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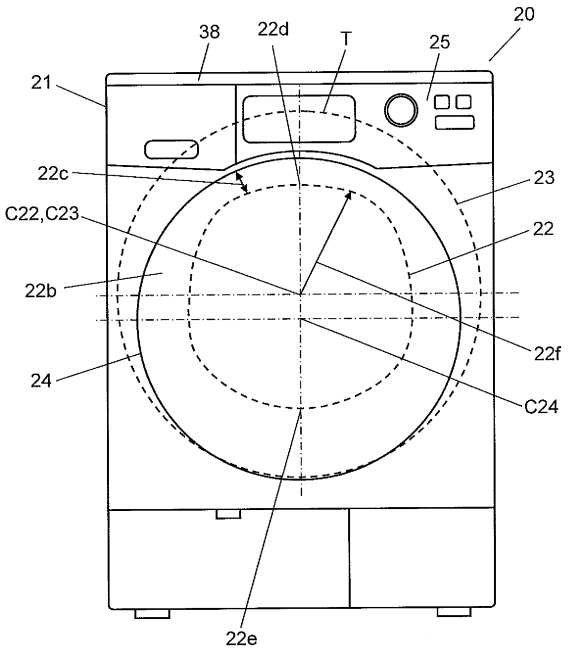
(54) CLOTHES DRYER

(57) A clothes dryer (20) in the present invention includes: a housing (21) having an opening (22) formed at a front face, for loading and unloading an object to be dried; a door (24) that closes the opening (22); an operating unit (25) that is provided at a top of the front face of the housing (21);a rotating drum (23) that holds the object to be dried; and a hot air generator that is provided below the rotating drum, and generates hot air blown into the rotating drum (23).The opening (22) has a center positioned approximately on a rotation axis of the rotating drum (23), and, furthermore, the opening (22) is an approximate quadrilateral.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to a clothes dryer for drying clothes.

BACKGROUND ART

[0002] A conventional clothes dryer, as illustrated in FIG. 6, has within housing 11, rotating drum 10 that holds clothes. The conventional clothes dryer dries the clothes by tumbling the clothes by rotating drum 10 and sending hot air through the clothes. Furthermore, the clothes dryer has opening 13 at front face 12 of housing 11. The clothes are loaded and unloaded through opening 13. Moreover, the clothes dryer has door 14 that closes opening 13 (see Patent Literature (PTL) 1).

[0003] Rotating drum 10, opening 13, and door 14 of the conventional clothes dryer are approximately concentrically arranged. In other words, a center of opening 13 and a center of closed door 14 are positioned on an extension of rotation axis A of rotating drum 10. Accordingly, opening 13 can be enlarged. This, in turn, makes it easier for a user to load and unload clothes. It is noted that opening 13 of the conventional clothes dryer disclosed in PTL 1 is what is referred to as a D-shaped opening in which a lower part of a circle is partially removed.

[0004] In order to reduce power consumption, some clothes dryers utilize a heat pump, instead of an electrical heater, as a heat source to generate hot air. Since the heat pump is large and heavy, the heat pump is usually provided in a lower part of housing 11. Rotating drum 10 of the clothes dryer should be large in order to increase load capacity, and the resulting rotating drum 10 is large in diameter. This narrows the space under a bottom edge of rotating drum 10. Thus, when the heat pump is provided in the lower part of housing 11 in the clothes dryer disclosed in PTL 1, the position of rotating drum 10 needs to be moved higher. Moreover, even if a heat pump were not used, there are cases where sufficient space is necessary under rotating drum 10 in order to improve efficiency in generation of hot air. In addition, the center of opening 13 and the center of rotating drum 10 are preferably aligned in order to facilitate loading and unloading of the clothes.

[0005] However, operating unit 16 is provided at a top of front face 12 of housing 11, which makes it difficult to move opening 13 higher, along with moving rotating drum 10 higher. Consequently, in order to align the center of opening 13 with the center of rotating drum 10, the circular shape of opening 13 needs to be reduced in size. This could make it difficult to load and unload the clothes.

Citation List

Patent Literature

[0006] PTL 1: European Patent No. 2365122

SUMMARY OF THE INVENTION

[0007] The clothes dryer according to the present invention includes: a housing having an opening formed at a front face, the opening being for loading and unloading an object to be dried; a door that closes the opening; an operating unit provided at a top of the front face of the housing; a rotating drum that holds the object to be dried; and a hot air generator that is provided below the rotating drum, and generates hot air that is blown into the rotating drum. Furthermore, the opening has a center positioned approximately on a rotation axis of the rotating drum, and the opening is in an approximate quadrilateral.

[0008] Furthermore, in the present invention, the opening has a rim provided with a contacting lip that contacts the door when the door is closed, and the opening is formed so that, when a contacting lip width is a distance between an end of the opening and a closest outer peripheral end of the contacting lip, the contacting lip width at left and right sides of a top edge of the opening is narrower than the contacting lip width at center of the top edge of the opening.

[0009] Furthermore, in the present invention, the opening is formed so that the contacting lip width at left and right sides of a bottom edge of the opening is narrower than the contacting lip width at center of the bottom edge of the opening.

[0010] Furthermore, in the present invention, the opening is formed so that a distance between the center of the opening and positions left and right of a top edge of the opening is greater than a distance between the center of the opening and a center of the top edge of the opening.

[0011] Furthermore, in the present invention, the opening is formed so that a distance between the center of the opening and positions left and right of a bottom edge of the opening is greater than a distance between the center of the opening and a center of the bottom edge of the opening.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a perspective view of a clothes dryer according to an embodiment of the present invention.
FIG. 2 is a configuration diagram illustrating a lateral cross-section of the clothes dryer according to the embodiment of the present invention.
FIG. 3 is a schematic diagram illustrating a front view of the clothes dryer according to the embodiment of the present invention.
FIG. 4A is a comparative diagram for describing a positional relation between a rotating drum and an opening of the clothes dryer according to the embodiment of the present invention.
FIG. 4B is a comparative diagram for describing a positional relation between the rotating drum and the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 4C is a comparative diagram for describing a positional relation between the rotating drum and the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 4D is a diagram for describing a positional relation between the rotating drum and the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5A is a diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5B is a diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5C is a diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5D is a diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5E is a diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 5F is a comparative diagram illustrating a shape of the opening of the clothes dryer according to the embodiment of the present invention.
FIG. 6 is a perspective view of a conventional clothes dryer.

DESCRIPTION OF EMBODIMENT

[0013] Described hereinafter is a clothes dryer according to an embodiment of the present invention, with reference to the drawings. It is noted that this embodiment shall not limit the present invention.

[0014] FIG. 1 is a perspective view of the clothes dryer according to this embodiment of the present invention. FIG. 2 is a configuration diagram illustrating a lateral cross-section of the clothes dryer according to this embodiment of the present invention.

[0015] At a front face of housing 21 of clothes dryer 20, opening 22 is formed for loading and unloading clothes, which is an object to be dried. The clothes are loaded into rotating drum 23 through opening 22. After the clothes is held inside rotating drum 23, door 24 is closed and a clothes drying operation is carried out. Instructions for the clothes drying operation, and so on, are given through operating unit 25 provided at a top of the front face of housing 21.

[0016] Rotating drum 23 rotates through transmission of force of motor 26 via pulley 27 and belt 28. In addition, motor 26 rotates fan 31 via pulley 29 and belt 30.

[0017] Heat pump 32 is provided as a hot air generator on a bottom face of housing 21 below rotating drum 23. Heat pump 32 includes compressor 33, condenser 34, and evaporator 35 etc. which are connected through a pipe inside of which a refrigerant circulates.

[0018] Furthermore, when fan 31 runs, a flow of air is created in housing 21 as illustrated by arrow F. The air dehumidified by evaporator 35 is heated by condenser 34 and becomes dry hot air. The hot air goes through drying duct 36 and enters rotating drum 23. The hot air is sent to the clothes tumbled by the rotation of the rotating 23, and dries the clothes.

[0019] The hot air that has dried the clothes flows into filter 37 provided in a back face of door 24, and returns to heat pump 32 through ventilating slot 22a formed in a sidewall of opening 22. The hot air that has dried the clothes decreases in temperature and includes water released from the clothes. In other words, the hot air that has dried the clothes cools and becomes humid. The cool and humid air is converted into hot and dry air again by heat pump 32, and sent to rotating drum 23. This is how the air circulates.

[0020] FIG. 3 is a schematic diagram illustrating a front view of clothes dryer 20 according to this embodiment of the present invention. Rotating drum 23 (indicated by a dashed line in FIG. 3) is provided inside housing 21, in an upper part of housing 21 because the hot air generator including heat pump 32 is provided below rotating drum 23. For example,

top T of rotating drum 23 is positioned near top panel 38 of housing 21. Operating unit 25 is positioned in front of top T of rotating drum 23. Opening 22 has center C22 positioned approximately on rotation axis A of rotating drum 23 as illustrated in FIG. 2. In other words, center C23 of rotating drum 23, which is rotation axis A of rotating drum 23, is approximately aligned with center C22 of opening 22.

[0021] FIG. 4A to FIG. 4D are comparative diagrams for describing positional relations between the rotating drum and the opening.

[0022] It is noted that, in FIG. 4A to FIG. 4D, the rotating drum is made as large as possible to the extent that that the rotating drum fits inside the housing, in order to dry as much clothes as possible. In addition, in FIG. 4A and FIG. 4B, a circular opening is made as large as possible to the extent that the clothes can be easily loaded and unloaded and the clothes in the rotating drum do not fall out from the opening when the door is open.

[0023] FIG. 4A to FIG. 4D illustrate the clothes dryer with the door removed. If no large hot air generator such as a heat pump is provided below rotating drum 23, rotating drum 23 can be provided within housing 21 near the center. Opening 220 is provided so that a center of opening 220 is approximately aligned with center C23 of rotating drum 23. In this case, rotating drum 23 can be provided so as not to be positioned behind operating unit 25.

[0024] In contrast, if a large hot air generator such as a heat pump is provided below rotating drum 23, as in the clothes dryer according to this embodiment, rotating drum 23 need to be provided in the upper part of housing 21. However, as illustrated in FIG. 4B, operating unit 25 is provided at the top of the front face of housing 21. Hence it is difficult to form opening 220 in such a way that the center of opening 220 is approximately aligned with center C23 of rotating drum 23. In other words, if opening 220 is to be provided to conform to rotating drum 23, operating unit 25 and opening 220 interfere with each other. In reality, the door to close opening 220 is larger than opening 220, resulting in greater interference with operating unit 25.

[0025] Hence, as illustrated in FIG. 4C, opening 220 needs to be made smaller in diameter. Accordingly, interference between operating unit 25 and opening 220 can be avoided. However, in this case, opening 220 becomes small, which makes it difficult for a user to load and unload the clothes.

[0026] Hence, as illustrated in FIG. 4D, the clothes dryer according to this embodiment has opening 22 that is an approximate quadrilateral. Specifically, opening 220 (indicated by a dashed line) is extended toward four corners (for example, at 45 degree angles) of housing 21 to be opening 22 that is an approximate quadrilateral. The resulting opening 22 is larger, and the user can easily load and unload clothes.

[0027] Here, the approximate quadrilateral is not limited to an exact square and rectangular, and includes shapes that a person recognizes as a quadrilateral, not a circle.

[0028] FIG. 5A to FIG. 5F are diagrams illustrating shapes of the opening. As illustrated in FIG. 5A, opening 22 may be shaped so that the sides of the quadrilateral are curves, not straight lines. In addition, as illustrated in FIG. 5B, opening 22 may be shaped so that the vertices of the quadrilateral are rounded, not sharp corners. Moreover, as illustrated in FIG. 5C, the shape of opening 22 may be recognized as an approximate quadrilateral, since opening 22 has four curvature portions R1 having the greatest curvature. In other words, opening 22 illustrated in FIG. 5C is shaped so that a curvature of lines equivalent to sides of the quadrilateral is smaller than a curvature of curvature portions R1. Moreover, as illustrated in FIG. 5D and FIG. 5E, the shape of opening 22 may be recognized as an approximate quadrilateral, since opening 22 has two curvature portions R1 having the greatest curvature, and two curvature portions R2 having the second greatest curvature. As illustrated in FIG. 5D and FIG. 5E, opening 22 may be either horizontally or vertically asymmetric. It is noted that, as illustrated in the comparative diagram in FIG. 5F, the shape of opening 220 cannot be recognized as an approximate quadrilateral. This is because even though opening 220 has two curvature portions R1 having the greatest curvature, opening 220 has only one curvature portion R2 having the second greatest curvature.

[0029] Furthermore, as illustrated in FIG. 1 to FIG. 3, opening 22 is provided so that center C22 of opening 22 is positioned higher than center C24 of door 24. At least, the center of opening 22 is positioned vertically higher than the center of door 24. In other words, the position of door 24 does not interfere with the position of rotating drum 23. Such positioning makes it possible to provide a large door 24.

[0030] Moreover, although the direction of rotation axis A of rotating drum 23 may be inclined to the horizontal, the direction of rotation axis A of rotating drum 23 may be horizontal as illustrated in FIG. 1 and FIG. 2. If rotation axis A of rotating drum 23 is horizontal, loading and unloading of the clothes tends to be difficult. Moreover, if rotation axis A of rotating drum 23 is horizontal, it is difficult for a standing user to see the inside of rotating drum 23 (that is, the clothes) from opening 22. Opening 22 for clothes dryer 20 according to this embodiment is large. Hence, even if rotation axis A of rotating drum 23 is horizontal, opening 22 the large opening 22 allows a user to easily load and unload the clothes, and allows a standing user to see the inside of rotating drum 23 (that is, the clothes) from opening 22. It is noted that the term horizontal in this embodiment refers not only to an exact horizontal, and includes design or installation error.

[0031] Moreover, as illustrated in FIG. 1 and FIG. 2, the back face of door 24 may be provided with filter 37 having approximately the same shape as a shape of opening 22. When door 24 is closed, filter 37 fits into opening 22 via a seal (not shown). Filter 37 includes, for example, a filter case having approximately the same shape as the shape of opening 22, and a removable filter body attached to the filter case. Clothes in drying process produce much lint. The lint

travels with hot air, and builds up in narrow paths of condenser 34 and evaporator 35. In terms of the air flowing through condenser 34 and evaporator 35, the lint build-up increases a loss of pressure and blocks a flow of hot air. In addition, the lint build-up decreases efficiency in heat exchange of condenser 34 and evaporator 35. The catching of lint by filter 37 suppresses build-up of lint in the narrow paths for condenser 34 and evaporator 35, keeps the flow of the hot air from being blocked, and reduces a decrease in heat exchange efficiency. In order to reduce a loss of pressure due to filter 37 itself, filter 37 is preferably large. Since an area of opening 22 is large, an area of filter 37 that is approximately the same in shape as opening 22 can be enlarged. Accordingly, the loss of pressure for filter 37 can be reduced.

[0032] Furthermore, the clothes dryer according to this embodiment has the structure described below.

[0033] As illustrated in FIG. 1 and FIG. 3, a rim of opening 22 is provided with contacting lip 22b that makes a contact with door 24 when door 24 is closed. Then, opening 22 is formed so that, when contacting lip width 22c is a distance between an end of opening 22 and a closest outer peripheral end of contacting lip 22b, left and right sides of center of top edge 22d of opening 22-that is, contacting lip width 22c at left and right sides of a top edge-is narrower than the contacting lip width at center of top edge 22d of opening 22.

[0034] Furthermore, opening 22 is formed so that left and right sides of center of bottom edge 22e of opening 22-that is, contacting lip width 22c at left and right sides of a bottom edge-is narrower than contacting lip width 22c at center of bottom edge 22e of opening 22.

[0035] The above structures allow opening 22 to be larger in area than a circular opening, so that the user can easily load and unload clothes.

[0036] Moreover, the clothes dryer according to this embodiment has the structure below.

[0037] As illustrated in FIG. 3, opening 22 is formed so that distance 22f between center C22 of opening 22 and positions left and right of center of top edge 22d of opening 22-that is, positions left and right of a top edge-is greater than distance 22f between center C22 of opening 22 and center of top edge 22d.

[0038] Furthermore, opening 22 is formed so that distance 22f between center C22 of opening 22 and positions left and right of center of bottom edge 22e of opening 22-that is, positions left and right of a bottom edge-is greater than distance 22f between center C22 of opening 22 and center of bottom edge 22e.

[0039] The above structures allow opening 22 to be larger in area than a circular opening, so that the user can easily load and unload clothes.

INDUSTRIAL APPLICABILITY

[0040] The present invention is applicable to a clothes dryer and a washing machine whose rotating drum is provided in an upper part of a housing.

REFERENCE MARKS IN THE DRAWINGS

[0041]

10 and 23	rotating drum
11 and 21	housing
12	front face
13, 22, and 220	opening
14 and 24	door
16 and 25	operating unit
20	clothes dryer
22a	ventilating slot
22b	contacting lip
22c	contacting lip width
22d	center of top edge
22e	center of bottom edge
22f	distance
26	motor
27	pulley
28	belt
29	pulley
30	belt
31	fan
32	heat pump (hot air generator)
33	compressor

34	condenser
35	evaporator
36	drying duct
37	filter
38	top panel
A	rotation axis
C22, C23, and C24	center
T	top
R1 and R2	curvature portion

Claims

1. A clothes dryer comprising:

a housing having an opening formed at a front face, the opening being for loading and unloading an object to be dried;
a door that closes the opening;
an operating unit provided at a top of the front face of the housing;
a rotating drum that holds the object to be dried; and
a hot air generator that is provided below the rotating drum, and generates hot air that is blown into the rotating drum,
wherein a center of the opening is positioned approximately on a rotation axis of the rotating drum, and
the opening is an approximate quadrilateral.

2. The clothes dryer according to claim 1,
wherein the hot air generator includes a heat pump.

3. The clothes dryer according to one of claims 1 and 2,
wherein a vertical center of the opening is positioned vertically higher than a vertical center of the door.

4. The clothes dryer according to one of claims 1 and 2,
wherein the rotation axis of the rotating drum is horizontal.

5. The clothes dryer according to one of claims 1 and 2,
wherein the door has a back face provided with a filter having a shape that is same as a shape of the opening.

6. A clothes dryer comprising:

a housing having an opening formed at a front face, the opening being for loading and unloading an object to be dried;
a door that closes the opening;
an operating unit provided at a top of the front face of the housing;
a rotating drum that holds the object to be dried; and
a hot air generator that is provided below the rotating drum, and generates hot air that is blown into the rotating drum,
wherein a center of the opening is positioned approximately on a rotation axis of the rotating drum, and
the opening has a rim provided with a contacting lip that contacts the door when the door is closed, and the opening is formed so that, when a contacting lip width is a distance between an end of the opening and a closest outer peripheral end of the contacting lip, the contacting lip width at left and right sides of a top edge of the opening is narrower than the contacting lip width at the top edge of the opening.

7. The clothes dryer according to claim 6,
wherein the opening is formed so that the contacting lip width at left and right sides of a bottom edge of the opening is narrower than the contacting lip width at the bottom edge of the opening.

8. A clothes dryer comprising:

a housing having an opening formed at a front face, the opening being for loading and unloading an object to be dried;
a door that closes the opening;
an operating unit provided at a top of the front face of the housing;
a rotating drum that holds the object to be dried; and
a hot air generator that is provided below the rotating drum, and generates hot air that is blown into the rotating drum,
wherein a center of the opening is positioned approximately on a rotation axis of the rotating drum, and
the opening is formed so that a distance between the center of the opening and left and right sides of a top edge of the opening is greater than a distance between the center of the opening and the top edge of the opening.

9. The clothes dryer according to claim 8,
wherein the opening is formed so that a distance between the center of the opening and left and right sides of a bottom edge of the opening is greater than a distance between the center of the opening and the bottom edge of the opening.

FIG. 1

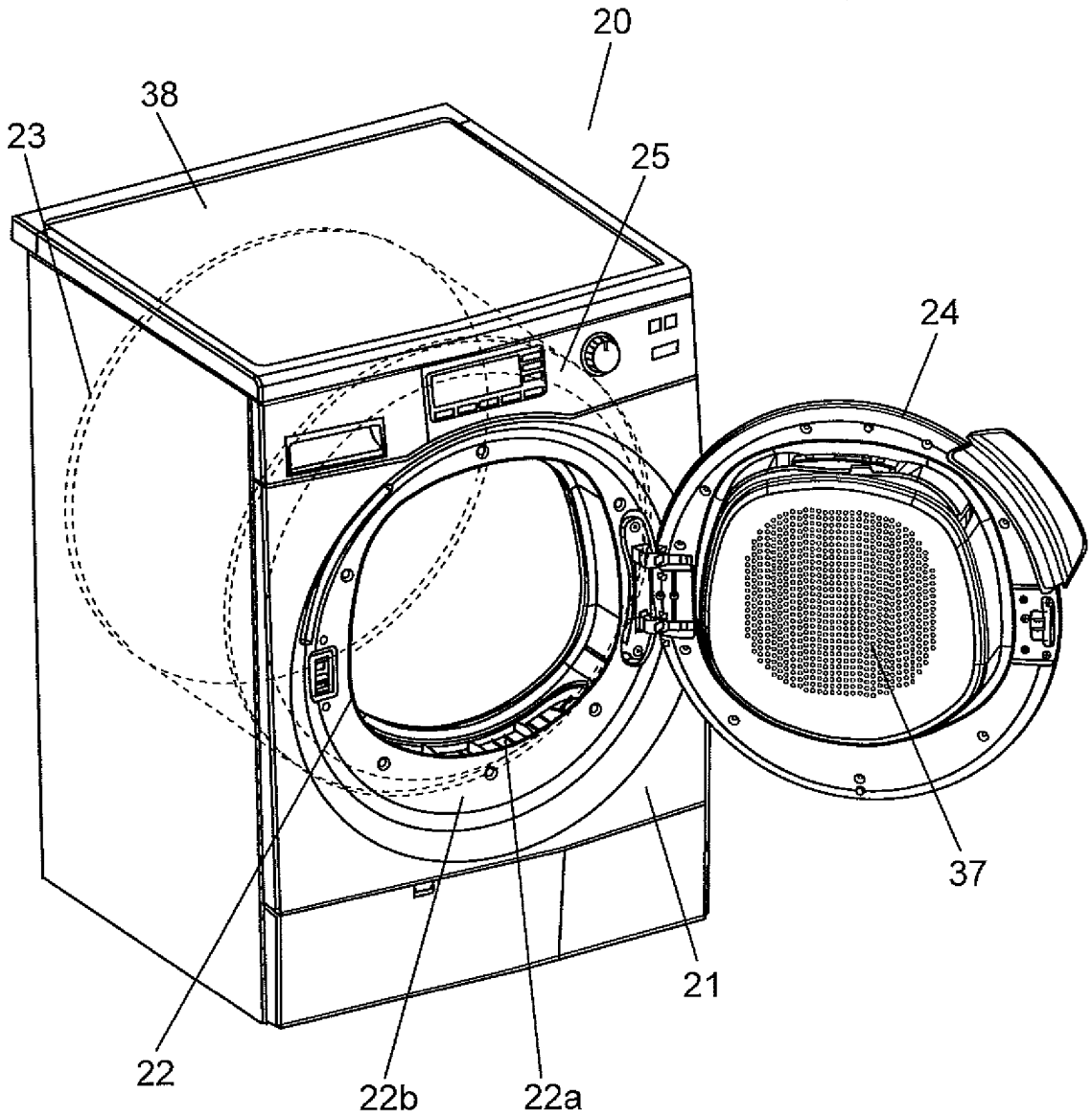


FIG. 2

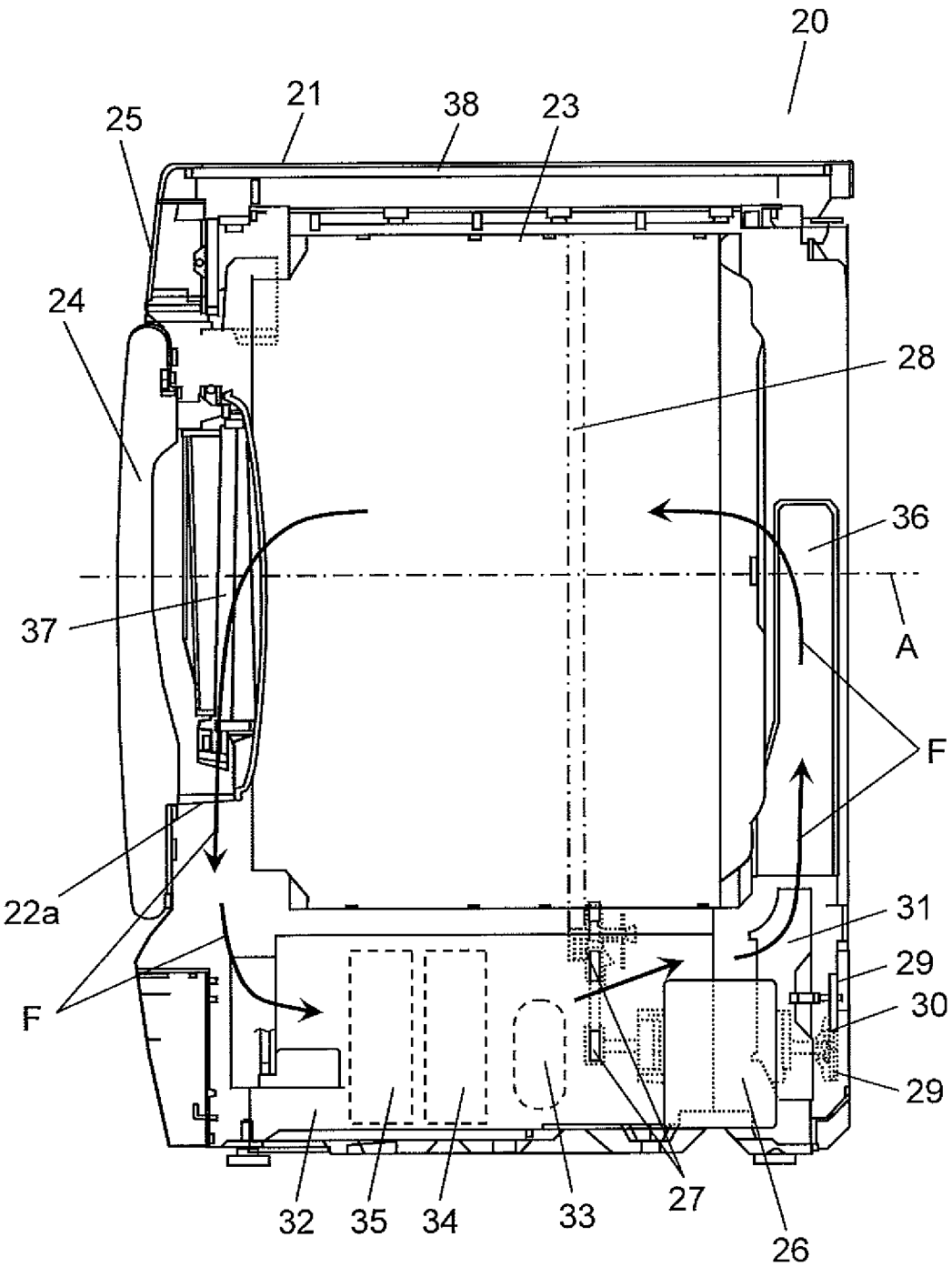


FIG. 3

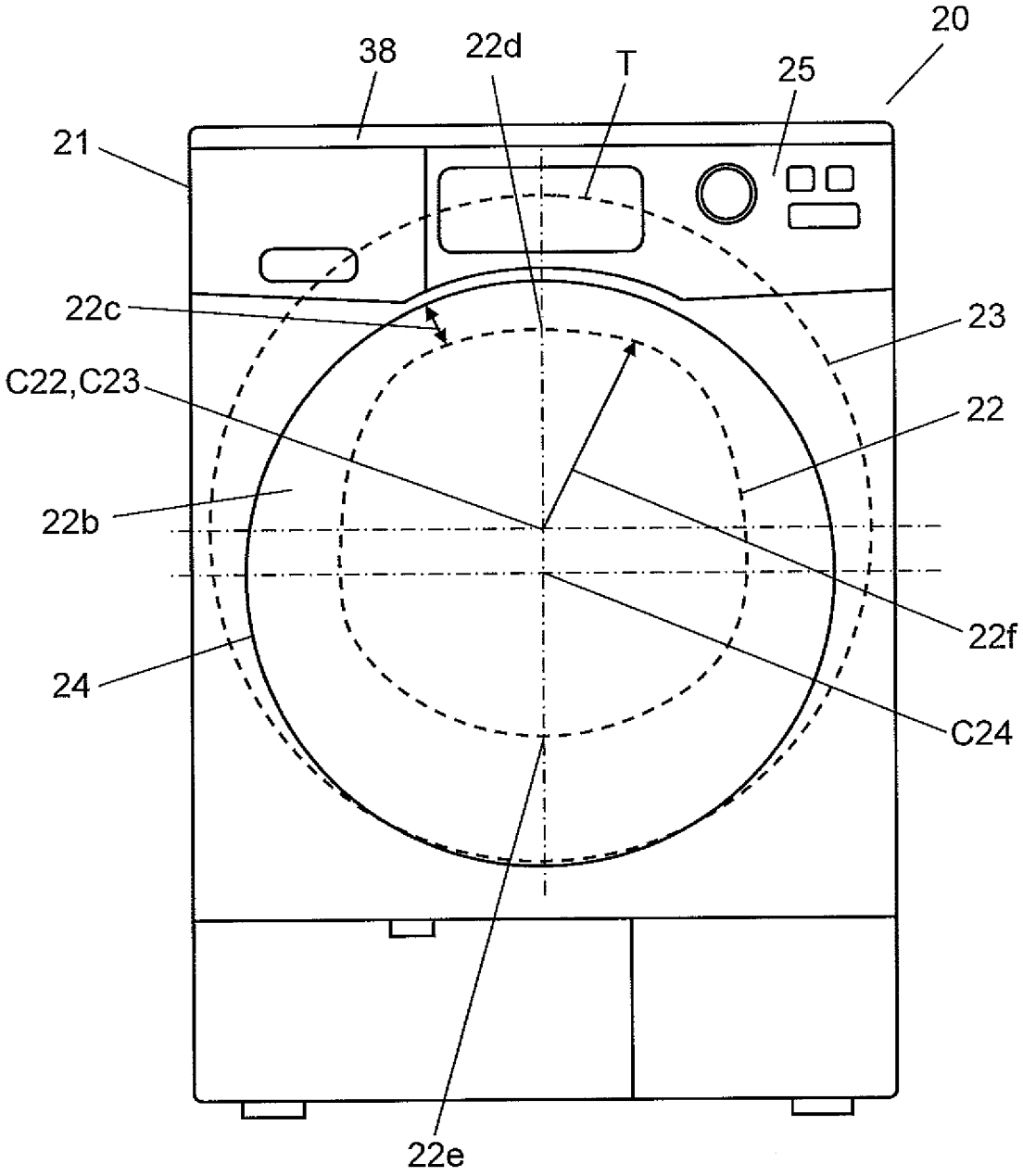


FIG. 4A

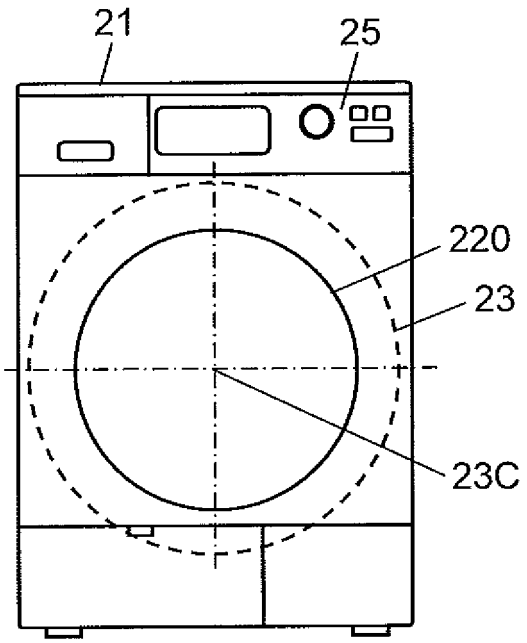


FIG. 4B

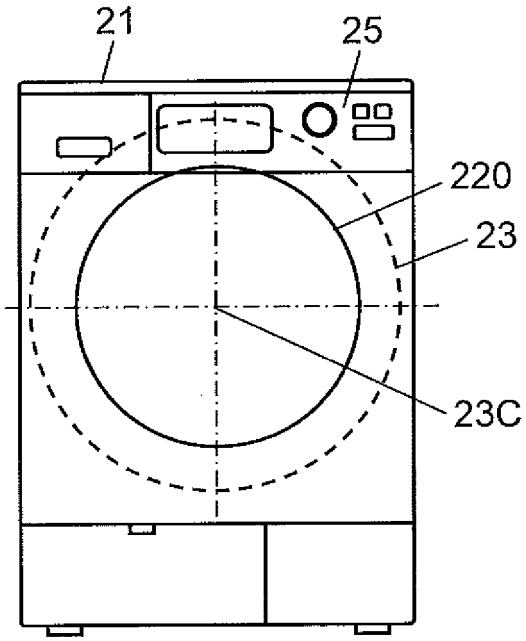


FIG. 4C

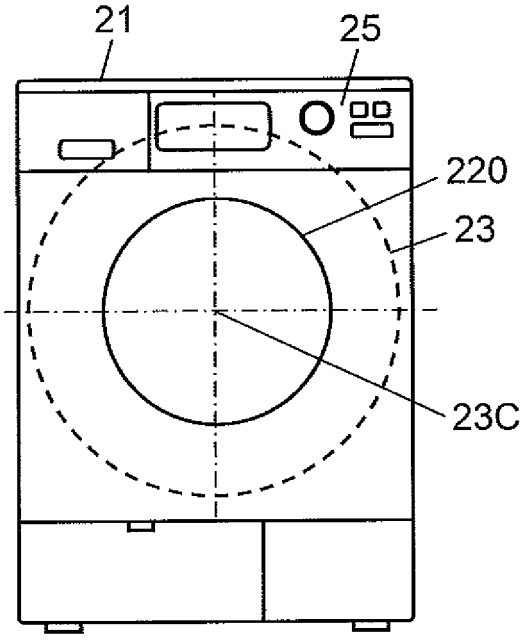


FIG. 4D

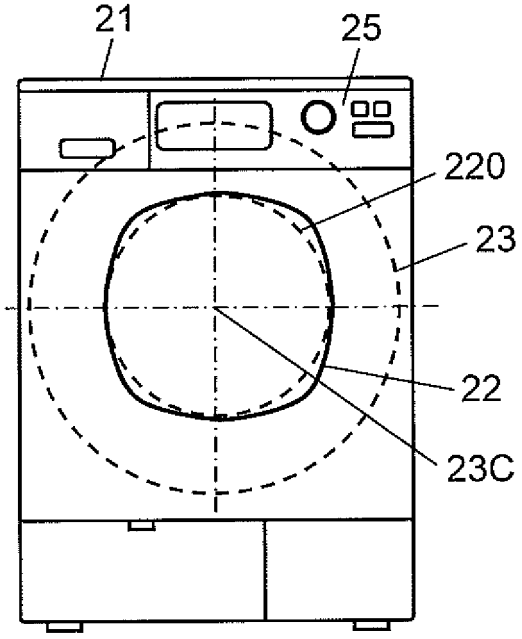


FIG. 5A

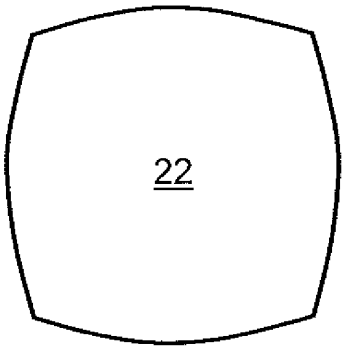


FIG. 5B

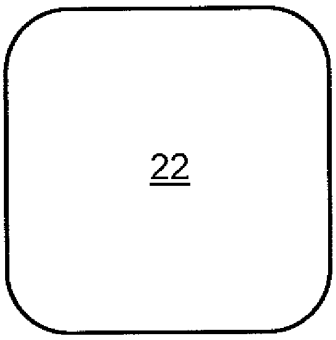


FIG. 5C

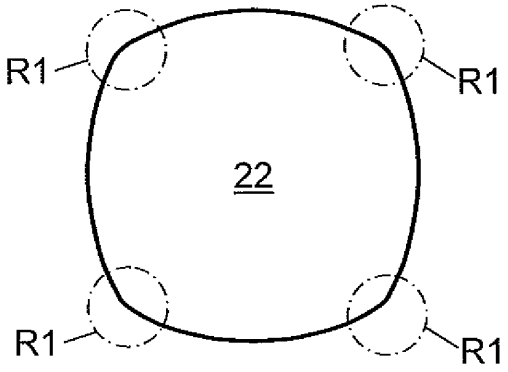


FIG. 5D

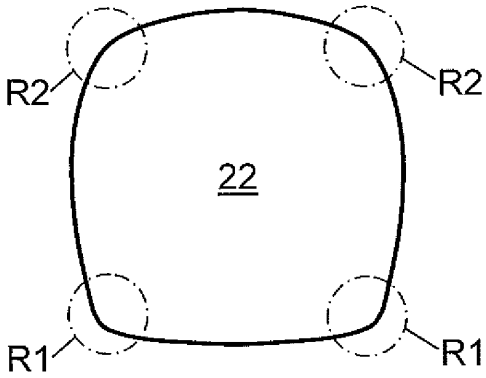


FIG. 5E

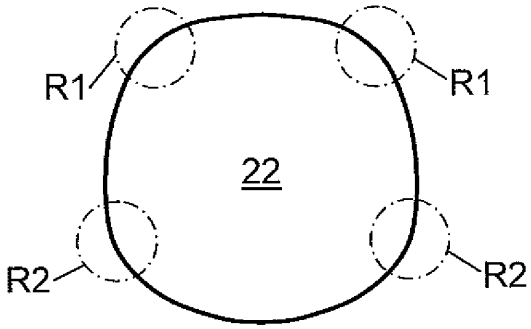


FIG. 5F

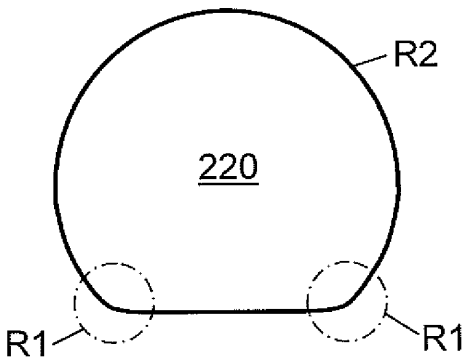
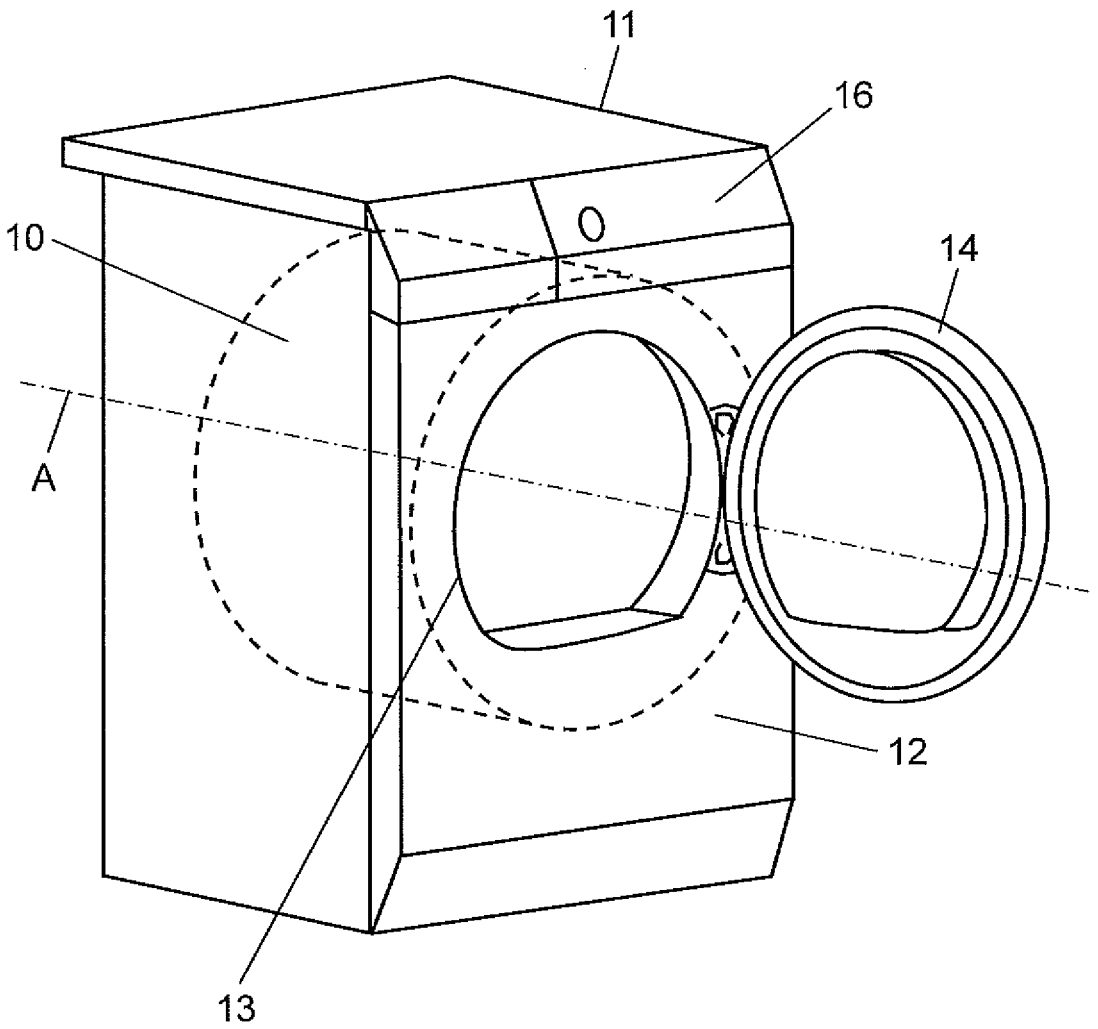


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/004411

A. CLASSIFICATION OF SUBJECT MATTER
D06F58/02(2006.01)i, *D06F25/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F58/02, D06F25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-325838 A (Toshiba Corp.), 20 December 2007 (20.12.2007), paragraph [0019]; fig. 1 (Family: none)	1-9
Y	JP 2004-105694 A (Kabushiki Kaisha Asahi Seisakusho), 08 April 2004 (08.04.2004), paragraphs [0016] to [0022], [0034]; fig. 3, 4 (Family: none)	1-9
Y	JP 2005-177513 A (LG Electronics Inc.), 07 July 2005 (07.07.2005), paragraph [0022]; fig. 1 & US 2005/0132604 A1 & EP 1548176 A2	5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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27 August, 2013 (27.08.13)	10 September, 2013 (10.09.13)
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