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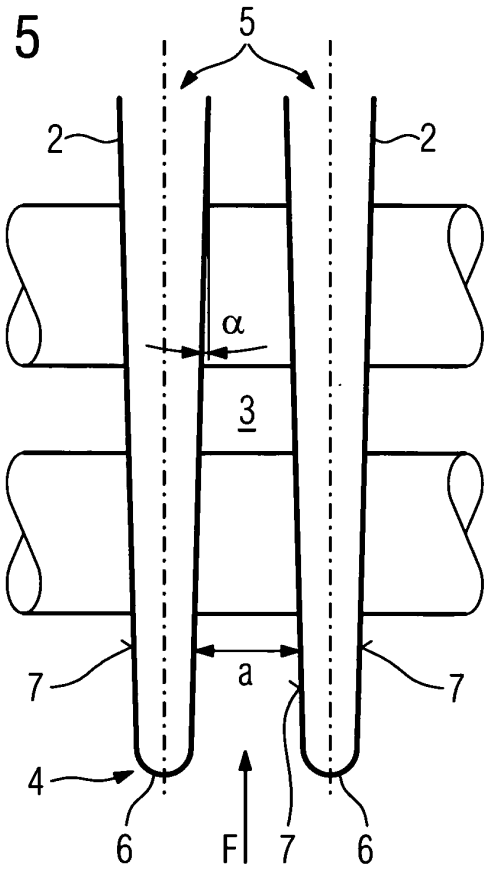
(54) Heat exchanger for a dryer, especially for a domestic dryer

(57) The invention relates to a heat exchanger (1) for a dryer, especially for a domestic dryer, which has a plurality of fins (2), wherein a flow channel (3) is established between two fins (2), wherein air is guided along a flow direction (F) through the flow channel (3) from an inlet edge (4) to an outlet edge (5). To improve the behaviour of the heat exchanger to collect lint, the invention is **characterized in that** at least the inlet edge (4) of the fin (2) has at least partially a rounded shape (6, 6', 6") seen in a direction perpendicular to the flow direction (F) and parallel to the surface (7) of the fin (3).

FIG 5



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Description

[0001] The invention relates to a heat exchanger for a dryer, especially for a domestic dryer, which has a plurality of fins, wherein a flow channel is established between two fins, wherein air is guided along a flow direction through the flow channel from an inlet edge to an outlet edge.

[0002] Heat exchangers of this type are usually employed in domestic laundry dryers, especially in heat pump tumble dryers to which this invention relates specifically. The heat exchanger consists of a plurality of flat panels which are arranged with a certain distance to another, i. e. between the panel surfaces of two adjacent fins a distance is kept. By this, a plurality of flow channels is created. Humid air from the laundry is blown through the flow channels. As the air is in contact with the surface of the fins a heat transmission can take place which is necessary for carrying out the drying of the laundry.

[0003] A certain problem is that the heat exchanger is exposed to a contamination with lint which is contained in the air. The heat exchangers, i. e. the evaporator and the condenser, especially of the heat pump tumble dryer, are not removable and an additional filter needs to be periodically cleaned due to the fact that not all lint is filtered by the main filtering system of the dryer. In spite of the fact that it was aimed that the filtering system is improved there are still certain amounts of lint which reach the heat exchangers. Especially, lint accumulations take place at the entrance of the evaporator and the condenser, which causes performance degradation. Consequently, it is necessary to clean the heat exchanger from time to time to ensure its function.

[0004] Therefore, it is an object of the invention to propose a heat exchanger for a dryer, especially for a domestic dryer, which is designed in such a way that the lint accumulation in the heat exchanger is significantly reduced. Consequently, it should become possible to go without a separate filter system which is arranged near the heat exchanger for cleaning the heat exchanger from lint.

[0005] The solution of this object according to the invention is **characterized in that** at least the inlet edge of the fin has at least partially a rounded shape seen in a direction perpendicular to the flow direction and parallel to the surface of the fin.

[0006] Normally, the fins have a flat shape.

[0007] The rounded shape can have a semi-circle shape according to a first preferred embodiment of the invention.

[0008] According to another embodiment of the invention, the rounded shape can connect the surfaces of the fin and a flat portion of the fin, wherein the flow direction is perpendicular on the flat portion. In this case the rounded shape can have a quadrant shape. Preferably, the quadrant shape has a radius of 10 % till 30 % of the width of the fin at the inlet edge.

[0009] A further preferred embodiment of the invention suggests that the rounded shape has a drop-shaped form. In this case the maximum width of the fin at the inlet edge measured in a direction perpendicular to the flow direction is greater than the width of the fin at a location in flow direction behind the inlet edge.

[0010] In general, also the outlet edge of the fin can have at least partially a rounded shape seen in a direction perpendicular to the flow direction and parallel to the surface of the fin.

[0011] The surface of the fin is preferably arranged under an acute angle to the flow direction. This angle can be between 0.25° and 2°. The distance between the surfaces of two fins can decreases in flow direction. By this design the turbulences between the surfaces of two adjacent fins are increased what also increases the heat transfer.

[0012] More than one plurality of fins can be arranged in succession in flow direction, wherein each set of fins have the proposed rounded shape at the inlet edge.

[0013] The heat exchanger can be an evaporator or a condenser of a domestic dryer.

[0014] The invention found out that the accumulation of the lint is mainly due to sharp edged on the entrance of the heat exchangers as being used by common fins of heat exchangers of domestic laundry dryers.

[0015] The invention aims to avoid the accumulation of lint on the heat exchangers with a new shape of the fins. Instead of the common known design with sharp edges on the entrance of the evaporator and the condenser, there is suggested to provide a radius specifically at the inlet edge of the fins.

[0016] Preferably at least some of the fins of the heat exchanger are bent fins, wherein the bending is the inlet edge of the fin comprising the at least partially rounded shape. Particularly, in top view these fins are bent like a "V", they are V-shaped, with an at least partially rounded tip of the "V". These fins comprise a draft angle between adjacent fins in order to have different dimensions between the entrance (inlet) and the exit (outlet) of the flow channel between two fins of the heat exchangers. More space between fins in the entrance is aimed in order to facilitate the crossing of the lint and lower pitch on the exit is aimed to improve the heat exchange.

[0017] With the suggested geometry of the fins (especially the V-shape due to the angle according to a preferred embodiment of the invention) the number of contact collars is doubled so there is a further improvement of heat exchange between refrigerant and fins.

[0018] By the invention certain advantages are reached:

- There is no need to clean additional filter on the heat exchangers. This means that there is the possibility to eliminate one of the filter which is usually employed in dryers according the state of the art.

[0019] Also there is a possibility to eliminate the access to the heat exchangers for cleaning the filter which can

be eliminated.

[0020] In the case of bad sealing of the filtering system there is no performance degradation.

[0021] According to the specific embodiment of the invention with an acute angel between the surface of the fin and the flow direction there is the benefit that the heat exchange is improved due to doubled contact collars.

[0022] Consequently, the new shape of the heat exchanger fins allows to avoid lint accumulation on the entrance of the heat exchangers.

[0023] In the drawings embodiments of the invention are depicted.

FIG 1 shows a perspective view of a part of a domestic dryer with two heat exchangers,

FIG 2 shows the top view on one of the heat exchangers of the arrangement according to FIG 1,

FIG 3 shows the detail "A" according to FIG 2,

FIG 4 shows the detail "A" for an alternative embodiment of the invention,

FIG 5 shows schematically two adjacent fins of the heat exchanger of the kind shown in FIG 3,

FIG 6a shows the top view on the end of a fin of the heat exchanger according to a first design,

FIG 6b shows the top view on the end of a fin of the heat exchanger according to a second design, and

FIG 6c shows the top view on the end of a fin of the heat exchanger according to a third design.

[0024] In FIG 1 a bottom part of a domestic laundry dryer is shown which has two heat exchangers 1, i. e. an evaporator (in the front) and a condenser (in the back). Air is flowing through the heat exchangers 1 in a flow direction F. As the air contains lint, in usual heat exchangers an accumulation of lint appears for example at a location marked with C in FIG 1. It is the aim of the invention to avoid this lint sedimentation.

[0025] Each heat exchanger 1 consists of a plurality of fins 2 which can be seen in the further figures.

[0026] In FIG 2 and FIG 3 the fins 2 form a plurality of flow channels 3, i. e. a flow channel 3 is established between two adjacent fins 2. Each fin 2 has an inlet edge 4 and an outlet edge 5. As can be seen in FIG 2, the heat exchanger 1 here consists of two sections, each having the plurality of fins 2.

[0027] TO avoid lint sedimentation it is essential that the inlet edge 4 of the fin 2 has at least partially a rounded shape, when regarded in a direction perpendicular to the flow direction F and parallel to the surface 7 of the fin 2.

[0028] Reference is made to FIG 4, FIG 5 and FIG 6 where details of this design are shown.

[0029] In FIG 4 the rounded shape is established by paint or lacquer which is applied to the inlet edge 4 of the fins 2. The paint forms a drop-shape contour at the inlet edge 4 of the fin 2 which ensures that lint does find no hold at the edge and consequently does not accumulate at the inlet edge 4.

[0030] The design according to FIG 5 comes up with fins 2 which are bent in the shown form (V-shape with rounded tip). I. e. the fins 2 are made from a thin metal sheet wherein the surfaces 7 are arranged under an acute angle α which is between 0.25° and 2.0° to the flow direction F. Consequently, the distance a between two adjacent fins 2 decreases in flow direction F. Beneficially, this arrangement of the fins produces turbulences between two facing surfaces 7 which improve the heat transfer.

[0031] Some of the possible forms of the rounded inlet edges 4 become apparent from Figures 6a till 6c.

[0032] In FIG 6a the rounded shape 6 of the fin 2 at the inlet edge 4 is semi-circular. This design can be used with or without the specific form of the surfaces 7 running under the angle α.

[0033] In FIG 6b the rounded shape 6' consists of two quadrants which connect a flat portion 8 of the fin 2. A preferred embodiment suggests a relation between the width b' of the fin at the inlet edge 4 to the radius r of the quadrant; the radius r can be between 10 % and 30 % of the width b'.

[0034] FIG 6c shows schematically a drop-shaped form of the rounded shape 6". In general the maximum width B of the fin 2 is here greater than the width b of the fin according to the base form at the inlet edge 4.

[0035] The fins 2 shown in FIG 6a, 6b and 6c can be compact sheets with surfaces 7, which means that the room between the surfaces 7 of one fin is filled with material. Or the fins 2 can be bent sheets, which means that the fin 2 is hollow, the hollow room between the surfaces 7 is just surrounded by the bent sheet. Furthermore, the edge designs shown in FIG 6a, 6b and 6c are shown with surfaces 7 running under the angle α. But all these edge designs can also be realized with surfaces 7 running parallel to the Flow direction.

Reference Numerals

[0036]

1	Heat exchanger
2	Fin
3	Flow channel
4	Inlet edge
5	Outlet edge
6	Rounded shape
6'	Rounded shape
6"	Rounded shape
7	Surface of the fin

8	Flat portion of the fin
F	Flow direction
C	Location with possible lint sedimentation
r	Radius
b	Width of the fin
b'	Width of the fin
B	Maximum width of the fin
α	Angle
a	Distance

Claims

1. Heat exchanger (1) for a dryer, especially for a domestic dryer, which has a plurality of fins (2), wherein a flow channel (3) is established between two fins (2), wherein air is guided along a flow direction (F) through the flow channel (3) from an inlet edge (4) to an outlet edge (5),
characterized in that
at least the inlet edge (4) of the fin (2) has at least partially a rounded shape (6, 6', 6") seen in a direction perpendicular to the flow direction (F) and parallel to the surface (7) of the fin (3).

2. Heat exchanger according to claim 1, **characterized in that** the fins (2) have a flat shape.

3. Heat exchanger according to claim 1 or 2, **characterized in that** the rounded shape (6) has a semicircle shape.

4. Heat exchanger according to claim 1 or 2, **characterized in that** the rounded shape (6') connects the surfaces (7) of the fin (2) and a flat portion (8) of the fin (2), wherein the flow direction (F) is perpendicular on the flat portion (8).

5. Heat exchanger according to claim 4, **characterized in that** the rounded shape (6') has a quadrant shape.

6. Heat exchanger according to claim 5, **characterized in that** the quadrant shape (6') has a radius (r) of 10 % till 30 % of the width (b') of the fin (2) at the inlet edge (4).

7. Heat exchanger according to claim 1 or 2, **characterized in that** the rounded shape (6") has a drop-shaped form.

8. Heat exchanger according to claim 7, **characterized in that** the maximum width (B) of the fin (2) at the inlet edge (4) measured in a direction perpendicular to the flow direction (F) is greater than the width (b) of the fin (2) at a location in flow direction (F) behind the inlet edge (4).

9. Heat exchanger according to at least one of claims 1 till 8, **characterized in that** the outlet edge (5) of the fin (2) has at least partially a rounded shape (6, 6', 6") seen in a direction perpendicular to the flow direction (F) and parallel to the surface (7) of the fin (3).

10. Heat exchanger according to at least one of claims 1 till 9, **characterized in that** the surface (7) of the fin (3) is arranged under an acute angle (α) to the flow direction (F).

11. Heat exchanger according to claim 10, **characterized in that** the angle (α) is between 0.25° and 2°.

12. Heat exchanger according to claim 10 or 11, **characterized in that** the distance (a) between the surfaces (7) of two fins (2) decreases in flow direction (F).

13. Heat exchanger according to at least one of claims 1 till 13, **characterized in that** at least some of the fins (2) of the heat exchanger are bent fins (2), wherein the bending is the inlet edge (4) of the fin (2) comprising the at least partially rounded shape (6, 6', 6").

14. Heat exchanger according to claim 14, **characterized in that** the bent fins (2) comprise a draft angle between adjacent fins (2) in order to have a decreasing distance (a) between the surfaces (7) of the adjacent fins (2) in flow direction (F).

15. Laundry dryer, preferably a heat pump dryer, comprising a rotatable drum for holding the laundry to be dried, **characterized in that** the dryer comprises a heat exchanger according to at least one of claims 1 till 14.

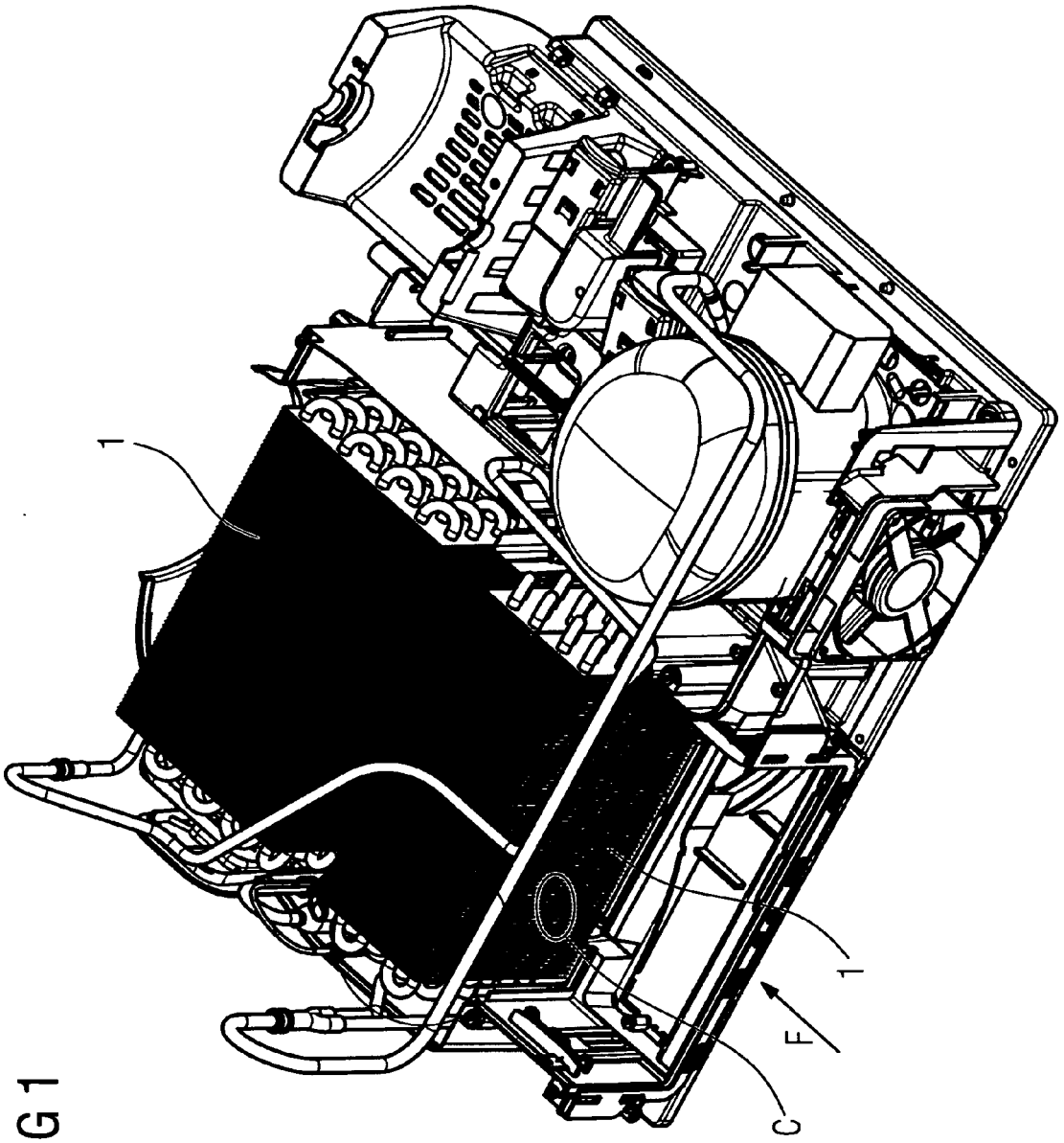


FIG 1

FIG 2

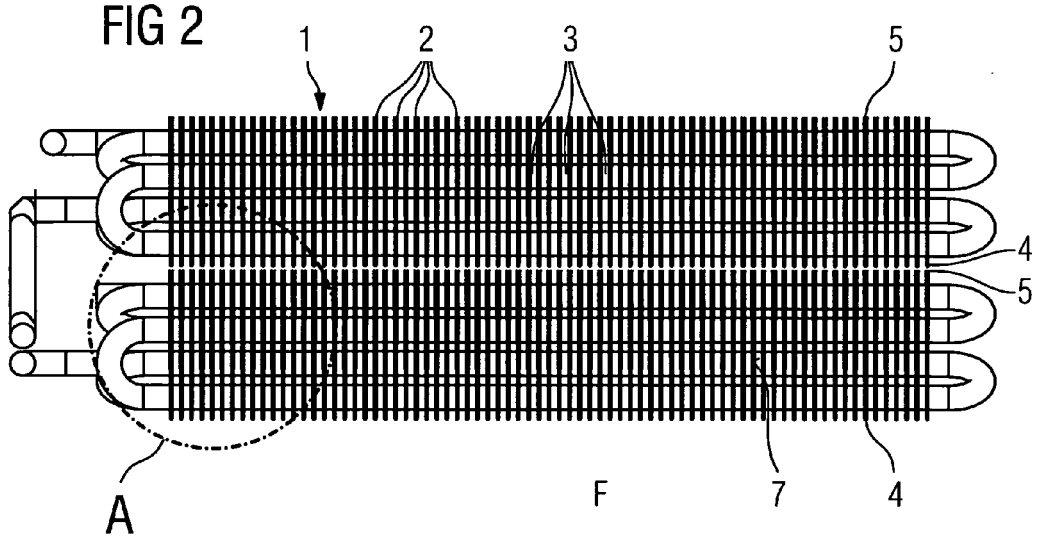


FIG 3

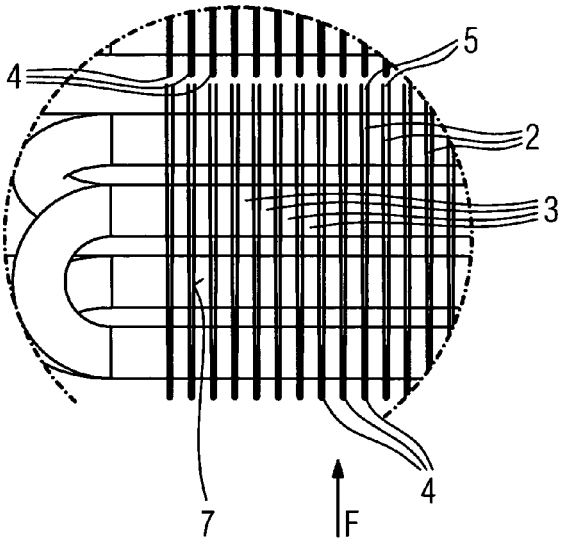


FIG 4

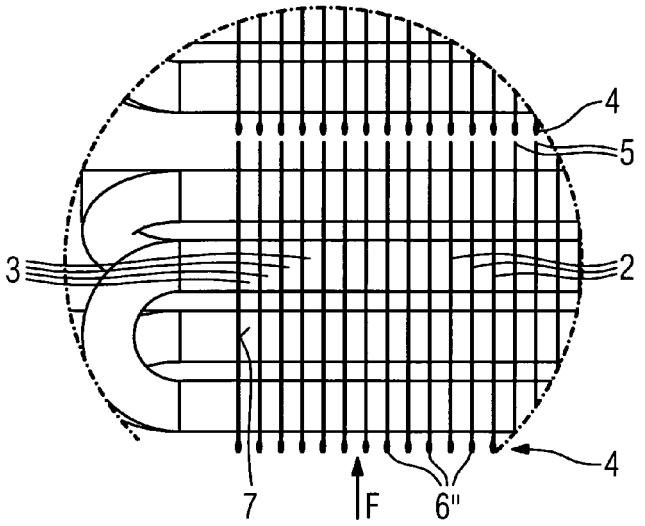


FIG 5

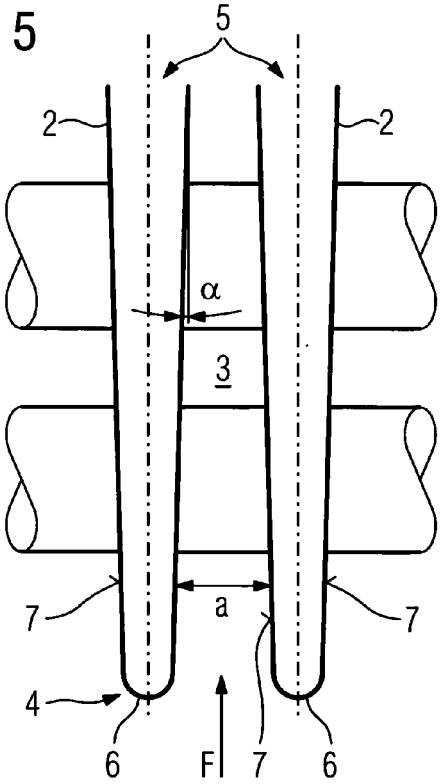


FIG 6c

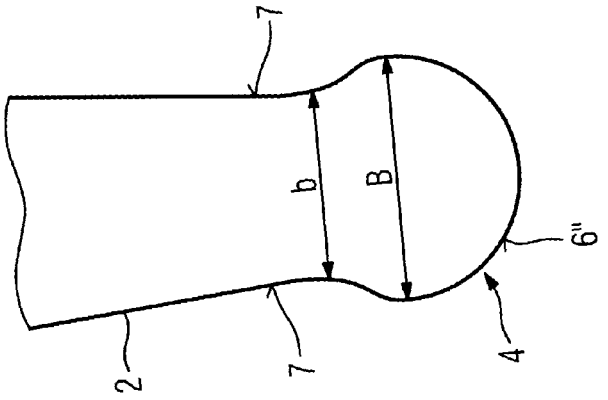


FIG 6b

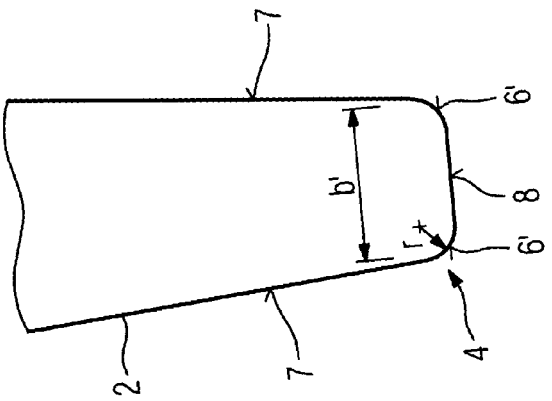
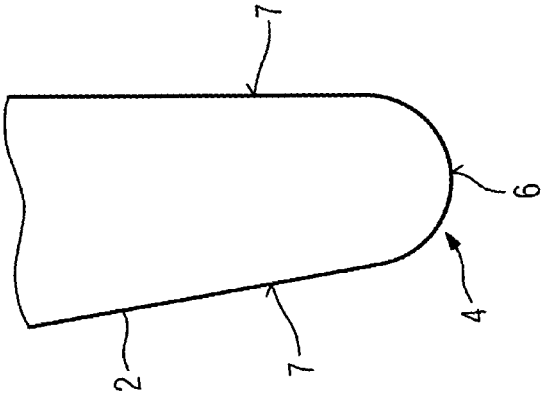


FIG 6a



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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 7604

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2008/146488 A (PANASONIC CORP [JP]; TANIGUCHI MITSUNORI; NISIHATA HIDEO; ANDOU TOSIAK) 4 December 2008 (2008-12-04) * abstract * -----	1,15	INV. D06F58/20 D06F58/22 F28D1/04
A	JP 60 082786 A (MATSUSHITA ELECTRIC IND CO LTD; MATSUSHITA REFRIGERATION) 10 May 1985 (1985-05-10) * abstract * -----	1,15	

TECHNICAL FIELDS SEARCHED (IPC)

D06F
F28D
F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 November 2009	Fachin, Fabiano

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 00 7604

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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12-11-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008146488 A	04-12-2008	NONE	
JP 60082786 A	10-05-1985	NONE	

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