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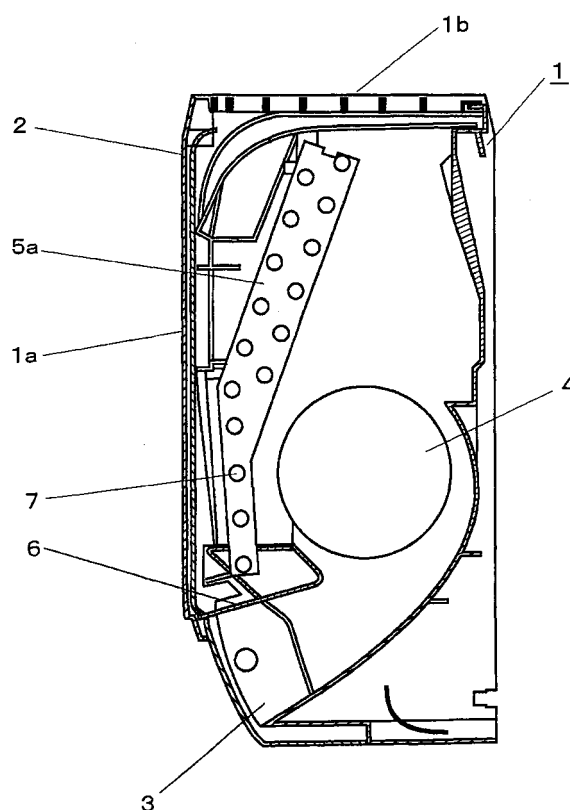
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(54) **Air conditioner**

(57) An air conditioner includes a housing (1) provided with an air suction opening (2) at a front surface (1a) or a top surface (1b) thereof; a cross flow fan (4) disposed in the housing (1); a heat exchanger (5a) installed between the air suction opening (2) and the cross flow fan (4); and a coolant tube (7) of passing through the heat exchanger (5a). The heat exchanger (5a) is fabricated as a single body whose front and rear surfaces are formed as a continuous surface and the coolant tube (7) is arranged in a single row in a lower portion of the heat exchanger while the coolant tube is arranged in two or more rows in an upper portion of the heat exchanger (5a).

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to an air conditioner having a thin and compact housing.

Background of the Invention

[0002] For an indoor split-type air conditioner in particular, there has been an increasing demand for making a housing thereof more compact and thin to enable a more efficient use of the household space. Conventionally, thinning of the housing has been achieved by reducing the housing dimension depth-wise. To this purpose, a heat exchanger is disposed between an air suction opening provided in a front or a top surface of the housing and a cross flow fan installed within the housing. For example, there has been proposed an air conditioner with a heat exchanger unit including an upper heat exchanger and a lower heat exchanger, wherein the lower heat exchanger is disposed between a front surface of a housing and a cross flow fan such that it stands almost upright on a drain pan, whereas the upper heat exchanger is connected to the upper end of the lower heat exchanger such that it is inclined toward the rear portion of the housing (see, for example, Japanese Patent Laid-open Application No. H9-210452). Here, the upper heat exchanger is designed to be thicker than the lower heat exchanger.

[0003] Fig. 4 shows a cross sectional view of a conventional air conditioner disclosed in Japanese Patent Laid-open Application No. H9-210452. As illustrated in the figure, lower heat exchanger 12 is installed between front surface 1a of the housing of the air conditioner and cross flow fan 4 such that it almost stands upright on drain pan 6, and upper heat exchanger 11 is installed on an upper end portion of lower heat exchanger 12 such that its rear surface is connected to the rear surface of lower heat exchanger 12 at joint portion 13.

[0004] Moreover, in the absence of a blocking member for preventing drain water from spurting out, front portion 14 of the lower end of upper heat exchanger 11 is cut obliquely such that its end is aligned with the front surface of lower heat exchanger 12.

[0005] However, in order to make the housing more compact, the heat exchanger accommodated therein must be reduced in size, requiring at least a partial reduction in thickness of the heat exchanger. In the above-described conventional configuration of the air conditioner, the front-to-back thickness of the upper heat exchanger is greater than that of the lower heat exchanger 9. If the two heat exchangers are disposed such that their rear surfaces are connected at the joint portion, the front portion of the lower end of the upper heat exchanger will protrude out more than the lower heat exchanger does. Accordingly, unless the front portion of the lower end of the upper heat exchanger is cut obliquely such that its

end is substantially aligned with the front surface of the lower heat exchanger, condensed water will spurt out from the housing.

[0006] Further, for the coolant tube in the heat exchanger unit partially arranged in a single row, the amount of heat exchange will be reduced and a velocity distribution of air stream passing through the heat exchanger will become non-uniform, which will, in turn, detrimentally affect the heat exchanging capacity of the of the heat exchanger or cause the temperature of the coolant tube to become non-uniform, resulting in, for example, dews condensing at the fan in hot and humid environments.

Summary of the Invention

[0007] It is, therefore, an object of the present invention to provide an air conditioner having a thin and compact housing, capable of preventing, without increasing the cost, condensed water from spurting out and dews from condensing at the fan, thereby improving its heat exchange capacity.

[0008] In accordance with a preferred embodiment of the present invention, there is provided an air conditioner including: a housing provided with an air suction opening at a front surface or a top surface thereof; a cross flow fan disposed in the housing; one heat exchanger installed between the air suction opening and the cross flow fan; and a coolant tube of passing through said one heat exchanger, wherein said one heat exchanger is fabricated as a single body whose front and rear surfaces are formed as a continuous surface and the coolant tube is arranged in a single row in a lower portion of said one heat exchanger while the coolant tube is arranged in two or more rows in an upper portion of said one heat exchanger.

Brief Description of the Drawings

[0009] The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a cross sectional view of an air conditioner in accordance with a first preferred embodiment of the present invention;

Fig. 2 sets forth a cross sectional view of an air conditioner in accordance with a second preferred embodiment of the present invention;

Fig. 3 presents a cross sectional view to illustrate an arrangement of fins in an air conditioner in accordance with a third preferred embodiment of the present invention; and

Fig. 4 shows a cross sectional view of a conventional air conditioner.

Detailed Description of the Preferred Embodiments

[0010] Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings. Here, it is to be noted that the present invention is not limited thereto.

(First preferred embodiment)

[0011] Fig. 1 is a cross sectional view of an air conditioner in accordance with a first preferred embodiment of the present invention.

[0012] As shown in Fig. 1, the air conditioner housing 1 is provided with air suction opening 2 in its front surface 1a or top surface 1b, and air discharge opening 3 at its lower portion. Further, cross flow fan 4 is disposed in a lower portion of housing 1 and front heat exchanger 5a is installed between air suction opening 2 and cross flow fan 4. When viewed from the side of the vertical cross section of the air conditioner shown in Fig. 1, front heat exchanger 5a is configured as a single body whose front and rear surfaces are formed as a continuous surface and it is installed on drain pan 6. Further, coolant tube 7 is arranged in front heat exchanger 5a in different number of rows in a lower portion and an upper portion of front heat exchanger 5a: a single row in the lower portion and two or more, e.g., two rows in the upper portion. Specifically, front heat exchanger 5a includes a number of fins 8 (see Fig. 3) arranged in parallel to each other along a horizontal direction (i.e., along a direction approximately perpendicular to the paper of Fig. 1), and coolant tube 7 is configured such that it passes through fins 8 in a zigzag pattern. Room air drawn into the air conditioner via air suction opening 2 by cross flow fan 4 is blown back out to the room through air discharge opening 3 after being cooled by heat exchanger 5a.

[0013] Below, an operation of the air conditioner having the above-described configuration will be explained.

[0014] As described, coolant tube 7 of front heat exchanger 5a is arranged in one row in the lower portion of front heat exchanger 5a and two rows in the upper portion thereof. Further, front heat exchanger 5a is fabricated as a single body whose front and rear surfaces are formed as a continuous surface. Therefore, unlike the conventional heat exchanger 10 as shown in Fig. 4, the upper portion of front heat exchanger 5a with two rows of coolant tube does not protrude out more than the lower portion thereof with the single row of coolant tube, thereby preventing condensed water from spouting out of front heat exchanger 5a.

[0015] Moreover, as a result of forming front heat exchanger 5a as a single body, a gap which used to be present at joint portion 13 between conventional upper and lower heat exchanger 11 and 12 does not exist, allowing condensed water to flow down along the entire surfaces of fins 8a uniformly, which, will, in turn, allow an effective treatment thereof.

[0016] Furthermore, in the configuration in accordance

with the first preferred embodiment, since front portion 14 of the lower end of upper heat exchanger 11 need not to be cut obliquely, an additional machining process for cutting out a part of the heat exchanger or forming a notch therein becomes unnecessary. Also, since the machining process for forming the cutout portion or the notch is not performed, no metal/material waste is generated, making the configuration of the first preferred embodiment very cost effective.

[0017] As described above, in accordance with the first preferred embodiment of the present invention, by employing the single-body heat exchanger, it is possible to avoid the configuration in which the upper portion of the heat exchanger with the coolant tube arranged in tube or more rows more protrudes out than the lower portion of the heat exchanger with the coolant tube arranged in the single row, thereby preventing condensed water from spouting out. Furthermore, due to the absence of a gap at the joint portion between the upper and the lower portion of the heat exchanger, condensed water is allowed to flow down along the entire surfaces of the fins uniformly, allowing an effective treatment thereof. In addition, a machining process for, e.g., cutting out a part of the heat exchanger or forming a notch therein becomes unnecessary and thus no metal/material waste is generated, making the configuration in accordance with the first preferred embodiment cost effective.

(Second preferred embodiment)

[0018] Fig. 2 shows a cross sectional view of an air conditioner in accordance with a second preferred embodiment of the present invention. Here, parts identical to those described in the first preferred embodiment will be assigned same reference numerals, and description thereof will be omitted.

[0019] As illustrated in Fig. 2, heat exchanger unit 5 includes front heat exchanger 5a formed as a single body; and rear heat exchanger 5b connected to the upper end portion of front heat exchanger 5a, wherein front and rear heat exchangers 5a and 5b are coupled in a substantially reversed "V" shape.

[0020] Hereinafter, an operation of the air conditioner with the above-described configuration will be explained.

[0021] In the air conditioner in accordance with the second preferred embodiment, a high-performance heat exchanger with an increased heat transfer area is realized without having to change the dimension of the housing 1 height-wise, by folding heat exchanger unit 5 multiple times. Further, with such a configuration of heat exchanger 5, the installation space for heat exchanger 5 is reduced, improving the space utilization thereof.

[0022] Moreover, by using heat exchanger unit 5 formed as a single body, the gap present at joint portion 13 of the upper and the lower heat exchangers of the conventional air conditioner, which was functionally useless therein, can be utilized as an effective heat transfer area. Therefore, the capacity of heat exchanger 5 can

be increased. Further, the velocity of airflow in the front heat exchanger 5a's lower portion where coolant tube 7 is arranged in a single row (hereinafter, simply referred to as "single-row portion"), is higher than those in the front heat exchanger 5a's upper portion and rear heat exchanger 5b where coolant tube 7 is arranged in two rows (hereinafter, simply referred to as "two-row portions"). As a result, by setting the air flow resistance of fins 8 in the single-row portion of front heat exchanger 5a to be greater than those of fins in the two-row portions of front heat exchanger 5a and rear heat exchanger 5b, an airflow velocity distribution can be made substantially uniform over the entire area of the heat exchanger unit 5 without having to install a blocking member. Consequently, the temperature of the air having passed through the single-row portion of front heat exchanger 5a can be made to be substantially identical with the temperature of the air that has passed through the two-row portions of front heat exchanger 5a and rear heat exchanger 5b. As a result, the capacity of heat exchanger unit 5 can be improved, and the condensing of dews at the fan that might be caused by the inflow of air of different temperatures can be prevented. Also, a cost-down effect can be obtained.

(Third preferred embodiment)

[0023] Referring to Fig. 3, there is provided a cross sectional view illustrating an arrangement of fins of a heat exchanger unit in accordance with a third preferred embodiment of the present invention. Here, parts identical to those described in the first or the second preferred embodiments will be assigned same reference numerals, and detailed description thereof will be omitted.

[0024] As shown in the figure, by forming slits 15 on fins 8b or increasing the number of slits 15 of fins 8b in a lower single-row portion of front heat exchanger 5a, air flow resistance of the lower single-row portion of front heat exchanger 5a, where the velocity of airflow is greater than those in two-row portions of front heat exchanger 5a and rear heat exchanger 5b with fins 8a and 8c, respectively, is increased, which, in turn, increases the capacity for heat exchange. At the same time, an airflow velocity distribution can be made substantially uniform over the entire area of the heat exchanger unit without having to install the blocking member, resulting in, as well as preventing the condensation of dews at the fan providing a cost-cutting effect.

[0025] Moreover, the air flow resistance of the lower single-row portion of front heat exchanger 5a can be increased by lowering the heights of slits 15 of fins 8b. With this configuration, an amount of air passing through the single-row portion of front heat exchanger 5a can be reduced without having to use the blocking member, preventing dews from condensing at the fan and providing a cost cutting effect.

[0026] The air conditioner in accordance with the present invention as described above employs a thin and

compact housing and is capable of preventing condensed water from spurting out or dews from condensing at the fan without increasing costs, all of which leading to an enhanced heat exchange capacity.

[0027] As described above, the air conditioner in accordance with the present invention is thin and compact and is capable of carrying out a treatment of water efficiently. Therefore, the present invention has advantages when it is applied to a multi air conditioner, a dehumidifier, or the like.

[0028] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. An air conditioner comprising:

a housing provided with an air suction opening at a front surface or a top surface thereof;
a cross flow fan disposed in the housing;
one heat exchanger installed between the air suction opening and the cross flow fan; and
a coolant tube of passing through said one heat exchanger,

wherein said one heat exchanger is fabricated as a single body whose front and rear surfaces are formed as a continuous surface and the coolant tube is arranged in a single row in a lower portion of said one heat exchanger while the coolant tube is arranged in two or more rows in an upper portion of said one heat exchanger.

2. The air conditioner of claim 1, further comprising another heat exchanger connected to an upper portion of said one heat exchanger, wherein the coolant tube is arranged in two or more rows in the said another heat exchanger, and wherein said one heat exchanger is installed in a frontal portion of the housing and said another heat exchanger is inclined toward a rear portion of the housing, the heat exchangers being arranged in a substantially reversed "V" shape.

3. The air conditioner of claim 1, wherein said one heat exchanger includes one or more fins through which the coolant tube passes and an air flow resistance of fins in the lower portion of said one heat exchanger, where the coolant tube is arranged in the single row, is set to be greater than that of fins in the upper portion of said one heat exchanger where the coolant tube is arranged in the two or more rows.

4. The air conditioner of claim 2, wherein the heat ex-

changers include one or more fins through which the coolant tube passes and an air flow resistance of fins in the lower portion of said one heat exchanger, where the coolant tube is arranged in the single row, is set to be greater than that of fins in said another heat exchanger where the coolant tube is arranged in the two or more rows.

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of said one heat exchanger is increased to be greater than that of the upper portion of said one heat exchanger or that of said another heat exchanger by adjusting the height of the slits.

5. The air conditioner of claim 1 or 2, wherein said one heat exchanger includes one or more fins through which the coolant tube passes and wherein a number of slits are formed in the lower portion of the fins, the slits having a predetermined height where the coolant tube is arranged in the single row to increase the air flow resistance of the fins. 10
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6. The air conditioner of claim 3 or 4, wherein a number of slits are formed in the lower portions of the fins where the coolant tube is arranged in the single row to increase the air flow resistance of the fins. 20
7. The air conditioner of claim 1, wherein slits are formed in the lower portion of said one heat exchanger where the coolant tube is arranged in the single row and the upper portion of said one heat exchanger where the coolant tube is arranged in the two or more rows, and the number of the slits formed in the lower portion of said one heat exchanger is greater than that in the upper portion thereof. 25
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8. The air conditioner of any one of claims 2 to 6, wherein slits are formed in the lower portion of said one heat exchanger where the coolant tube is arranged in the single row and in the upper portion of said one heat exchanger and in said another heat exchanger where the coolant tube is arranged in the two or more rows, and the number of the slits formed in the lower portion of said one heat exchanger is greater than those provided in the upper portion of said one heat exchanger or said another heat exchanger. 35
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9. The air conditioner of claim 1, wherein slits are formed in the lower portion of said one heat exchanger where the coolant tube is arranged in the single row and in the upper portion of said one heat exchanger where the coolant tube is arranged in the two or more rows, and an air flow resistance of the lower portion of said one heat exchanger is increased to be greater than that of the upper portion thereof by adjusting the height of the slits. 45
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10. The air conditioner of any one of claims 2 to 6, wherein slits are formed in the lower portion of said one heat exchanger where the coolant tube is arranged in the single row, in the upper portion of said one exchanger and in said another heat exchanger where the coolant tube is arranged in the two or more rows, and an air flow resistance of the lower portion 55

FIG. 1

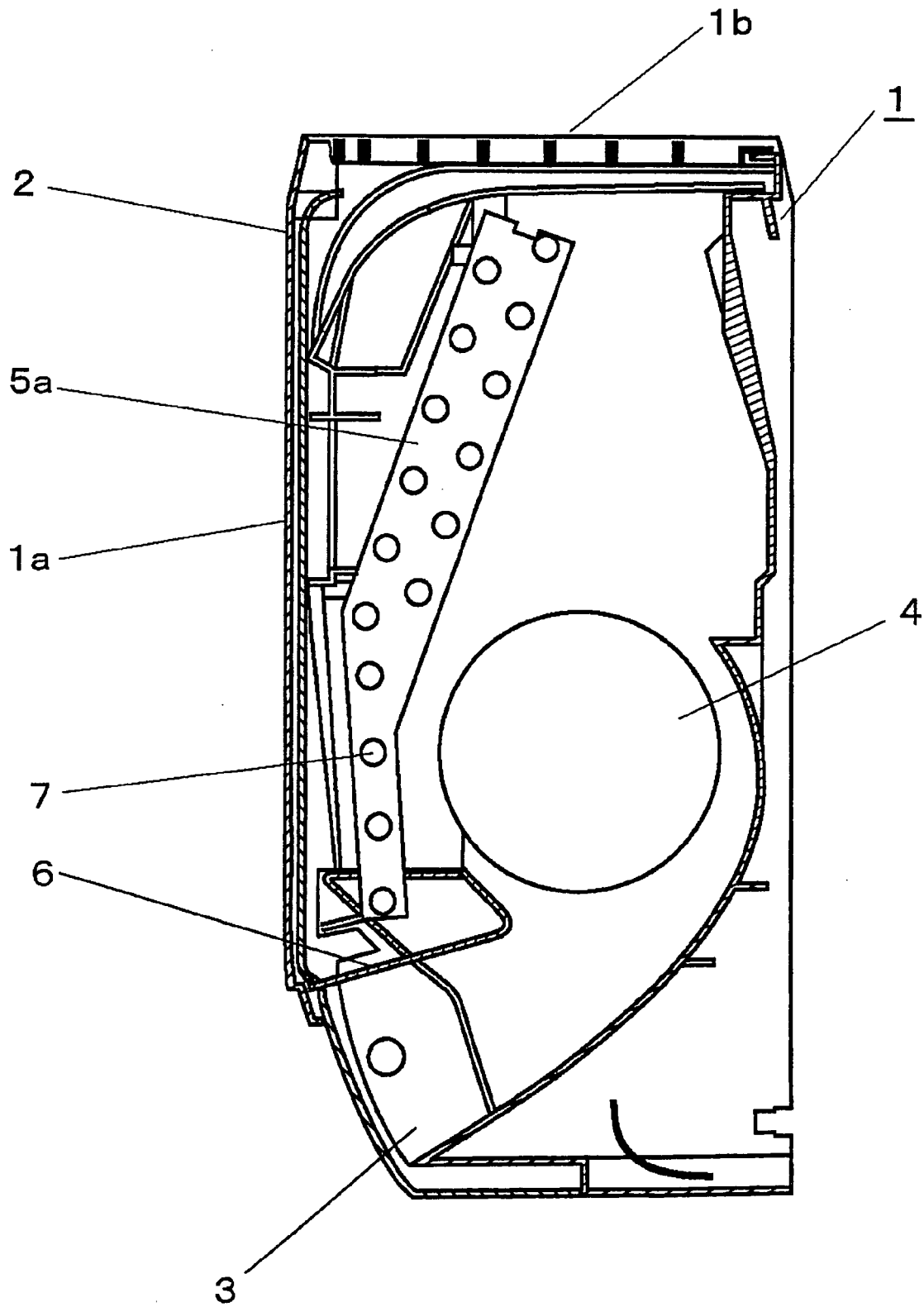


FIG. 2

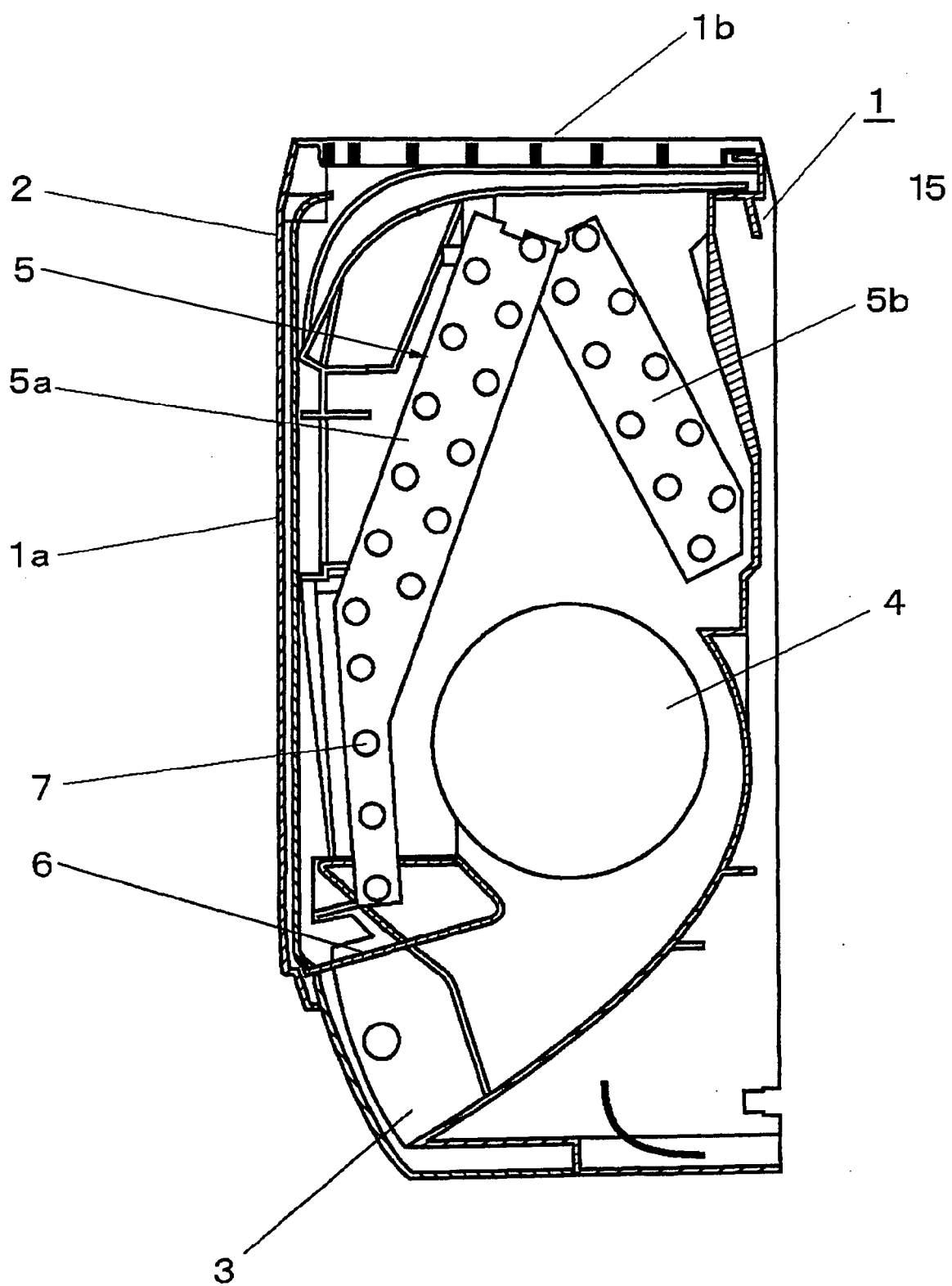


FIG. 3

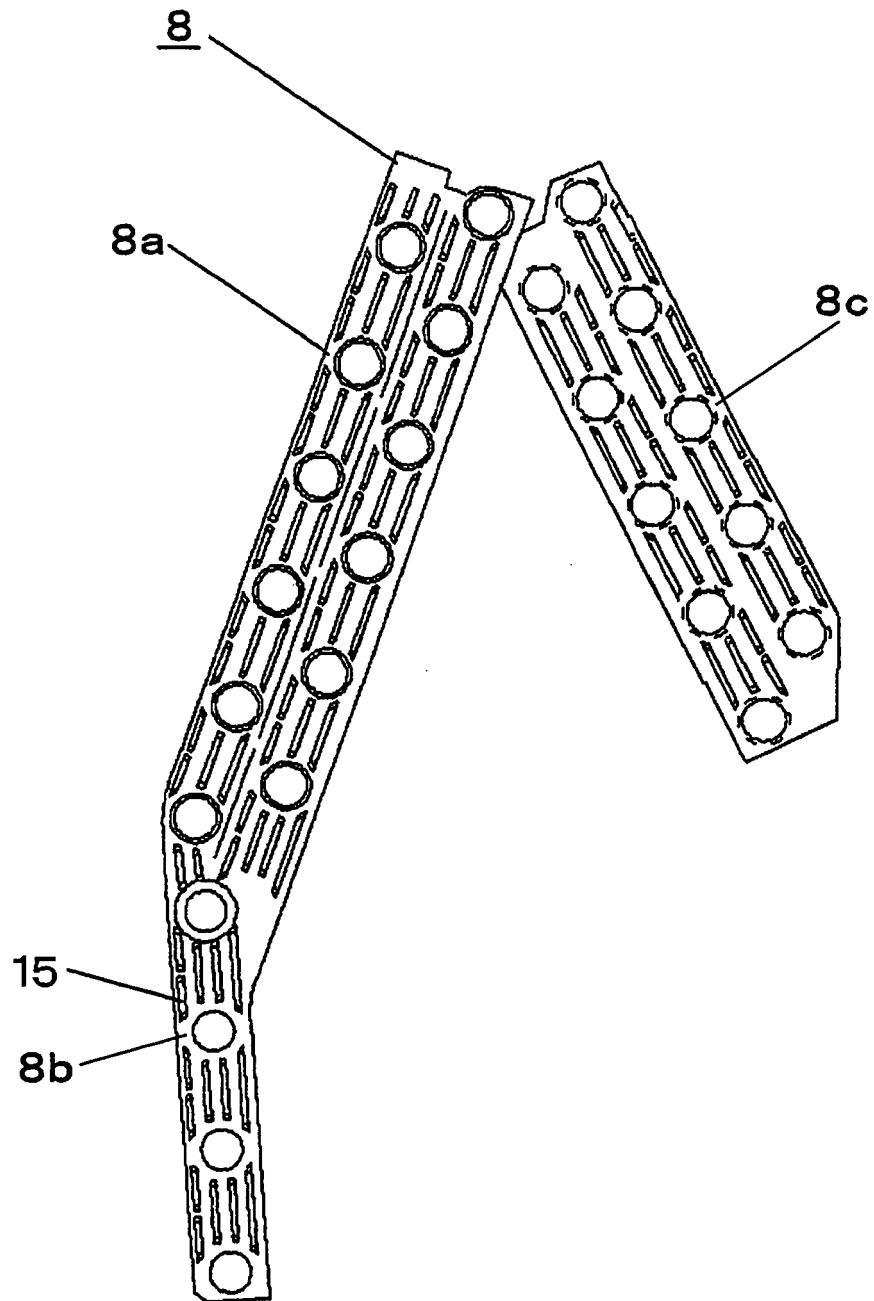


FIG. 4
(PRIOR ART)

