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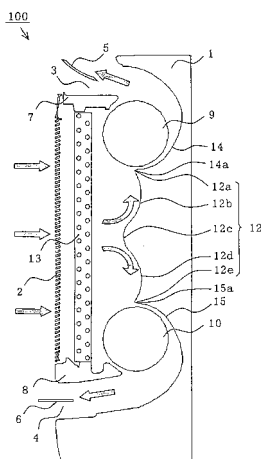
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(54) **Air conditioner**

(57) To provide a simply-constructed air conditioner having a separator forming air flow that is smoothly diverted toward an upper fan and a lower fan, and that has a low disturbance and an increased speed. The air conditioner includes an enclosure 1; a suction port 2; a heat exchanger 13; an upper blowing port 3 and a lower blowing port 4; an upper fan 9 and a lower fan 10; an upper rear guider 14 and a lower rear guider 15; and a corrugated separator 12 having a substantially W-shaped cross section. Here, the corrugated separator 12 includes a central mountain portion 12c which projects in a substantially arcuate shape toward the front surface of the enclosure, at the central portion in the cross section thereof; and an upper valley portion 12b and a lower valley portion 12d each of which caves in a substantially arcuate shape in the cross section thereof toward the rear surface of the enclosure, and is connected with the central mountain portion 12c. Also, the lower edge 14a of the upper rear guider 14 and the upper edge 12a of the upper valley portion 12b of the corrugated separator 12 are connected, and the upper edge 15a of the lower rear guider 15 and the lower edge 12e of the lower valley portion 12d of the corrugated separator 12 are connected.

FIG. 1



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Description

[0001] The present invention relates to an air conditioner, and more specifically, it concerns an indoor unit of an air conditioner, the indoor unit having a blowing port at each of upper and lower portions of the front surface thereof.

[0002] Hitherto, in order to keep a comfortable indoor temperature and humidity, an air conditioner that has a blowing port at each of the upper and lower portions thereof has been disclosed (refer to Patent Document 1, for example).

[0003] Also, to prevent volumes of air blowing upward and downward from interfering with each other, it has been proposed that a partition plate is arranged between an upper fan and a lower fan (refer to Patent Document 2, for example).

[0004] Furthermore, in order that air flow is stabilized even when there is a difference in speed between an upper fan and a lower fan, it has been proposed that a partition plate is made movable between the upper fan and the lower fan (refer to Patent Document 3, for example).

[0005] [Patent Document 1] Japanese Unexamined Utility Model Registration Application Publication No. 55-67934 (pp. 3 to 4 and Fig. 3)

[0006] [Patent Document 2] Japanese Unexamined Patent Application Publication No. 61-153426 (p. 2 and Fig. 1)

[0007] [Patent Document 3] Japanese Unexamined Patent Application Publication No. 8-178338 (p. 3 and Fig. 2)

[0008] However, the arrangements disclosed in Patent Documents 1 to 3 have involved problems in that they cannot make full use of the capabilities of the upper side blower (upper fans) and the lower side blower (lower fans), and that these blowers (fans) generate noises.

[0009] Specifically, the arrangement disclosed in Patent Document 1 has a separator that projects in a mountain-shape in its cross section toward the front surface, between the upper blower and the lower blower, and that diverts sucked air upward and downward. Therefore, between each of the lower ends of the separator and respective one of the upper blower and the lower blower (i.e., on the suction side of each of the blowers), a predetermined gap over a predetermined range is not secured, thereby disturbing air flow and restricting an increase in air speed.

[0010] The arrangement disclosed in the Patent Document 2 is of a type that is formed simply by erecting a partition plate on the planar rear surface. Therefore, air sucked around the partition plate is subject to stagnation and/or disturbance, and a predetermined gap over a predetermined range is not secured on the suction side of each of the upper fan and the lower fan, thereby disturbing air flow and restricting an increase in air speed.

[0011] Moreover, the arrangement disclosed in Patent Document 3 has a movable partition plate, and hence, it requires a moving mechanism. As a result, because of deterioration of maintainability due to an increase in the number of components and a rise in the weight, and due to possible failures and the like, and in addition, because of the need to secure a moving range of the partition plate, a predetermined gap over a predetermined range is not secured on suction side of each of the upper fan and the lower fan, thereby disturbing air flow and restricting an increase in air speed.

[0012] The present invention has been made to solve the above-described problems. An object of the present invention is to obtain a simply-constructed air conditioner having a separator forming air flow that is smoothly diverted toward an upper fan and a lower fan, and that has a low disturbance and an increased speed. A further object of the present invention is to obtain a low-noise air conditioner that is prevented from the reduction in air volume even under the condition of "blowoff by upper-fan alone" (in which only the upper fan is operated, with the lower fan stopped).

[0013] An air conditioner according to the present invention is characterized by including an enclosure; a suction port installed in a front central portion of the enclosure; a heat exchanger installed inside the enclosure and facing the suction port; an upper blowing port and a lower blowing port, respectively, installed at a front upper portion and a front lower portion of the enclosure; an upper fan and a lower fan that blow air toward the upper blowing port and the lower blowing port, respectively; an upper rear guider and a lower rear guider each of which has an arcuate cross section, and is disposed on the rear surface side of a respective one of the upper fan and the lower fan; and a corrugated separator having a substantially W-shaped cross section and installed inside the enclosure, the corrugated separator facing the heat exchanger. Herein, the corrugated separator includes central mountain portion which projects at the central portion thereof in a substantially arcuate shape in the cross section toward the front surface of the enclosure; and an upper valley portion and a lower valley portion each of which caves in a substantially arcuate shape in the cross section thereof toward the rear surface of the enclosure, and is smoothly connected with a respective one of the upper part and the lower part of the central mountain portion. Also, the lower edge of the upper rear guider and the upper edge of the upper valley portion of the corrugated separator are connected, and the upper edge of the lower rear guider and the lower edge of the lower valley portion of the corrugated separator are connected.

[0014] In the air conditioner according to the present invention, the upper rear guider and the lower rear guider, respectively, are provided for the upper fan and the lower fan, and the central mountain portion projecting in a substantially arcuate shape in the cross section thereof, of the corrugated separator having a substantially W-shaped cross section, smoothly diverts air flow and guides the diverted air flows to the rear guiders. This produces a large rectification effect, a noise reduction effect, and a capability enhancing effect with respect to the upper fan and lower fans.

[0015] The crest of the central mountain portion of the corrugated separator may be located further toward the rear surface side than a surface connecting the lower edge of the heat exchanger and the lower edge of the upper rear guider.

Further, it may be located in the middle between the upper fan and the lower fan in the vertical direction. There may be provided a wind-direction adjusting plate for closing the lower blowing port or changing the direction of wind.

The invention will be further described by way of example with reference to the accompanying drawings in which:-

Fig. 1 is a longitudinal sectional view explaining the construction of an air conditioner according to a first embodiment of the present invention;

Fig. 2 is a longitudinal sectional view explaining the construction of an air conditioner according to a second embodiment of the present invention; and

Fig. 3 is a longitudinal sectional view of the main portion of a separator of an air conditioner according to a third embodiment of the present invention.

[0016] In Fig. 1, an indoor unit 100 of an air conditioner (the overall apparatus of this air conditioner is not shown) has an enclosure 1. In the front surface (left side in Fig. 1) of the enclosure 1, an upper blowing port 3 is provided at an upper portion thereof, and a lower blowing port 4 is provided at a lower portion thereof. A suction port 2 is installed in the front central portion, and an upper airflow-direction adjusting plate 5 and a lower airflow-direction adjusting plate 6 for varying the direction of airflow are installed in the upper blowing port 3 and the lower blowing port 4, respectively.

[0017] Inside the enclosure 1, there are provided an upper cross-flow fan 9 and a lower cross-flow fan 10 for blowing airflow toward the upper blowing port 3 and the lower blowing port 4, respectively. Behind the upper cross-flow fan 9 and the lower cross-flow fan 10, there are provided an upper rear guider 14 and a lower rear guider 15, respectively, each of which has a substantially arcuate cross section.

[0018] Facing the suction port 2, a heat exchanger 13 is installed inside the enclosure 1. At the upper edge of the heat exchanger 13, there is provided an upper blowing nozzle 7 for dividing off the upper blowing port 3 and the heat exchanger 13, while at the lower edge of the heat exchanger 13, there is provided a lower blowing nozzle 8 for dividing off the lower blowing port 4 and the heat exchanger 13.

[0019] Furthermore, on the rear surface side (right side in Fig. 1) of the heat exchanger 13, a corrugated separator 12 is arranged. The corrugated separator 12, which has a substantially W-shaped cross section, includes a central mountain portion (hereinafter referred to as a "bump") 12c which projects in a substantially arcuate shape in the cross section toward the front surface, at the central portion, and an upper valley portion 12b and a lower valley portion 12d, each of which caves in a substantially arcuate shape in the cross section thereof toward the rear surface of the enclosure and is smoothly connected with a respective one of the upper part and the lower part of the bump 12c. Also, the lower edge 14a of the upper rear guider 14 and the upper edge 12a of the upper valley portion 12b of the corrugated separator 12 are connected, and the upper edge 15a of the lower rear guider 15 and the lower edge 12e of the lower valley portion 12d of the corrugated separator 12 are connected.

[0020] Next, description will be made of operations of the air conditioner according to the first embodiment of the present invention. In the indoor unit 100 (upper/lower fans two-flow type indoor unit) of the air conditioner, having the above-described features, indoor air is sucked in from the suction port 2 by being drawn with the upper cross-flow fan 9 and the lower cross-flow fan 10, and after having been subjected to a heat exchange by the heat exchanger 13, it is diverted while being rectified upward and downward by the bump 12c with a substantially arcuate cross section. The diverted air flows are smoothly guided by the upper valley portion 12b and the lower valley portion 12d, and sucked into the upper cross-flow fan 9 and the lower cross-flow fan 10, respectively. Then, the air sucked by the fans is blown off from the upper blowing port 3 and the lower blowing port 4 at angles predetermined by the upper airflow-direction adjusting plate 5 and the lower airflow-direction adjusting plate, respectively.

[0021] Herein, in the corrugated separator 12, the upper valley portion 12b, the bump 12c, and the lower valley portion 12d, each of which has a substantially arcuate cross section, are connected by a smooth curve to thereby exhibit a substantially W-shaped cross section. Here, since the upper edge 12a of the upper valley portion 12b and the lower edge 12e of the lower valley portion 12d, respectively, are connected to the lower edge 14a of the upper rear guider 14 and the upper edge 15a of the lower rear guider 15, a corrugated casing (number of valleys: four) is formed of the upper rear guider 14, the separator 12, and the lower rear guider 15. Therefore, there occurs no air flow disturbance at the time of the above-described diversion, and therefore, a low-noise indoor unit 100 is formed. In addition to the absence of disturbance, rectification and speed-up of air flow are achieved by the upper rear guider 14 and the lower rear guider 15, so that air volume is increased.

[0022] Furthermore, because of the absence of a moving mechanism such as a partition plate for diverting air flows upward and downward, an air conditioner can be obtained that is simple in construction, and in which an increase in the number of components and a rise in the weight are prevented to thereby maintain a low manufacturing cost, as well as an improved reliability is achieved.

[Second Embodiment]

[0023] While, in the above-described first embodiment, a airflow path configuration in the case of "two-flows by upper/lower fans" has been explained, a configuration in the case of "one-flow by blowoff of upper-fan alone" will now be described.

[0024] Fig. 2 is a longitudinal sectional view explaining the construction of an air conditioner according to a second embodiment of the present invention. Here, parts that are the same as or equivalent to those in the first embodiment (Fig. 1) are designated by the same reference numerals, and descriptions thereof are partly omitted.

[0025] In Fig. 2, the lower blowing port 4 is closed by rotating the lower airflow-direction adjusting plate 6. A broken line A in Fig. 2 is a line connecting the lower edge 13a of the heat exchanger 13 and the lower edge 14a of the upper rear guider 14, and the crest of the bump 12c of the separator 12 is characterized by being located further toward the rear surface side than the broken line A. By virtue of such a feature of the separator 12, even in the case of "one-flow by blowoff of upper-fan alone", air sucked from the lower part of the heat exchanger 13 smoothly flows along the separator 12 without a resistance by the bump 12c. This prevents a decrease of air volume, and allows noise reduction.

[Third Embodiment]

[0026] Fig. 3 is a longitudinal sectional view of the main portion of a separator of an air conditioner according to a third embodiment of the present invention. Here, parts that are the same as or equivalent to those in the first embodiment (Fig. 1) are designated by the same reference numerals, and descriptions thereof are partly omitted.

[0027] In Fig. 3, the crest of the bump 12c with a substantially arcuate shaped cross section, of the separator 12 is disposed at a position such that the distance h1 between the center of the upper cross-flow fan 9 and the above-described crest equals to the distance h2 between the center of the lower cross-flow fan 10 and the crest, namely, at a position satisfying a condition ($h1 = h2$).

[0028] It is not desirable that the curves of the upper valley portion 12b and the lower valley portion 12d each connecting with the bump 1c be too deep like a dotted line B, or too shallow like a dotted line C, because, in either case, sucked airflow is extremely bent to thereby constitute a resistance. It is therefore important to form curves that guides air smoothly. These curves vary depending on specifications of fans or heat exchanger to be used.

[0029] As described above, by disposing the bump 12c with a substantially arcuate shaped cross section at a substantially middle position between the upper fan 9 and the lower fan 10, the ratio of air volume between the upper and lower fans becomes nearly equal (namely, close to (1:1)). Consequently, the speed of air passing through the heat exchanger 13 is made uniform, resulting in reduced noise. Furthermore, the uniformization of the speed of air passing through the heat exchanger 13 eliminates nonuniformity in heat exchange, thereby enhancing heat exchanger effectiveness.

[0030] It will be appreciated that the features above while referred to as three embodiments can be combined to advantage in a single air conditioning unit.

[Reference Numerals]

[0031]

- 1: enclosure
- 2: suction port
- 3: upper blowing port
- 4: lower blowing port
- 5: upper airflow-direction adjusting plate
- 6: lower airflow-direction adjusting plate
- 7: upper blowing nozzle
- 8: lower blowing nozzle
- 9: upper cross-flow fan
- 10: lower cross-flow fan
- 12: separator
- 12b: upper valley portion
- 12c: central mountain portion (bump)
- 12d: lower valley portion
- 13: heat exchanger
- 14: upper rear guider
- 15: lower rear guider

Claims

1. An air conditioner comprising:

an enclosure (1);
a suction port (2) installed at a front central portion of the enclosure (1);
a heat exchanger (13) installed inside the enclosure (1) and facing the suction port (2);
an upper blowing port (3) and a lower blowing port (4), respectively, installed at a front upper portion and a front lower portion of the enclosure (1);
an upper fan (9) and a lower fan (10) that blow air toward the upper blowing port (3) and the lower blowing port (4), respectively;
an upper rear guider (14) and a lower rear guider (15) each of which has an arcuate cross section, and is disposed rearwardly of a respective one of the upper fan (9) and the lower fan (10); and
a separator (12) having a substantially W-shaped cross section and installed inside the enclosure (1), the separator (12) facing the heat exchanger (13),
wherein the separator (12) comprises:

a central convex portion (12c) which projects with a substantially arcuate cross-sectional shape toward the front surface of the enclosure (1); and
an upper concave portion (12b) and a lower concave portion (12d) each of which curves with a substantially arcuate cross-sectional shape toward the rear surface of the enclosure, and smoothly connected with a respective one of the upper part and the lower part of the central convex portion (12c), and

wherein the lower edge of the upper rear guider (14) and the upper edge of the upper concave portion (12b) of the separator (12) are connected, and the upper edge of the lower rear guider (15) and the lower edge of the lower concave portion (12d) of the separator (12) are connected.

2. An air conditioner according to Claim 1, wherein the crest of the central convex portion (12c) of the separator (12) is located further toward the rear of the air conditioner than a plane connecting the lower edge of the heat exchanger (13) and the lower edge of the upper rear guider (14).

3. An air conditioner according to Claim 1 or 2, wherein the crest of the central convex portion (12c) of the separator (12) is located in the middle between the upper fan (9) and the lower fan (10) in the vertical direction.

4. An air conditioner according to any one of Claims 1 to 3, wherein there is provided a airflow-direction adjusting plate (6) for closing the lower blowing port (4) or changing the direction of airflow therefrom.

FIG. 1

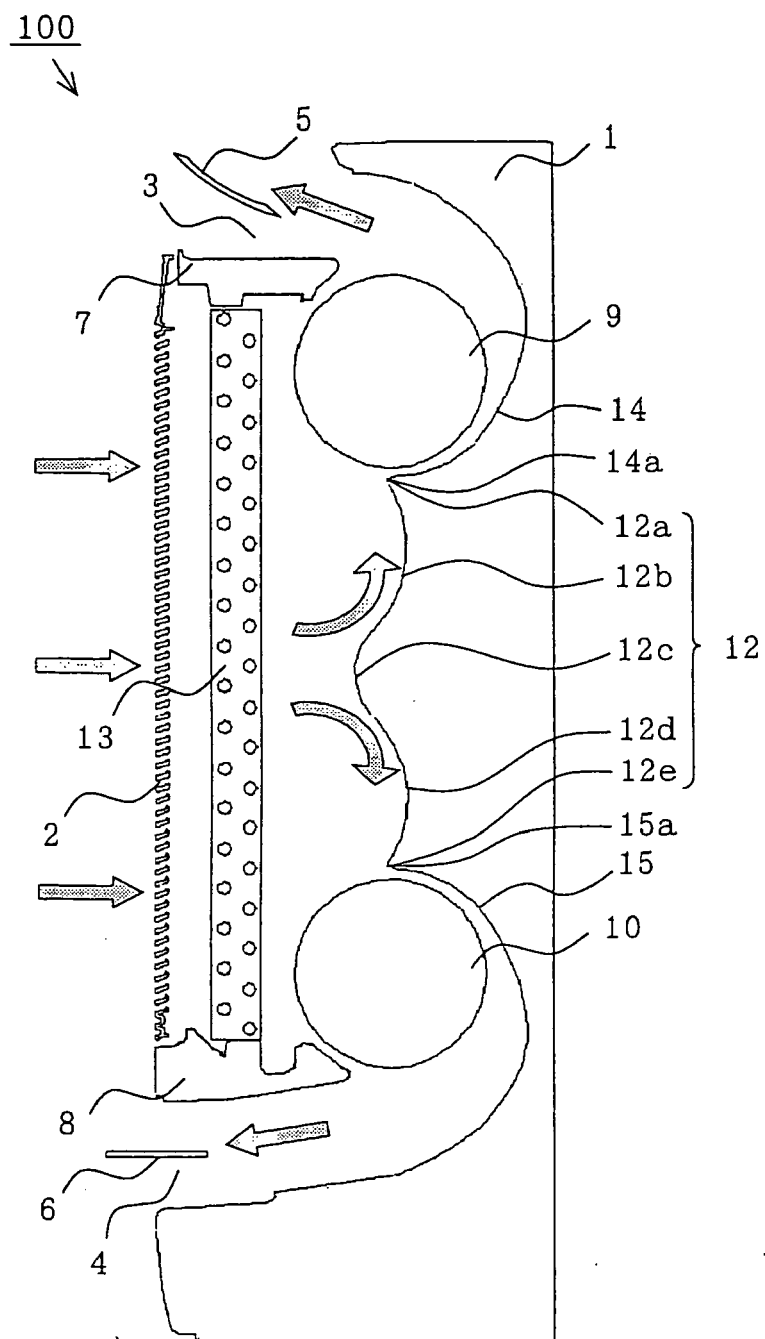


FIG. 2

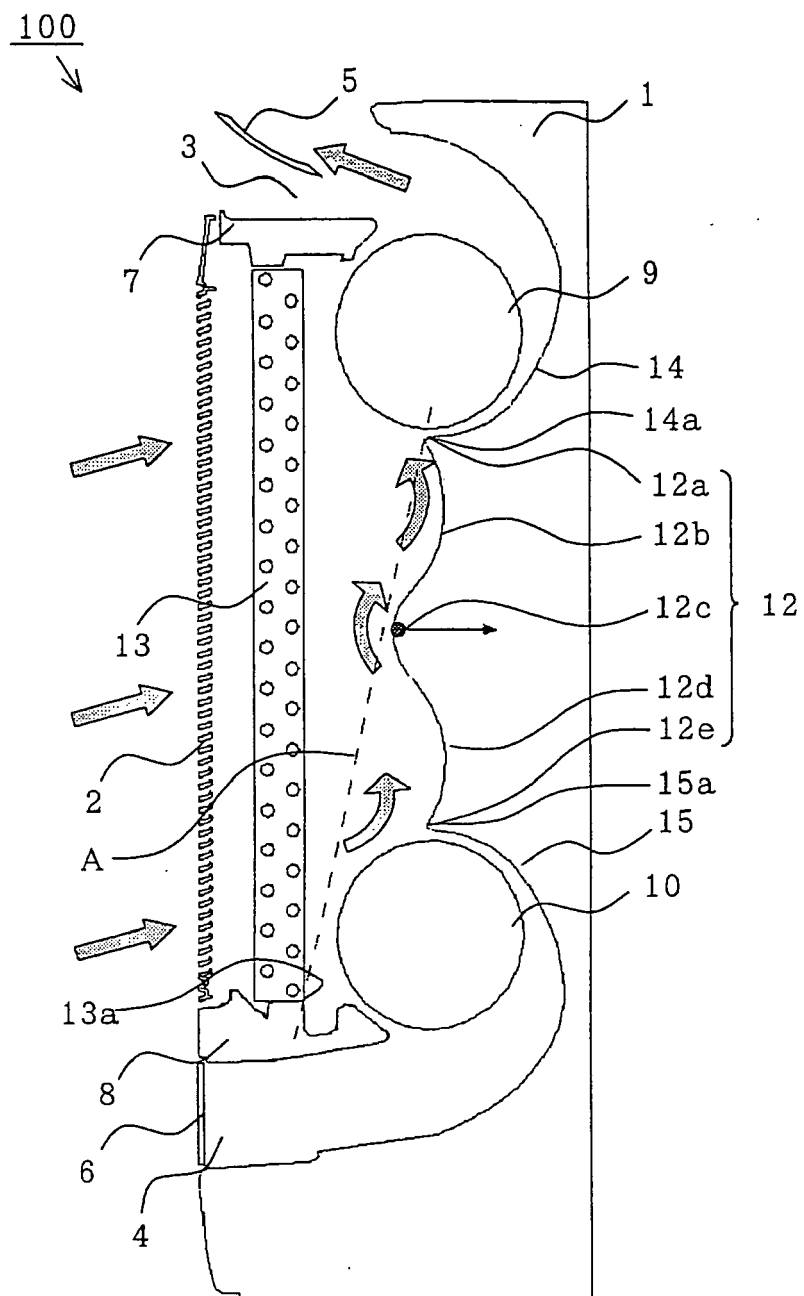
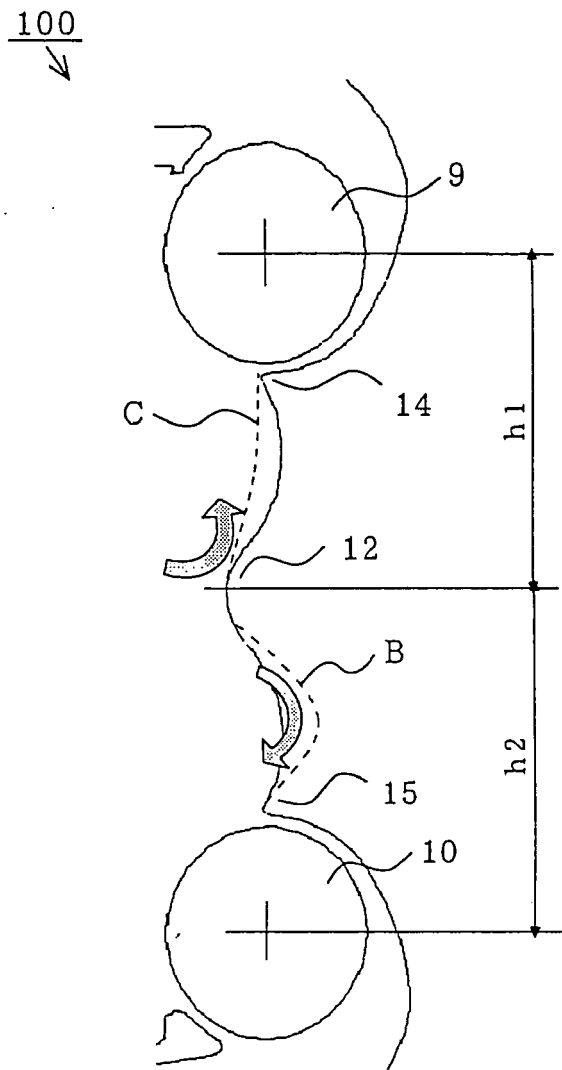


FIG. 3





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EUROPEAN SEARCH REPORT

Application Number
EP 06 25 1294

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