 and the outer tub 3. The heating device 7 heats the process air passing through the air passage 4. The high-temperature process air enters the outer tub 3 and the inner tub 2 placed inside the outer tub 3 to evaporate moisture in the clothes. The cooling water supply device 8 supplies the cooling water to the outer tub 3. The high-temperature and high-humidity process air exchanges heat with the cooling water film when passing through the first region 301. A temperature of the process air drops, such that the carried moisture is condensed into water and separated from the process air. The dry process air enters the air passage 4 to be reheated to enter a next cycle, such that the moisture in the clothes is gradually dried.

[0013] The cooling water supply devices 8 may be respectively arranged on both sides of the outer tub 3.

[0014] In Embodiment 2 as shown in FIG. 3, an inner tub 200 and an outer tub 300 of a clothes dryer 100 are inclined upwards. A rear wall 320 of the outer tub 300 is provided with a cooling water supply device 801. The cooling water supply device 801 is the same as or similar to the cooling water supply device 8 of Embodiment 1 in structure.

[0015] An inner surface 3002 of the rear wall 320 of the outer tub has a hydrophilically treated first region 303 below a water outlet region 8100 of the cooling water supply device 801. The first region 303 is inclined upwards to facilitate the downward flowing of water flow along a surface of the region. The rest of the inner surface 3000 of the outer tub 300 is a hydrophobic second region 304.

[0016] Specific embodiments described above and illustrated in the accompanying drawings are merely intended to describe the present invention. Any form of variations made by a person of ordinary skill in the art to the present invention within the scope of the basic technical idea of the present invention falls within the protection scope of the present invention.

10 Claims

1. A clothes dryer, comprising an inner tub (2, 200) for accommodating clothes and an outer tub (3, 300) arranged around the inner tub, an inner tub wall (21) having first holes (22) in dense distribution to be in spatial communication with the outer tub, a cooling water supply device (8, 801) being connected with an outer tub wall (31, 320) to supply cooling water required for a drying process to an inner surface (30, 3002) of the outer tub wall, and the cooling water supply device comprising a water outlet region (810, 8100), wherein the inner surface of the outer tub wall has a hydrophilically treated first region (301, 303) below the water outlet region, and the rest of the inner surface of the outer tub wall is a hydrophobic second region (302, 304).
2. The clothes dryer according to claim 1, wherein the hydrophilic treatment comprises at least one of electrical spark etching, laser etching, spraying hydrophilic coating, and plasma treatment.
3. The clothes dryer according to claim 1, wherein the water outlet region comprises a group of second holes (81) located on the outer tub wall, and the second holes are horizontally or obliquely arranged.
4. The clothes dryer according to claim 1, wherein the hydrophilic first region is located on an inclined or curved surface facing upwards.
5. The clothes dryer according to claim 1, wherein the cooling water supply device (8) is connected with a cylindrical side wall (31) of the outer tub, and the first region (301) is located on the inner surface (30) of the side wall of the outer tub.
6. The clothes dryer according to claim 5, wherein the first region is located at a lower position relative to a central axis (9) of the outer tub.
7. The clothes dryer according to claim 1, comprising a fan (6) associated with the outer tub to propel process air in the outer tub to flow, and a heating device (7) associated with the outer tub to heat the process air.
8. The clothes dryer according to claim 7, wherein an

inlet (41) and an outlet (42) of an air passage (4) are in fluid connection with a rear portion of the outer tub and a front portion of the outer tub, respectively, and the fan and the heating device are located in the air passage.

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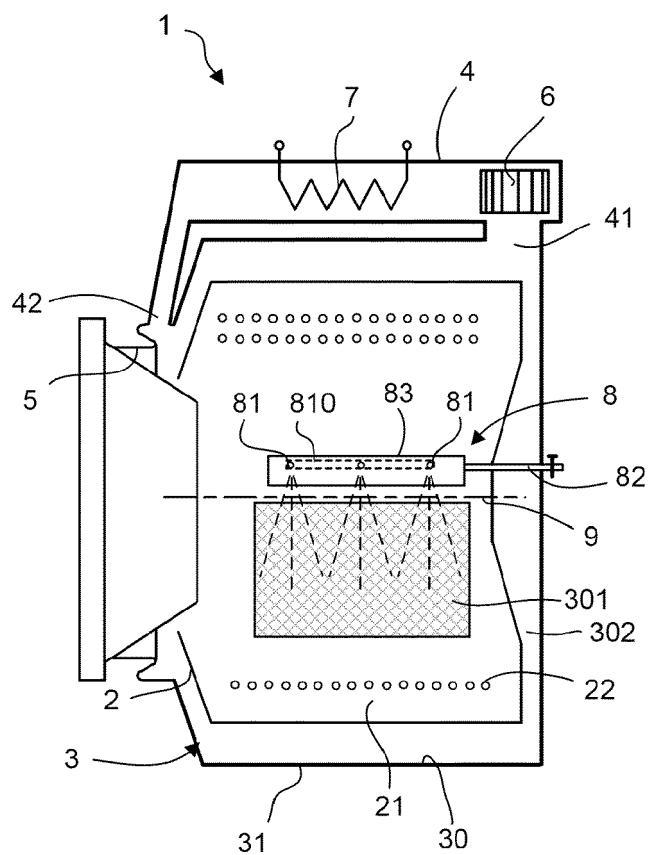


FIG. 1

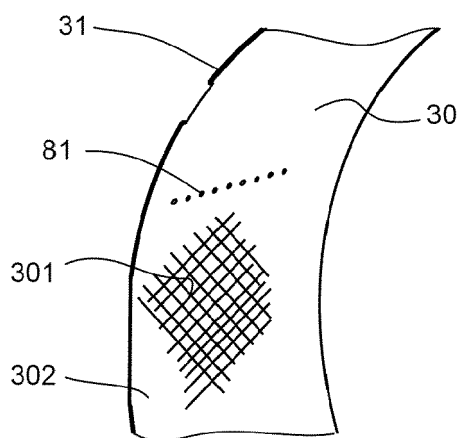


FIG. 2

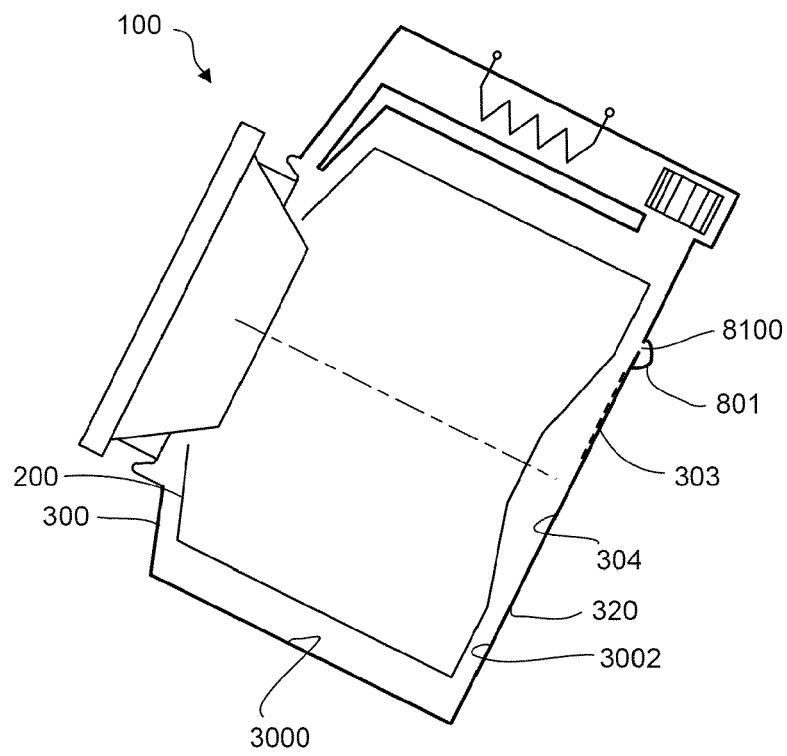


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 19 21 3099

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A	US 2003/233854 A1 (MATSUDA EIJI [JP] ET AL) 25 December 2003 (2003-12-25) * paragraph [0038] - paragraph [0040]; figures 1, 4-5 *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F F28F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 February 2020	Examiner Diaz y Diaz-Caneja
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

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

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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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