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Description

[TECHNICAL FIELD]

[0001] The present invention relates to a heat exchanger for motor vehicles, and more particularly it relates to a heat exchanger having a core part thereof which is provided with a plurality of corrugated fins formed with louvers thereon.

[BACKGROUND OF THE INVENTION]

[0002] Corrugated fins with louvers, used for conventional heat exchangers, are disclosed in Japanese Patent Applications Laid-Open Publication No. 9 - 61081, No. 11 - 173784, No. 2000 - 18880, No. 2002 - 350077 and No. 2003 - 83691. The corrugated fins and a plurality of tubes are alternately piled up to form a core part of the heat exchanger.

On the other hand, Japanese Patent Application Laid-Open No. 2005 - 257104 discloses a conventional integrated heat exchanger, in which corrugated fins are extended into both core parts of a radiator and a condenser. The corrugated fins are provided with a plurality of dimple portions, formed like a cylindrical projection, between the core parts of the condenser and the radiator to improve coolability of the radiator by increasing a heat radiation area.

[DISCLOSURE OF THE INVENTION]

[PROBLEM(S) TO BE SOLVED BY THE INVENTION]

[0003] The conventional heat exchangers, however, have a problem in that heat exchange efficiency thereof is poor because cooling air discharged through the core part of the condenser passes through the louvers of the core part of the radiator without sufficient introduction thereto.

In the last conventional integrated heat exchanger, the projections have no operation or effects of surely introducing the cooling air to the louvers of the core part of the radiator, although they contribute to increase in heat radiation area.

Such a problem also occurs in conventional radiators and condensers which are independent from each other and are provided with corrugated fins, respectively.

[0004] The present invention is made in order to solve the above-described problem, and its object is to provide a heat exchanger for motor vehicles which can improve coolability thereof by surely conducting cooling air to louvers arranged between core parts of the heat exchanger.

[MEANS FOR SOLVING THE PROBLEMS]

[0005] In order to solve the above-described problem, according to a first aspect of the present invention there is provided a heat exchanger for motor vehicles including

a pair of tanks located apart from each other and a core part located between the pair of tanks. The core part has a plurality of tubes and a plurality of corrugated fins arranged between the adjacent tubes, where the corrugated fins are formed with a plurality of louvers. The corrugated fins have an upstream projecting portion provided with a projecting portion so that cooling air converges downward to be conducted to the louvers by the projecting portion.

[0006] Preferably, the heat exchanger has a radiator with a core part and a condenser with a core part, the core parts being arranged near each other to have a plurality of corrugated fins, piled up alternately with tubes, so that upstream portions and downstream portions of the corrugated fins are shared for the core parts, respectively. The corrugated fins are formed with first louvers at a position corresponding to the core part of the condenser and second louvers at a position corresponding to the core part of the radiator. The projecting portion is provided on the corrugated fins between the core parts.

[0007] Preferably, the heat exchanger has a radiator with a core part and a condenser with a core part arranged near the core part of the radiator. A plurality of first corrugated fins of the radiator, piled up alternately with tubes, have upstream projecting portions, and a plurality of second corrugated fins of the condenser, piled up alternately with tubes, have downstream projecting portions to approach the upstream projecting portions. The upstream projecting portions and the downstream projecting portions have the projecting portion.

[0008] Preferably, the projecting portion projects in a direction where the cooling air flows into the louvers arranged at a downstream side of the projecting portion.

[0009] Preferably, the projecting portion includes a first projecting portion and a second projecting portion that are arranged like a V-letter shape. The first projecting portion and the second projecting portion are arranged symmetrically relative to a central line extending in a longitudinal direction of the corrugated fin at a central height thereof. The first projecting portion and the second projecting portion have linear portions whose extended lines intersect each other on the central line.

[0010] Preferably, the projecting portion includes a first projecting portion and a second projecting portion that are arranged like a V-letter shape. The first projecting portion and the second projecting portion are arranged symmetrically relative to a central line extending in a longitudinal direction of the corrugated fin at a central height thereof. The first projecting portion and the second projecting portion have curved portions which are bent to further depart from each other toward the downstream side.

[0011] Preferably, the first corrugated fins and the second corrugated fins are different in at least one of fin pitch and fin height.

[EFFECT OF THE INVENTION]

[0012] In the heat exchanger of the present invention, the heat changers include the pair of tanks located apart from each other and the core part located between the pair of tanks. The core part has the plurality of tubes and the plurality of corrugated fins arranged between the adjacent tubes, where the corrugated fins are formed with the plurality of louvers. The corrugated fins have the upstream projecting portion provided with the projecting portion so that the cooling air converges downward to be conducted to the louvers by the projecting portion. Therefore, coolability of the heat exchanger can be improved.

[0013] The heat exchanger has the radiator with the core part and the condenser with the core part, the core parts being arranged near each other to have the plurality of corrugated fins, piled up alternately with the tubes, so that the upstream portions and the downstream portions of the corrugated fins are shared for the core parts, respectively. The corrugated fins are formed with the first louvers at the position corresponding to the core part of the condenser and the second louvers at the position corresponding to the core part of the radiator. The projecting portion is provided on the corrugated fins between the core parts. This can improve especially the coolability of the radiator.

[0014] The heat exchanger has the radiator with the core part and the condenser with the core part arranged near the core part of the radiator. The plurality of first corrugated fins of the radiator, piled up alternately with the tubes, have the upstream projecting portions, and the plurality of second corrugated fins of the condenser, piled up alternately with the tubes, have the downstream projecting portions to approach the upstream projecting portions. The upstream projecting portions and the downstream projecting portions have the projecting portion. This can improve the coolability of the radiator, protecting the upstream and downstream projecting portions from buckling due to contact with their peripheral parts.

[0015] The projecting portion projects in the direction where the cooling air flows into the louvers arranged at the downstream side of the projecting portion. This enables the cooling air to be separated by the projecting portion to be well conducted to the louvers.

[0016] The projecting portion includes the first projecting portion and the second projecting portion that are arranged like the V-letter shape. The first projecting portion and the second projecting portion are arranged symmetrically relative to the central line extending in the longitudinal direction of the corrugated fin at the central height thereof. The first projecting portion and the second projecting portion have the linear portions whose extended lines intersect each other on the central line. The projecting portion can be manufactured in a simple shape and enables the cooling air to well converge downward.

[0017] The projecting portion includes the first projecting portion and the second projecting portion that are arranged like the V-letter shape. The first projecting portion

tion and the second projecting portion are arranged symmetrically relative to the central line extending in the longitudinal direction of the corrugated fin at the central height thereof. The first projecting portion and the second projecting portion have the curved portions which are bent to further depart from each other toward the downstream side. This enables the cooling air to well converge downward, enhancing torsion rigidity of the corrugated fins.

[0018] The first corrugated fins and the second corrugated fins are different in at least one of the fin pitch and the fin height. The fin pitches and the fin heights thereof can be set appropriately in compliance with respective demands from heat radiation of the radiator and the condenser.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0019] The objects, features and advantages of the present invention will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front perspective view showing an integrated heat exchanger of a first embodiment according to the present invention;

FIG. 2 is a front view showing the integrated heat exchanger of the first embodiment;

FIG. 3 is an enlarged side view showing a core part of the integrated heat exchanger of the first embodiment, taken along a line S3 - S3 in FIG. 1;

FIG. 4 is a cross sectional side view showing a corrugated fin used for the core part, taken along a line S4 - S4 in FIG. 3;

FIG. 5 is a cross sectional rear view showing the corrugated fin, taken along a line S5 - S5 in FIG. 3;

FIG. 6 is a perspective rear view showing a test model of the corrugated fin used in the first embodiment;

FIG. 7 is an enlarged side view showing the corrugated fin having dimples and a heat insulating portion used in the first embodiment;

FIG. 8 is an enlarged side view explaining an operation of the corrugated fin used in the first embodiment;

FIG. 9 is a cross sectional bottom view explaining the operation of the corrugated fin used in the first embodiment;

FIG. 10 is a rear perspective view showing a half part of a first test model of a corrugated fin A1 to be compared with the corrugated fin used in the first embodiment, where the other half of the first test model is symmetrically constructed although not illustrated;

FIG. 11 is a ; a rear perspective view showing a half part of a second test model of a corrugated fin A2 to be compared with the corrugated fin used in the first embodiment, where the other half of the first test model is symmetrically constructed although not il-

lustrated;

FIG. 12 is a rear perspective view showing a third test model of a corrugated fin A3 to be compared with the corrugated fin used in the first embodiment; FIG. 13 is a rear perspective view showing a fourth test model of a corrugated fin A4 to be compared with the corrugated fin used in the first embodiment; FIG. 14 is a rear perspective view showing a fifth test model of a corrugated fin A5 to be compared with the corrugated fin used in the first embodiment; FIG. 15 is a rear perspective view showing a half part of a sixth test model of a corrugated fin A6 to be compared with the corrugated fin used in the first embodiment, where the other half of the first test model is symmetrically constructed although not illustrated;

FIG. 16 is a rear perspective view showing a seventh test model of a corrugated fin A7 to be compared with the corrugated fin used in the first embodiment; FIG. 17 is a table showing test results of the first corrugated fin of the first embodiment and first to seventh corrugated fins;

FIG. 18 is a side view showing a corrugated fin used for a heat exchanger of a second embodiment according to the present invention;

FIG. 19 is a cross sectional bottom view explaining an operation of the corrugated fin used in the second embodiment, taken along a line S19 - S19;

FIG. 20 is a side view showing a corrugated fin used for a heat exchanger of a third embodiment;

FIG. 21 is a cross sectional bottom view showing the corrugated fin, taken along a line S21 - S21 in FIG. 20;

FIG. 22 is a perspective front view showing a radiator and a condenser of the third embodiment before they are assembled with each other;

FIG. 23 is a perspective front view showing the radiator and the condenser of the third embodiment after they are assembled with each other;

FIG. 24 is a side view showing a corrugated fin used in a fourth embodiment according to the present invention;

FIG. 25 is a rear perspective view showing a corrugated fin as a modification of the corrugated fins of the embodiments; and

FIG. 26 is a cross sectional bottom view showing a corrugated fin as another modification of the corrugated fins of the embodiments.

[DESCRIPTION OF REFERENCE NUMBERS]

[0020]

B1 receiving bracket
B2 inserting bracket
P1 inlet port
P2 outlet port
R1 first chamber

R2 second chamber
R3 third chamber
R4 fourth chamber
S 1 partition plate

5 1 Radiator
1a core part
1b first tank
1c second tank
1d tube
10 1e mounting pin
2 condenser
2a core part
2b first tank
2c second tank
15 2d tube
2e connector
2f, 2g, 2h connecting pipe
2i receiver
3 corrugated fin
20 3a first louver
3b second louver
3c first dimple portion
3d second dimple portion
3e linear portion
25 3f semicircular portion
3g first slit portion
3h second slit portion
3i heat insulating portion
4, 5 reinforcement
30 20 corrugated fin
20a upstream end portion
21 first projecting portion
22 second projecting portion 23 first dimple portion
24 second dimple portion
35 30 corrugated fin
30a downstream end portion
31 first projecting portion
32 second projecting portion
41 first projecting portion
40 42 second projecting portion
50, 51, 53 louver
52 return louver

[BEST MODE FOR CARRYING OUT THE INVENTION]

45 [0021] Embodiments of the present invention will be described below with reference to the accompanying drawings. Throughout the following detailed description, similar reference characters and numbers refer to similar elements in all figures of the drawings, and their descriptions are omitted for eliminating duplication.

[0022] A first embodiment will be described.

Herein, "a longitudinal direction of a motor vehicle" is expressed as "a frontward and rearward direction", and "a lateral direction of the motor vehicle" is expressed as "a left and right direction".

55 [0023] First a construction of the first embodiment will be described.

Referring to FIG. 1 to FIG. 3, in the first embodiment, a heat exchanger for motor vehicles employs an integrated heat exchanger including a radiator 1 and a condenser 2 that is arranged in front of the radiator 1, being integrally assembled therewith.

[0024] The radiator 1 is what is called a parallel-flow type radiator in which a pair of tanks 1b and 1c is located at a right side and a left side of a core part 1a, respectively. The core part 1a includes a plurality of tubes 1d and a plurality of corrugated fins 3, where both end portions of the tubes 1d are inserted in and fixed to the first and second tanks 1b and 1c, respectively, and each of the corrugated fins 3 is disposed between the adjacent tubes 1d. The corrugated fins 3 are shared with the core part 1a of the radiator 1 and a core part 2a of the condenser 2.

[0025] On top and bottom portions of the first and second tanks 1b and 1c, four mounting pins 1e are vertically provided, respectively, for mounting the integrated heat exchanger on the motor vehicle. An inlet port P1 is provided on a rear surface of the first tank 1b, and an outlet port P2 is provided on a rear surface of the second tank 1c.

[0026] The condenser 2 is equipped with a pair of tanks 2b and 2c at a right side and a left side of the core part 2a, respectively.

The core part 2a includes a plurality of tubes 2d and the corrugated fins 3, where both end portions of the tubes 2d are inserted in and fixed to the first tank 2b and the second tank 2c, respectively, and each of the corrugated fins 3 is disposed between the adjacent tubes 2d.

[0027] As shown in FIG. 2, an inner space of the first tank 2b is divided by a partition plate S1 into a first chamber R1 and a fourth chamber R4, and an inner space of the second tank 2c is divided by another partition plate S1 into a second chamber R2 and a third chamber R3.

[0028] On the first tank 2b, a connector 2e is provided to fluidically communicate with the first chamber R1, and a connecting pipe 2f is provided to fluidically communicate with the fourth chamber R4, while, on the second tank 2c, a receiver tank 2j is provided to fluidically communicate with the second chamber R2 through a connecting pipe 2g and also with the third chamber R3 through a connecting pipe 2h.

[0029] A pair of reinforcements 4 and 5 are inserted into and fixed to upper end portions of the first tanks 1b and 2b of the radiator 1 and condenser 2 and lower end portions of the second tanks 1c and 2c thereof, respectively. Accordingly, the radiator 1 and the condenser 2 are integrally connected with each other by the pair of the reinforcements 4 and 5.

[0030] As shown in FIG. 3 to FIG. 6, in the first embodiment, the corrugated fins 3 are formed with a plurality of first louvers 3a at a position corresponding to the core part 2a of the condenser 2 and a plurality of second louvers 3b at a position corresponding to the core part 1a of the radiator 1, the first and second louvers 3a and 3b being raised in directions opposite to each other.

[0031] The corrugated fins 3 are formed with a first

dimple portion (a first projecting portion) 3c and a second dimple portion (a second projecting portion) 3d, which are arranged along an appropriate V-letter shape, at the radiator core part side so that cooling air converges from a front side (an upstream side of the cooling airflow) toward a rear side (a downstream side of the cooling airflow). The first and second dimple portions 3c and 3d correspond to a projecting portion of the present invention.

[0032] The first dimple portion 3c is designed to project in a direction where the cooling air passing through the first louvers 3a flows into the second louvers 3b as shown in FIG. 9. The second dimple portion 3d is designed similarly.

[0033] As shown in FIG. 7, the first and second dimple portions 3c and 3d are arranged symmetrically to each other relative to a central line Z1 extending in a longitudinal direction of the corrugated fin 3 at a central height thereof. The first and second dimple portions 3c and 3d are inclined at the same angle relative to the central line Z1 so that extended lines thereof intersect with each other at their downstream side at a predetermined angle of α . The angle α is preferably set to be approximately 90°.

[0034] The first and second dimple portions 3c and 3d are formed to have a cross section having a pair of linear portions 3e and a pair of semicircular portions 3f connected with both end portions of the linear portions 3e. They are press-formed with the first and second louvers 3a and 3b at the same time when the corrugated fin 3 is manufactured, or they are formed by press working in advance of corrugation formation of material to be the corrugated fin 3.

[0035] The height H, as shown in FIG. 5, width W, length L and angle α of the first and second dimple portions 3c and 3d may be set appropriately.

[0036] A portion of the corrugated fin 3 at the condenser core part side is provided with a first slit portion 3g and a second slit portion 3h, where the first slit portion 3g extends downward from a top portion of a folded portion of the corrugated fin 3 and the second slit portion 3h extends upward from a bottom portion of the folded portion so that they exceed the central line X1 to be overlapped with each other. They form a heat insulating portion 3i that vertically and zigzag connects an upstream portion and a downstream portion of the corrugated fin 3.

[0037] The heat insulating portion 3i may have a shape different from that of the first embodiment, and it may be removed according to the level of need.

[0038] Aluminum is used for all parts of the integrated heat exchanger, and one side portions of connecting portions of the parts are provided thereon with clad layers (brazing sheets) of brazing material. The parts are temporarily assembled, and then they are heat-treated in a not-shown heat furnace, so that the connecting portions of the parts are brazed and fixed with each other.

[0039] Next the operation of the corrugated fin 3 of the first embodiment will be described.

In the integrated heat exchanger of the first embodiment,

a cooling medium, which enters the first tank 1b at a temperature of approximately 110°C from a not-shown engine side through the inlet port P1 of the radiator 1, is cooled down to approximately 60°C, while it flows through the tubes 1d, due to heat exchange between the cooling medium and the cooling air (ram airflow generated when the motor vehicle is running and/or airflow generated by the motor fan) passing through the core part 1a. The cooled cooling medium enters the second tank 1c, and then it is discharged toward the engine side through the outlet port P2.

[0040] On the other hand, a cooling medium, which enters the first chamber R1 of the first tank 2b of the condenser 2 at a temperature of approximately 70°C from a not-shown compressor side through the connector 2e, is heat-exchanged between the cooling medium and the cooling air passing through the core part 2a of the condenser 2 while it flows through the tubes 2d fluidically connecting the first chamber R1 and the second chamber R2.

[0041] The cooling medium entering the second chamber R2 is conducted to the receiver tank 2j through the connecting pipe 2g, being gas-liquid separated therein. Only the liquid cooling medium enters the third chamber R3 through the connecting pipe 2h, and then it is supercooled down to approximately 45°C due to heat exchange between the cooling medium and the cooling air while it flows through the tubes 2d fluidically connecting the third chamber R3 and the fourth chamber R4.

[0042] The supercooled cooling medium in the fourth chamber R4 is discharged to a not-shown evaporator side through the connecting pipe 2f and the connector 2e.

[0043] As shown in FIG. 8 and FIG. 9, the cooling air CA, indicated by dashed arrows, enters from a front side of the integrated heat exchanger and passes the first louvers 3a that correspond to the core part 2a of the condenser 2. Then it flows, being separated by the first and second dimple portions 3c and 3d; along a first flow path X1 where it flows along insides of the first and second dimple portions 3c and 3d to run through the second louvers 3b that correspond to the core part 1a of the radiator 1, and also along a second flow path X2 where it passes over the corrugated fin 3 in a lateral direction of the corrugated fin 3 to flow along outsides of the first and second dimple portions 3c and 3d and return, then running through the second louvers 3b. This enables the cooling air to be avoided from flowing away from the first louvers 3a in the lateral direction, thus surely flowing through the second louvers 3b to improve a heat radiation performance of the corrugated fin 3.

[0044] In addition, the heat insulating portion 3i suppresses heat transfer from a radiator side toward a condenser side in the corrugated fin 3. This can suppress harmful effects due to heat transfer between the core parts 1a and 2a.

Incidentally, the heat insulating portion 3i is preferably provided between the core parts 1a and 2a, at the condenser side where the condenser 2 is arranged at the

upstream side of the cooling air CA and a temperature of the cooling medium thereof is low. The first and second dimple portions 3c are preferably provided at the radiator side, where a temperature of the cooling medium of the radiator 1 is high.

[0045] FIG. 17 shows the test results in the heat radiation test which measured and compared the corrugated fin 3 of the first embodiment and corrugated fins A1 - A7 with various shapes shown in FIG. 10 to FIG. 16. The corrugated fin A2 has a conventional normal shape.

In the test, the cooling air CA is simulated as that generated when a motor vehicle runs at vehicle speeds of 40 to 120 km/h at an outside air temperature of 20°C, and, as shown in FIG. 6, pressures and temperatures of the cooling air CA were measured at an inlet Y1 of the corrugated fin 3 and its temperatures were measured at an outlet Y2 thereof. In the table of FIG. 17, each measured temperature is indicated by "TEMP (°C)", and each measured pressure is indicated by "PRES (Pa)".

[0046] As shown in FIG. 17, the temperature of the corrugated fin 3 of the first embodiment is the highest at the outlet Y2 compared to those of the corrugated fins A1 to A7. This demonstrates that the corrugated fin 3 of the first embodiment is superior to the corrugated fins A1 to A7 in the heat radiation performance.

In addition, the pressure at the inlet Y1 is low, thus a flow resistance being low. This demonstrates that the first embodiment can provide smooth flow of the cooling air CA. Incidentally, although the similar test was conducted by using a corrugated fin having first and second dimple portions shaped like a V-letter where the first and second dimple portions so that cooling air CA diffuses from the front side toward the rear side thereof, this test cannot produce favorable result.

[0047] The effects of the corrugated fin of the first embodiment will be described.

As described above, the integrated heat exchanger of the first embodiment is constructed so that the core part 1a of the radiator 1 and the core part 2a of the condenser 2 are arranged near each other and that the corrugated fins 3 are piled up alternately with the tubes 1d and 2d of the core part 1a and the core part 2a to be shared therewith. The first and second louvers 3a and 3b are formed, rising in the opposite directions, at the position of the corrugated fin 3 corresponding to the core part 2a of the condenser 2 and at the position thereof corresponding to the core part 1a of the radiator 1, respectively, and the first and second dimple portions 3c and 3d are provided between the core part 1a and the core part 2a. Therefore, the cooling air CA can be surely conducted to the second louvers 3b at the core part 1a side, which especially improves coolability of the radiator 1.

[0048] The first and second dimple portions 3c and 3d are projected in the directions where the cooling air CA passing through the first louvers 3a flows into the second louvers 3b at the downstream side. This enables the cooling air CA to hit the first and second dimple portions 3c and 3d to separate therefrom, then being well conducted

to the second louvers 3b.

[0049] The projecting portion consists of the first and second dimple portions 3c and 3d that are arranged like the V-letter shape so that the cooling air CA converges from the upstream side of the cooling air CA toward downstream side. In addition, they are arranged symmetrically relative to the central line Z1 extending in the longitudinal direction of the corrugated fin 3 at the central height thereof, and they have the linear portions 3e whose extended lines intersect with each other on the central line Z1. Therefore, they can be manufactured in a simple shape to converge the cooling air CA toward the downstream side.

[0050] With the first and second dimple portions 3c and 3d, the heat insulating portion 3i is press-formed to vertically zigzag connect portions of the corrugated fin 3, consisting of the first and second opening portions 3g and 3h provided so that they respectively extend from the top portion and the bottom portion of the folded portion of the corrugated fin 3 toward the central line Z1 to overlap with each other. This improves the coolability of the radiator 1, suppressing the heat transfer from the radiator 1 to the condenser 2 to decrease deterioration in the coolability of the condenser 2.

[0051] Next a heat exchanger of a second embodiment according to the present invention will be described.

[0052] As shown in FIG. 18, in the second embodiment, a radiator 1 is independently used, where a core part 1a of the radiator 1 is equipped with a plurality of corrugated fins 20 only for the radiator 1. The corrugated fin 20 for the core part 1a of the radiator 1 is projected toward an upstream side from the core part 1a, and this upstream projecting portion is formed with a first projecting portion 21 and a second projecting portion 22 that are arranged like a V-letter shape so that an interval between the first and second projecting portions 21 and 22 becomes narrower toward a downstream side.

[0053] In the second embodiment, each of the first and second projecting portions 21 and 22 consists of two dimple portions 23 and 24, formed in a quadrangular pyramid shape, which project in a direction where cooling air CA flows into louvers 3b of the corrugated fin 20 as shown in FIG. 19.

An angle β between the first and second projecting portions 21 and 22 is set to be 90° .

Incidentally, the first and second projecting portions 21 and 22 may consist of more than two dimple portions, or they may employ the first and second dimple portions 3c and 3d of the first embodiment.

The sizes, shapes and angle β of the dimple portions 23 and 24, and a length of the upstream projecting portion of the corrugated fin 20 may be set appropriately.

[0054] The operation of the corrugated fin 20 of the second embodiment is similar to that of the first embodiment, and its explanation is omitted.

[0055] In the second embodiment, as shown in FIG. 19, the cooling air CA converges by the first and second projecting portions 21 and 22 to converge and flow down-

ward, thus being surely conducted to the louvers 3b. This increases a heat exchange efficiency to improve coolability of the radiator 1.

[0056] In addition, the upstream projecting portion increases a heat radiation area and can conduct the cooling air CA to the louvers 3b.

[0057] Next heat exchangers of a third embodiment according to the present invention will be described.

[0058] As shown in FIG. 20 and FIG. 21, a radiator 1 and a condenser 2 have a plurality of first corrugated fins 20 and a plurality of second corrugated fins 30, respectively. The second corrugated fins 30 of a core part 2a of the condenser 2 project downward from the core part 2a to have downstream projecting portions so that their downstream end portions 30a are arranged near upstream end portions 20a of the second corrugated fins 20. Each of the downstream projecting portions of the first corrugated fins 30 is formed with a first projecting portion 31 and a second projecting portion 32. The first and second projecting portions 31 and 32 have shapes similar to those of the first projecting portion 21 and the second projecting portion 22 of the corrugated fin 20, and each of the first and second projecting portions 31 and 32 consists of two dimple portions 33 and 34. On the other hand, each of the first and second projecting portions 21 and 22 formed on the second corrugated fins 20 consists of two dimple portions 23 and 24 similarly to those of the second embodiment.

Incidentally, although the dimple portions 22, 23, 33 and 34 have the same shapes in this embodiment, they may have different shapes. A distance between the downstream end portion 30a and the upstream end portion 20a may be set appropriately.

[0059] In addition, as shown in FIG. 22, in the heat exchangers of the third embodiment, the radiator 1 has a pair of tanks 1b and 1c, on their upper portions and lower portions, which are respectively provided with four receiving brackets B1 that are shaped like an L-letter opening upward and project forward, while the condenser 2 has a pair of tanks 2b and 2c, on their upper portions and lower portions, which are respectively provided with four inserting brackets B2 that are shaped like a plate and project laterally outwardly. As shown in FIG. 23, the inserting brackets B2 of the condenser 2 are inserted from above into the brackets B1 of the radiator 1 to engage with each other, thereby integrally fixing the radiator 1 and the condenser 2 with each other.

[0060] In the third embodiment, the downstream projecting portions of the corrugated fins 30 and the upstream projecting portions of the corrugated fins 20 increase heat radiation areas thereof, thus improving coolability of the radiator 1 and that of the condenser 2 and suppressing harmful effects due to heat transfer the radiator 1 and the condenser 2.

[0061] The cooling air surely converges toward the downstream side and is conducted to the louvers 3b by using the first and second projecting portions 31 and 32 of corrugated fins 30 of the condenser 2 and the first and

second projecting portions 21 and 22 of the corrugated fins 20 of the radiator 1.

[0062] When the radiator 1 is independently used like the second embodiment, buckling of the upstream projecting portions of the corrugated fins 20 may occur due to contact with their peripheral parts, while, in the third embodiment, the upstream projecting portions of the corrugated fins 20 and the downstream projecting portions of the corrugated fins 30 are arranged so that the downward end portions 30a and the upstream end portions 20a are arranged near each other. Therefore, they are protected from the buckling.

[0063] In addition, in the third embodiment, the fin pitches and heights of the corrugate fins 20 and the corrugated fins 30 may be set to be different from each other, and accordingly they may be set appropriately in compliance with respective demands from heat radiation of the radiator 1 and the condenser 2.

[0064] Next a fourth embodiment according to the present invention will be described.

[0065] As shown in FIG. 24, in an integrate heat exchanger of the fourth embodiment, a corrugated fin 3 has a first projecting portion 41 and a second projecting portion 42 formed to have curved portions instead of the liner portions 3e of the first embodiment so that the curved portions are bent to further depart from each other toward a downstream side

[0066] Therefore, in the fourth embodiment, the first and second projecting portions 41 and 42 enable the cooling air to effectively converge toward the downstream side, and they enhance torsional rigidity of the corrugated fins 3.

[0067] The foregoing invention has been described in terms of preferred embodiments. However, it is believed obvious that modification and variation of the present invention is possible in light of the above teachings.

[0068] For example, the louvers and tubes may be appropriately set in the number, length, thickness, angles, arrangement and so forth.

[0069] The heat insulating portion is not indispensable, and, as shown in FIG. 25 of a modification, they may be replaced by two louvers 50 and 51 connected at both end portions thereof that form openings therebetween. These louvers 50 and 51 can provide the similar effects.

[0070] As shown in FIG. 26, in another modification of the corrugated fins of the embodiments, a return louver 52 and third louvers 53 may be provided at the downstream side of the second louvers 3b so that the cooling air CA, passing through the second louvers 3b and changed its flow direction, changes again the flow direction by the third louvers 53.

[INDUSTRIAL AVAILABILITY]

[0071] The integrated heat exchanger of the present invention is available to those used for motor vehicles and others as long as it cools cooling medium flowing through a core part by cooling air through corrugated fins.

Claims

1. A heat exchanger (1, 2) for a motor vehicle comprising:

a pair of tanks (1b, 1c; 2b, 2c) located apart from each other; and

a core part (1a 2a) located between the pair of tanks (1b, 1c; 2b, 2c) and having a plurality of tubes (1d; 2d) and a plurality of corrugated fins (3; 20; 30) arranged between the adjacent tubes (1d; 2d), the corrugated fins (3; 20; 30) being formed with a plurality of louvers (3a, 3b; 50, 51, 53) wherein

the corrugated fins (3; 20; 30) have an upstream projecting portion provided with a projecting portion (3c, 3d; 21, 22; 31, 32; 41, 42) so that cooling air (CA) converges downward to be conducted to the louvers (3a; 53) by the projecting portion (3c, 3d; 21, 22; 31, 32; 41, 42).

2. The heat exchanger (1, 2) according to claim 1, wherein

the heat exchanger has a radiator (1) with a core part (1a) and a condenser (2) with a core part (2a), the core parts (1a, 2a) being arranged near each other to have a plurality of corrugated fins (3), piled up alternately with tubes (1d; 2d), so that upstream portions and downstream portions of the corrugated fins (3) are shared for the core parts (1a, 2a), respectively, wherein

the corrugated fins (3) are formed with first louvers (3a) at a position corresponding to the core part (2a) of the condenser (2) and second louvers (3b) at a position corresponding to the core part (1a) of the radiator (1), and wherein

the projecting portion (3c, 3d; 21, 22; 31, 32; 41, 42) is provided on the corrugated fins (3) between the core parts (1a, 2a).

3. The heat exchanger (1, 2) according to claim 1, wherein

the heat exchanger has a radiator (1) with a core part (1a) and a condenser (2) with a core part (2a) arranged near the core part (1a) of the radiator (1), wherein

a plurality of first corrugated fins (20) of the radiator (1), piled up alternately with tubes (1d), have upstream projecting portions, and a plurality of second corrugated fins (30) of the condenser (2), piled up alternately with tubes (2d), have downstream projecting portions to approach the upstream projecting portions, and wherein

the upstream projecting portions and the downstream projecting portions have the projecting portion (21, 31).

4. The heat exchanger (1, 2) according to any one of

claims 1 to 3, wherein
 the projecting portion (3c, 3d; 21, 22; 31, 32; 41, 42)
 projects in a direction where the cooling air (CA)
 flows into the louvers (3b) arranged at a downstream
 side of the projecting portion (3c, 3d; 21; 31).

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5. The heat exchanger (1, 2) according to any one of
 claims 1 to 4, wherein
 the projecting portion (3c, 3d; 21; 31) includes a first
 projecting portion (3c; 23; 33) and a second project-
 ing portion (3d; 24; 34) that are arranged like a V-
 letter shape, wherein
 the first projecting portion (3c; 23; 33) and the second
 projecting portion (3d; 24; 34) are arranged symmet-
 rically relative to a central line (Z1) extending in a
 longitudinal direction of the corrugated fin (3; 20; 30)
 at a central height thereof, and wherein
 the first projecting portion (3c; 23; 33) and the second
 projecting portion (3d; 24; 34) have linear portions
 (3e) whose extended lines intersect each other on
 the central line (Z1).

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6. The heat exchanger (1, 2) according to any one of
 claims 1 to 4, wherein
 the projecting portion includes a first projecting por-
 tion (41) and a second projecting portion (42) that
 are arranged like a V-letter shape, wherein
 the first projecting portion (41) and the second pro-
 jecting portion (42) are arranged symmetrically re-
 lative to a central line (Z1) extending in a longitudinal
 direction of the corrugated fin (3) at a central height
 thereof, and wherein
 the first projecting portion (41) and the second pro-
 jecting portion (42) have curved portions which are
 bent to further depart from each other toward the
 downstream side.

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7. The heat exchanger (1, 2) according to any one of
 claims 1 to 6, wherein
 the corrugated fins (20, 30) includes first corrugated
 fins (20) for a radiator (1) and second corrugated fins
 (30) for a condenser (2), the first corrugated fins (20)
 and the second corrugated fins (30) being different
 in at least one of fin pitch and fin height.

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FIG. 1

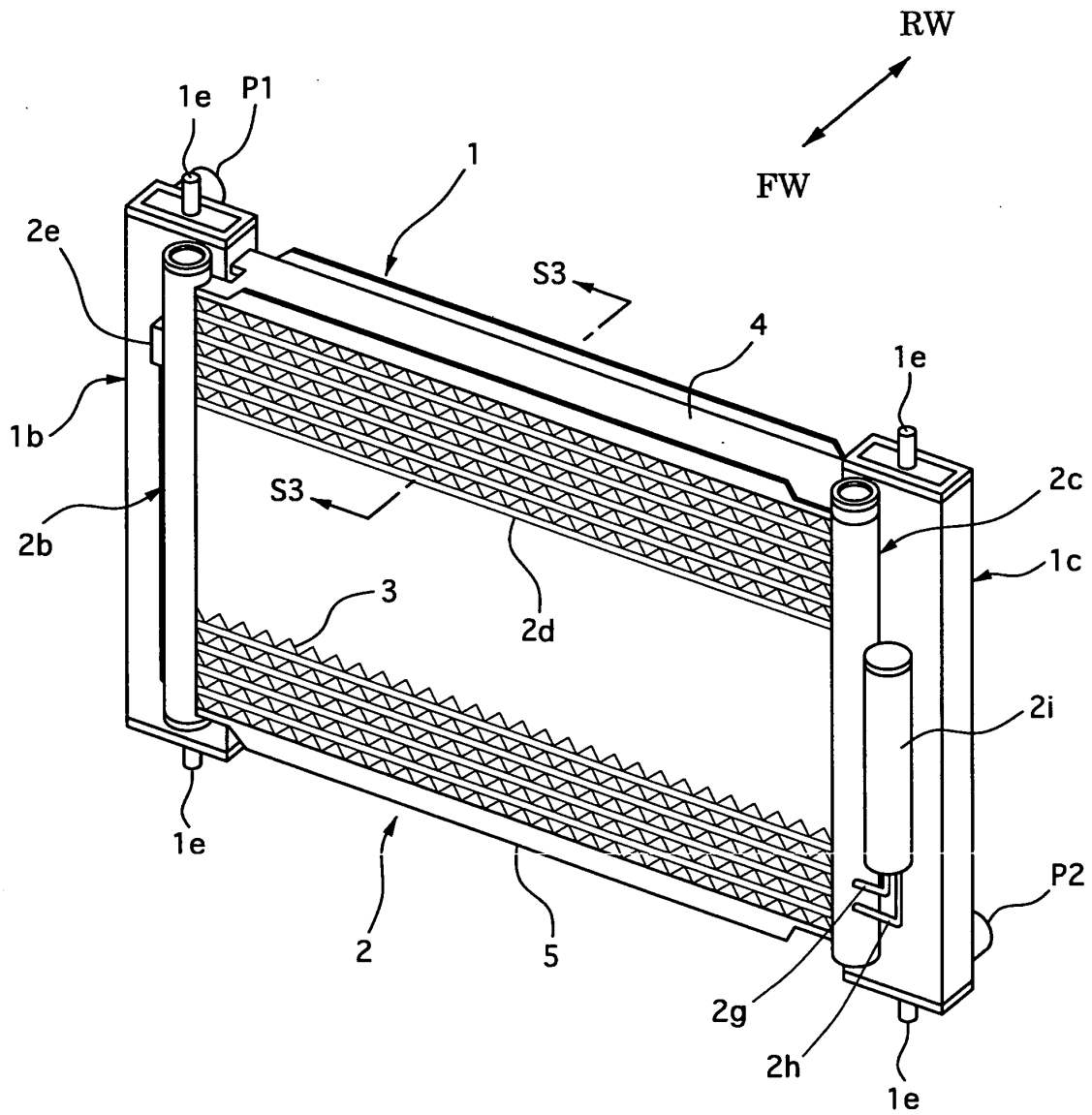


FIG. 2

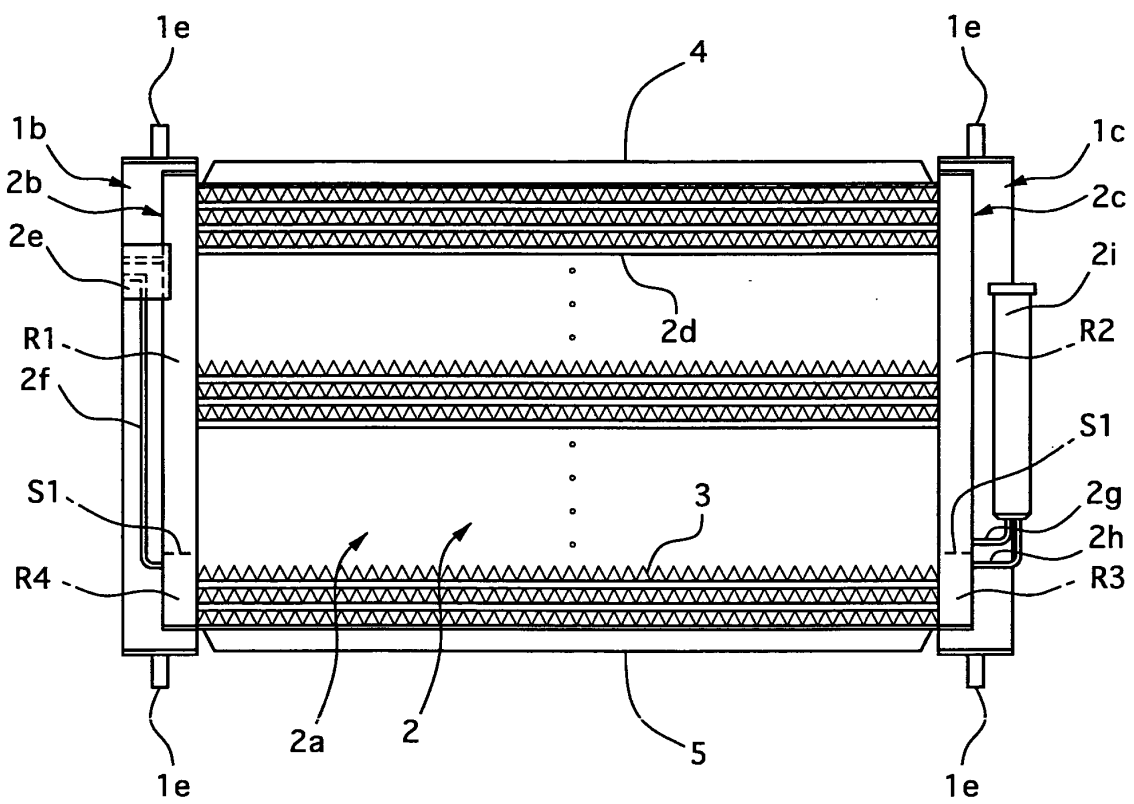


FIG. 3

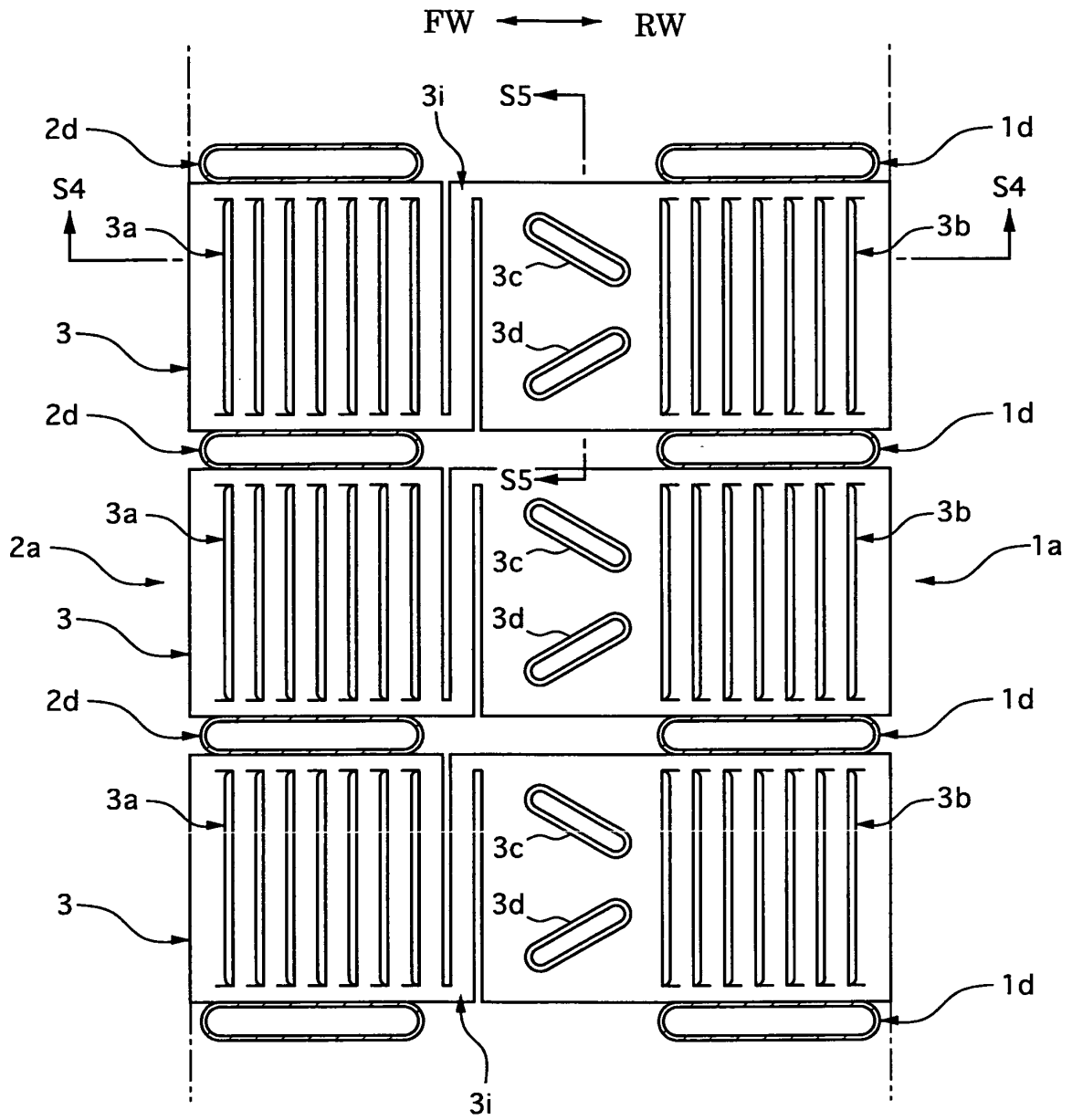


FIG. 4

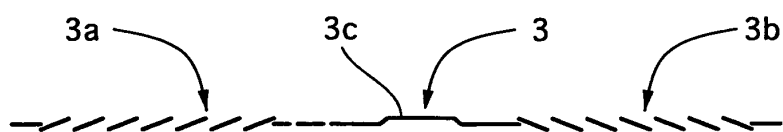


FIG. 5

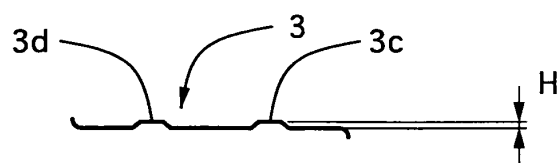


FIG. 6

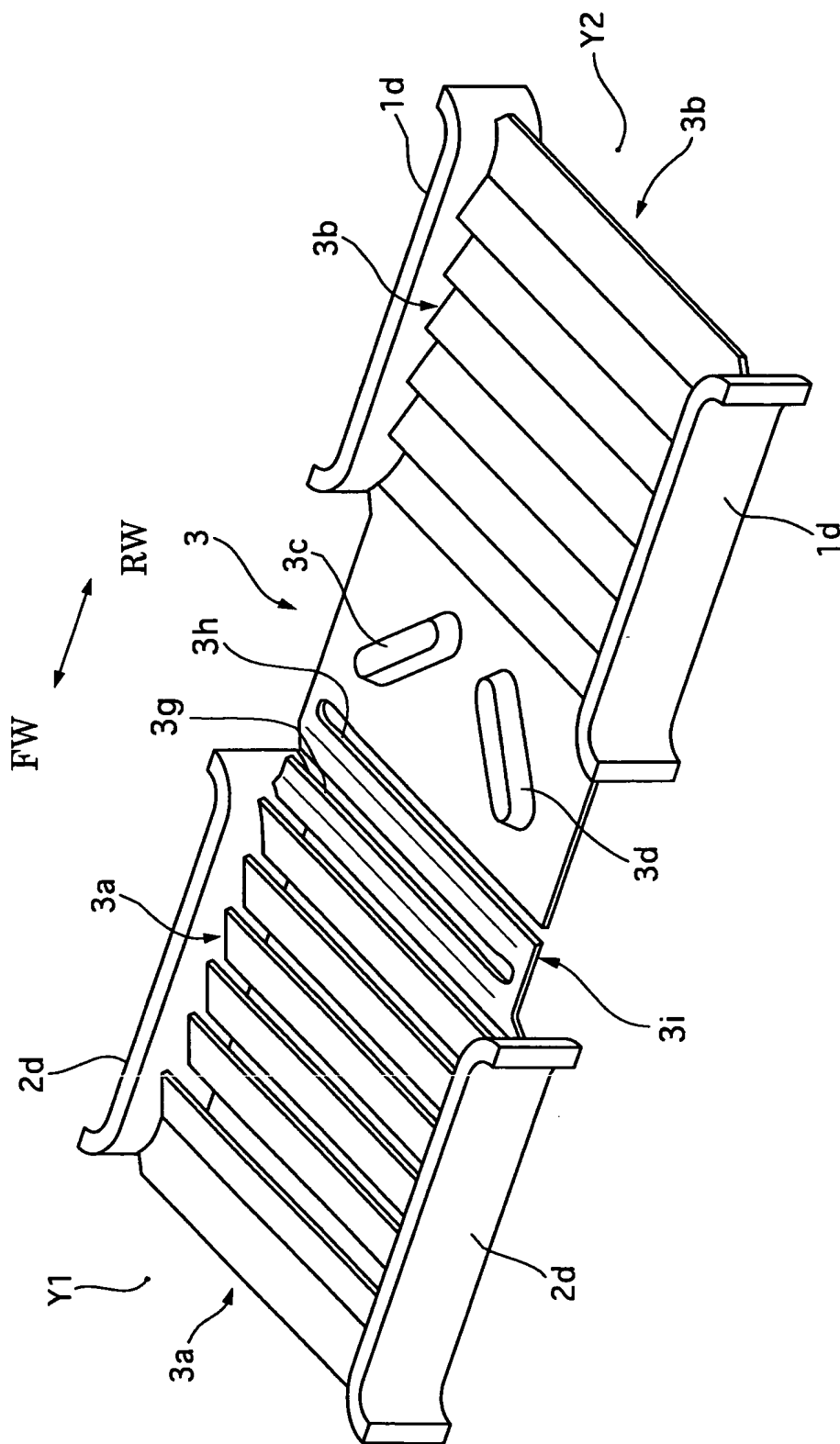


FIG. 7

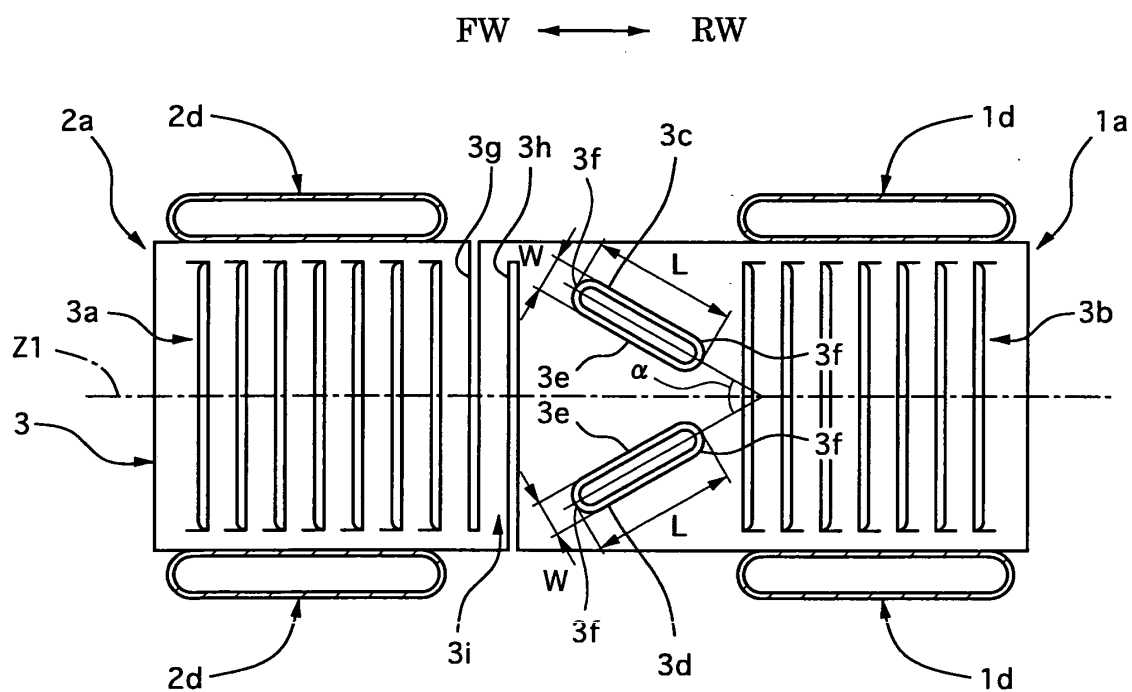


FIG. 8

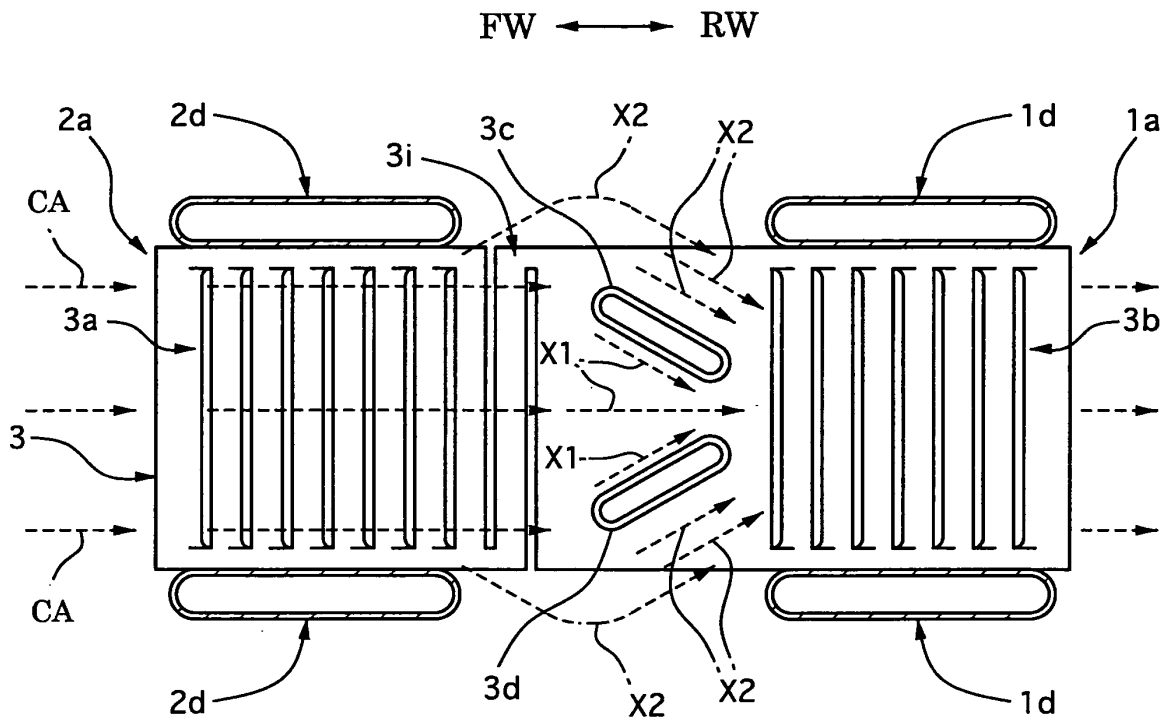


FIG. 9

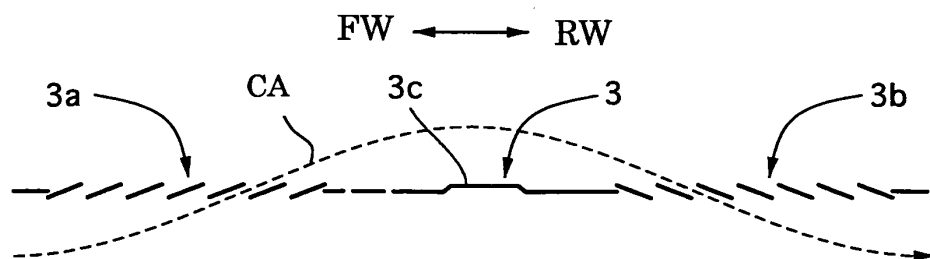


FIG. 10

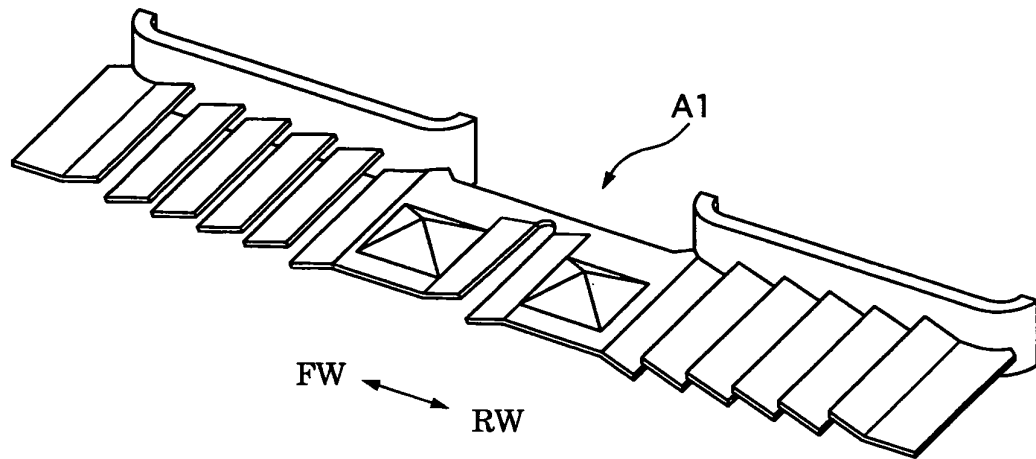


FIG. 11

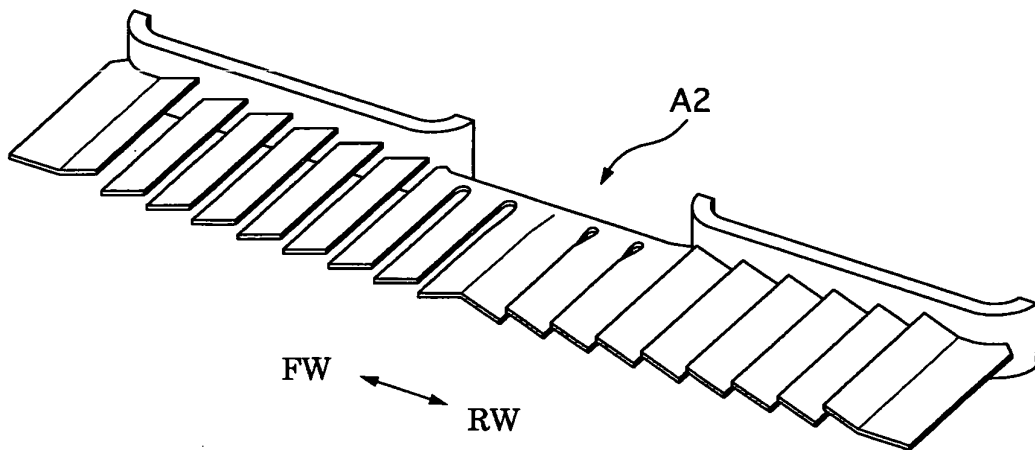


FIG. 12

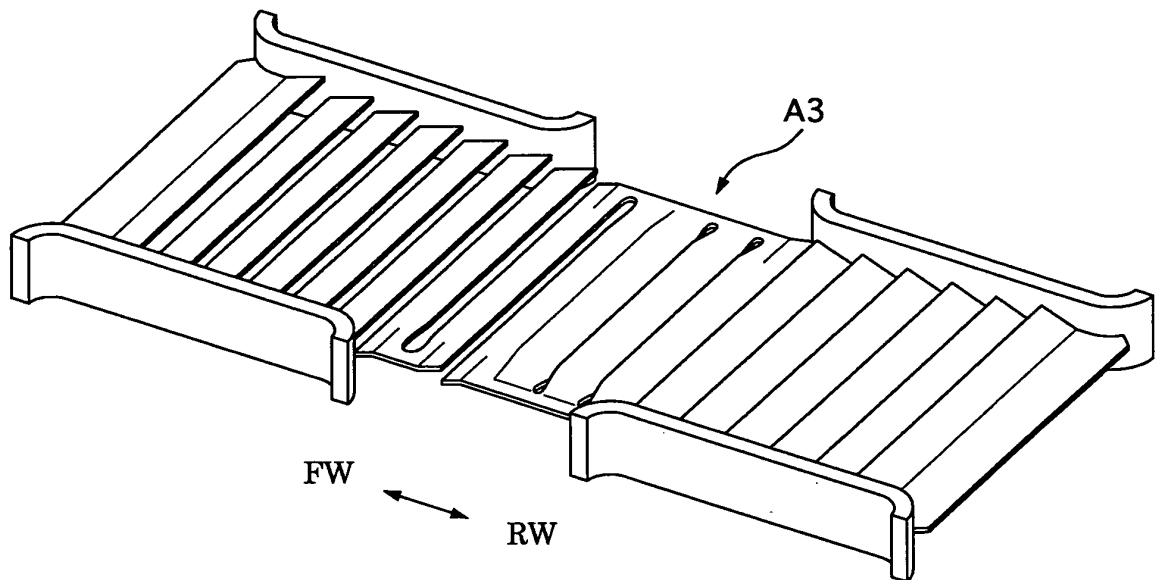


FIG. 13

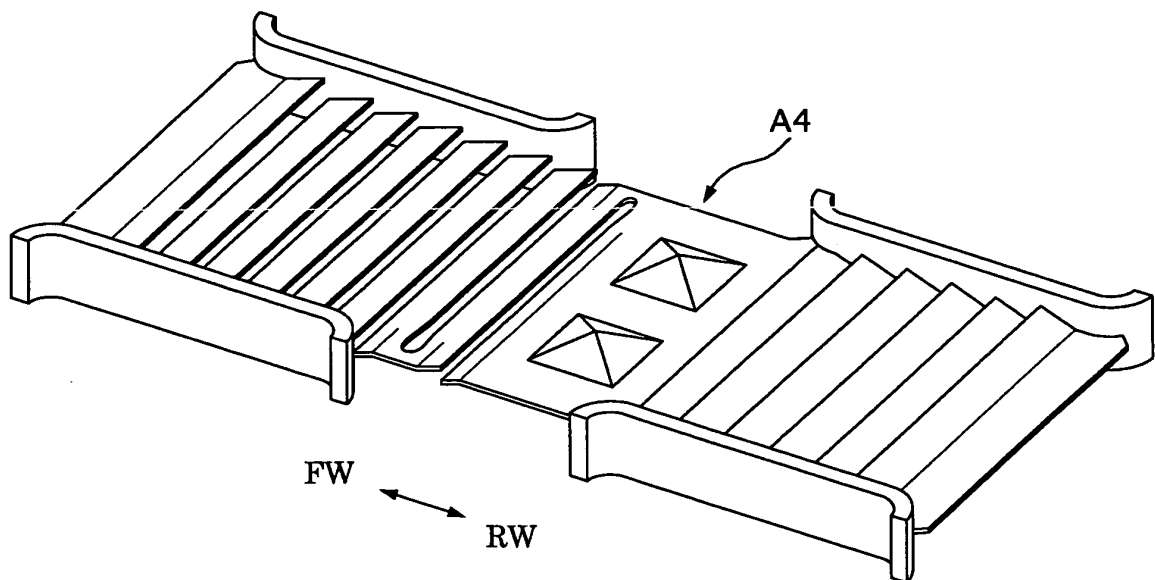


FIG. 14

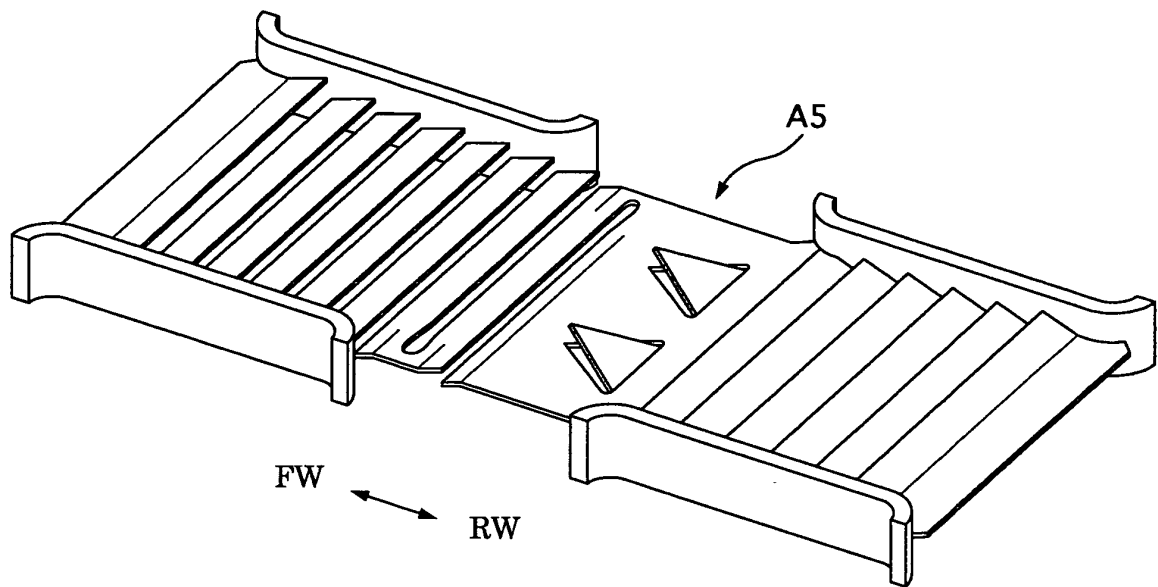


FIG. 15

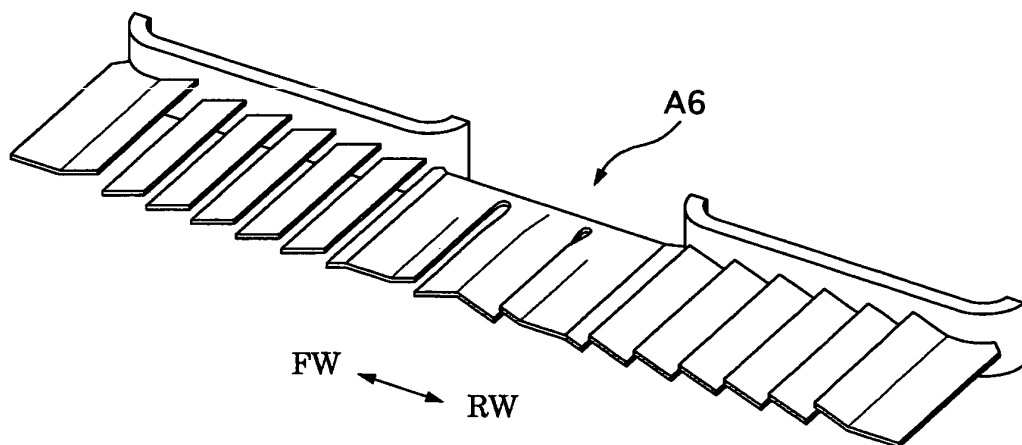


FIG. 16

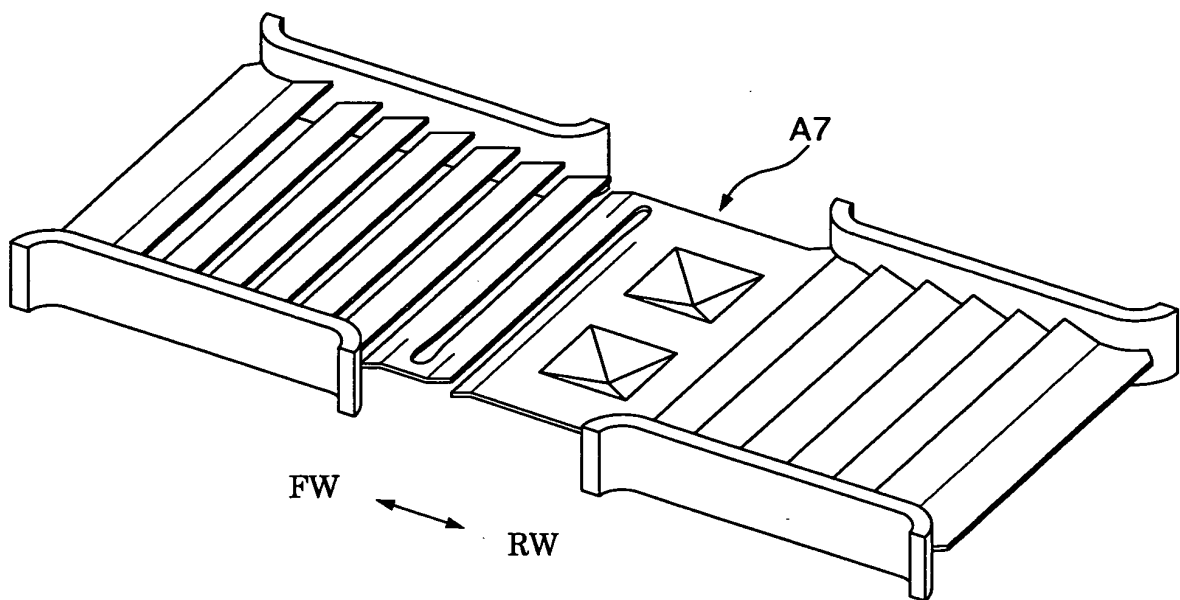


FIG. 17

	INVENTION		TYPE A 1		TYPE A 2		TYPE A 3		TYPE A 4		TYPE A 5	
	PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)
INLET	16360	20	16980	20	17560	20	17600	20	17160	20	17000	20
OUTLET		95.41		93.51		91.05		91.88		95.25		94.96

TYPE A 6		TYPE A 7	
PRES (Pa)	TEMP(°C)	PRES (Pa)	TEMP(°C)
INLET	16470	17390	20
OUTLET	91.94		94.93

FIG. 18

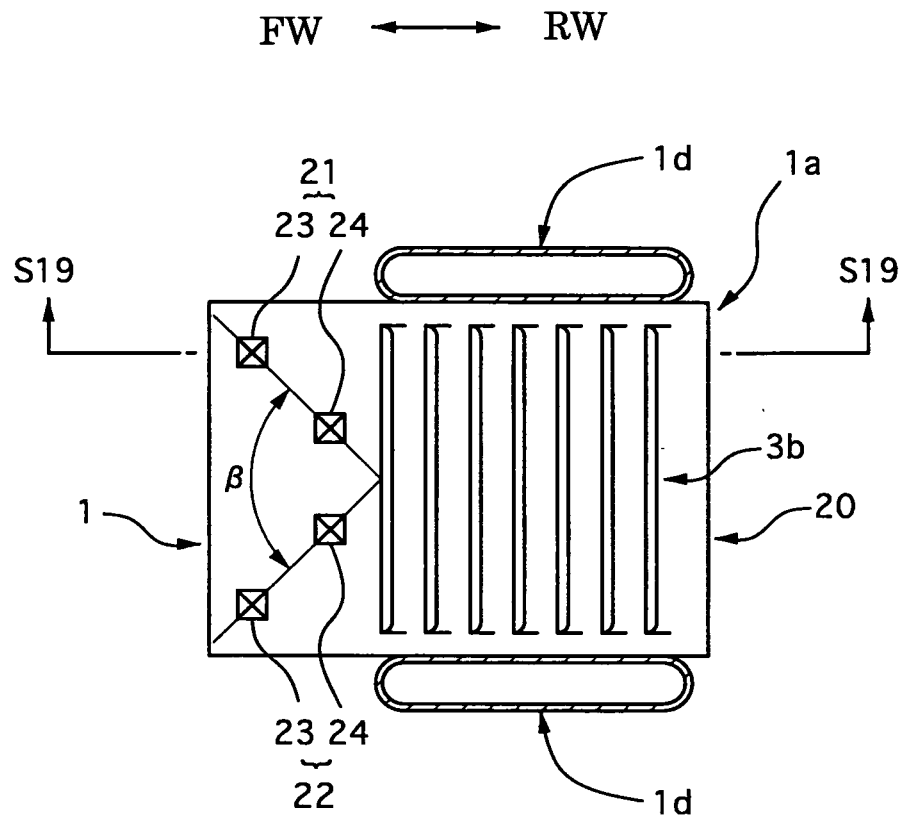


FIG. 19

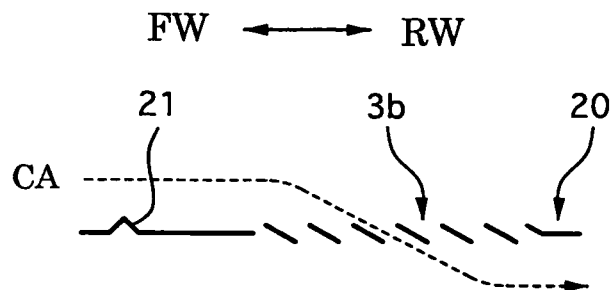


FIG. 20

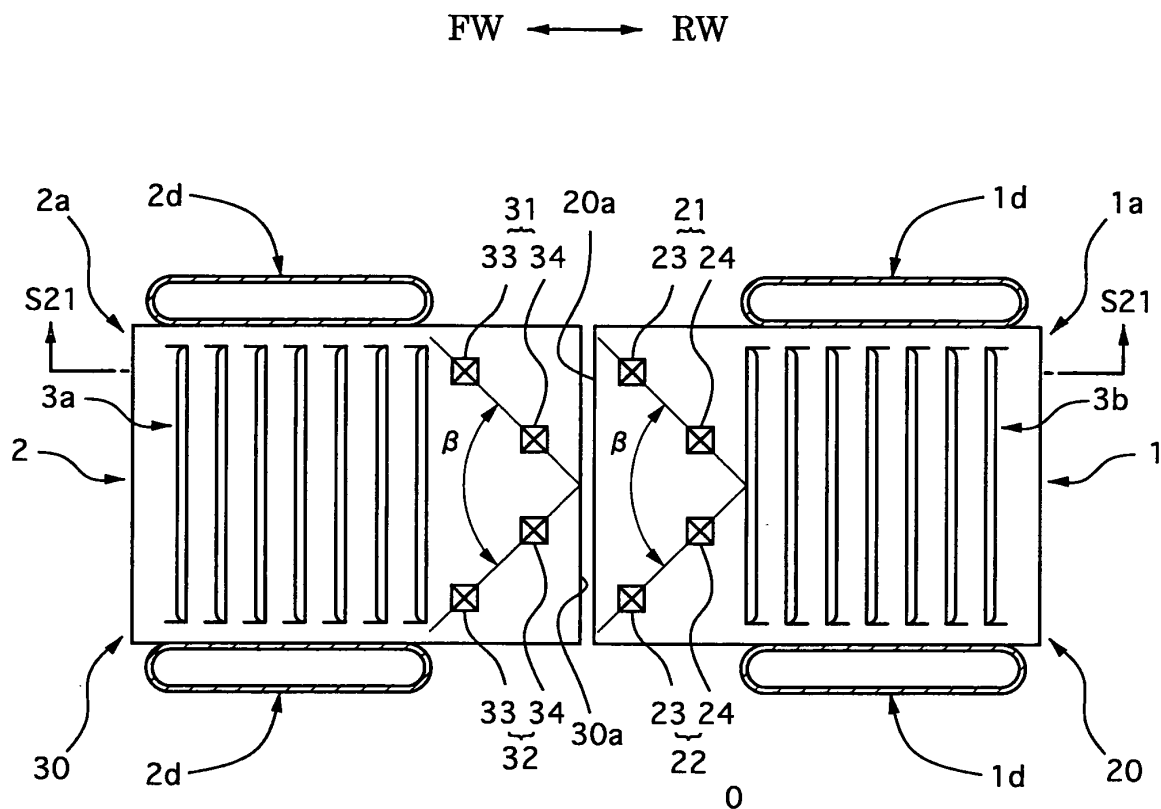


FIG. 21

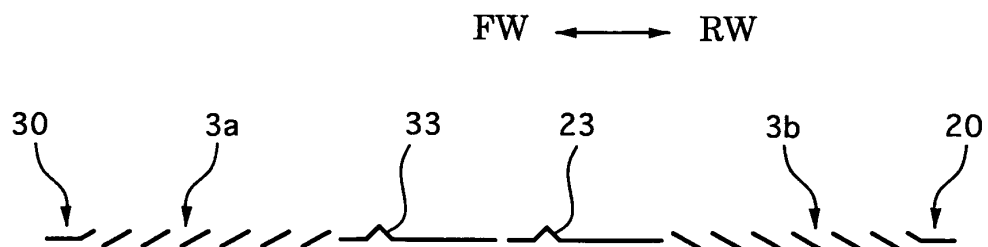


FIG. 22

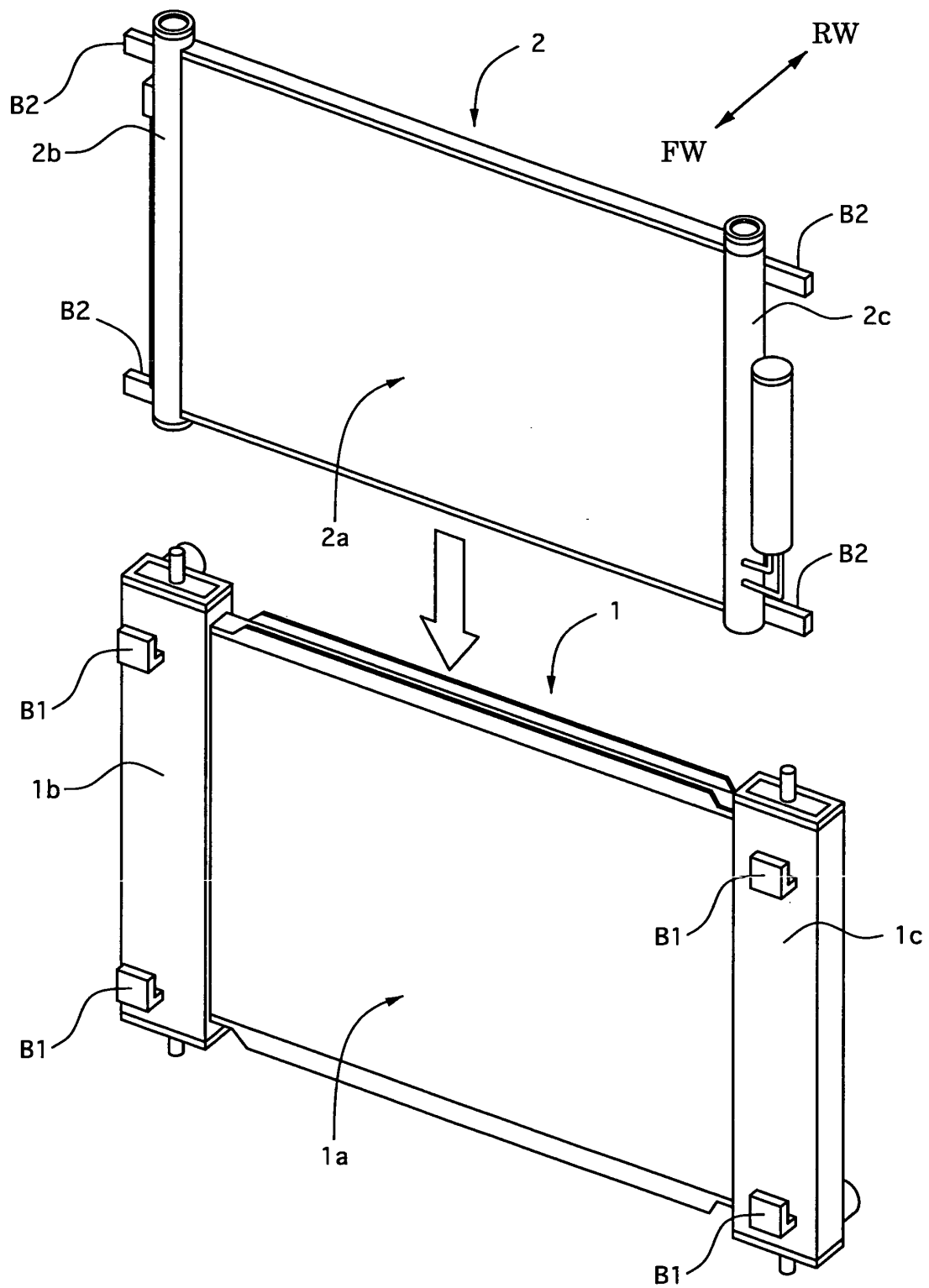


FIG. 23

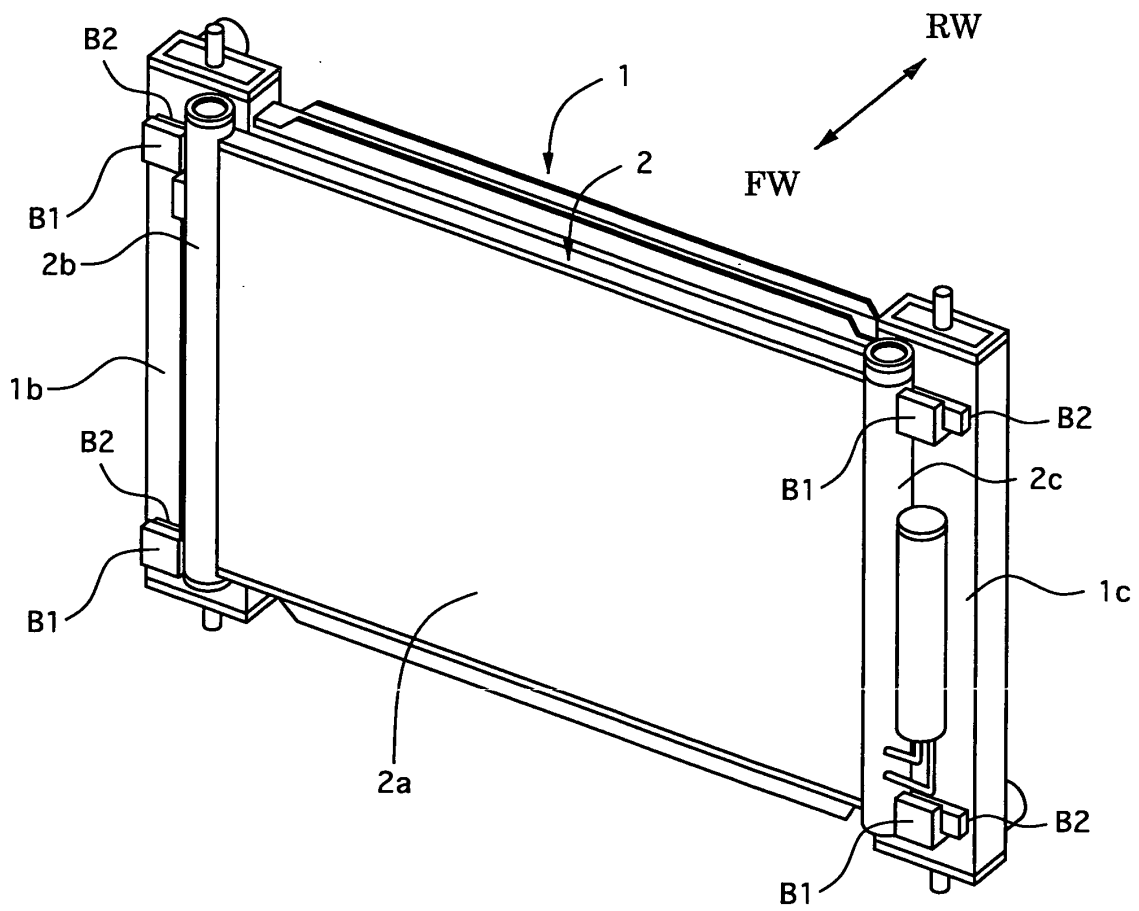


FIG. 24

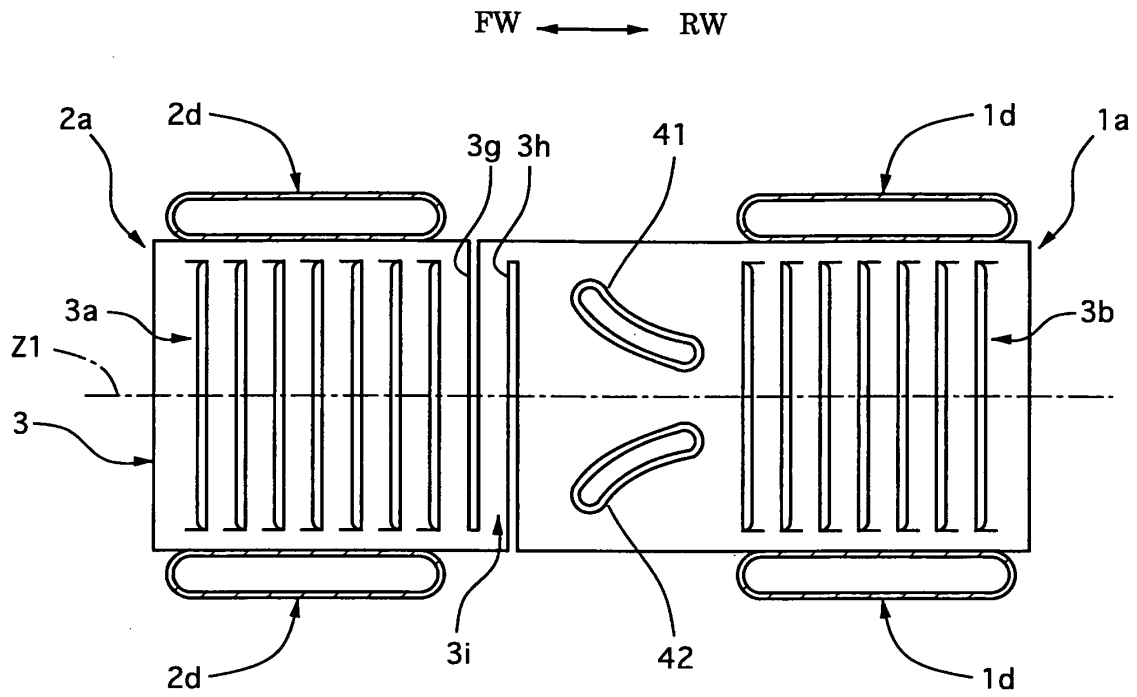


FIG. 25

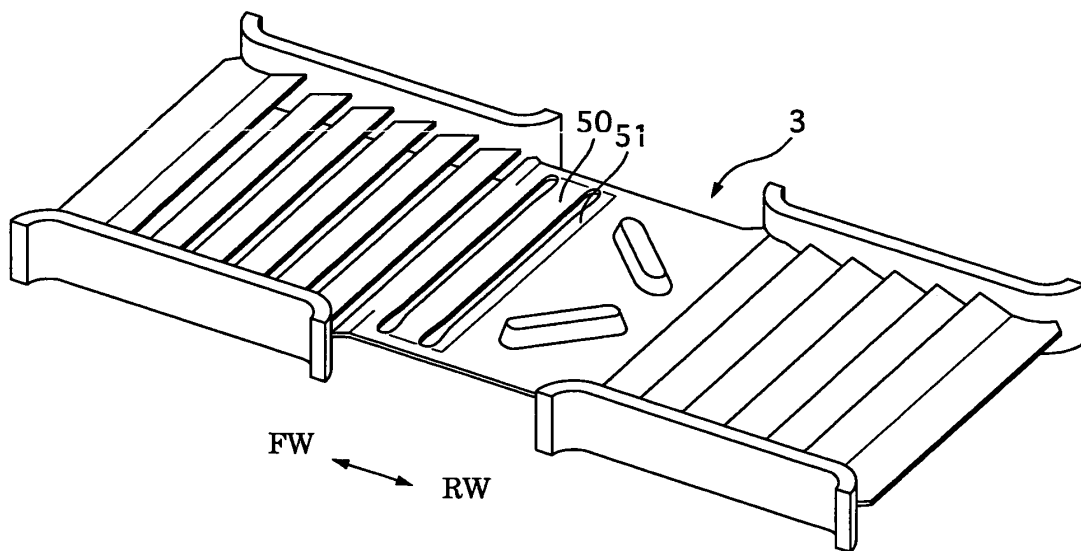
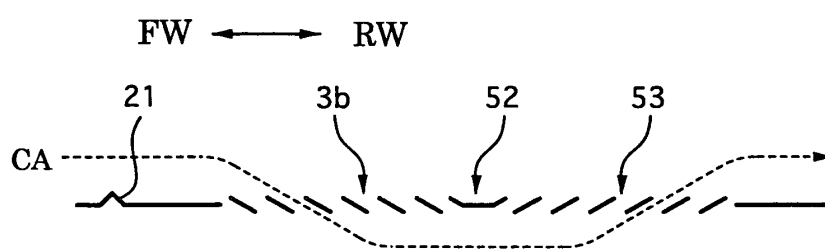


FIG. 26



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/051494

A. CLASSIFICATION OF SUBJECT MATTER

F28F1/30(2006.01) i, F28F9/26(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)

F28F1/30, F28F9/26

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	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007	Toroku Jitsuyo Shinan Koho	1994-2007

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.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 162749/1988 (Laid-open No. 85271/1990) (Calsonic Corp.), 04 July, 1990 (04.07.90), Claims; page 5, line 10 to page 10, line 17; Figs. 1 to 5 (Family: none)	1-8
X	JP 2001-174179 A (Denso Corp.), 29 June, 2001 (29.06.01), Claims; Par. Nos. [0001] to [0061]; Figs. 1 to 11	1-8

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

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
15 February, 2007 (15.02.07)Date of mailing of the international search report
27 February, 2007 (27.02.07)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/051494

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-257104 A (Calsonic Kansei Corp.), 22 September, 2005 (22.09.05), Full text; all drawings	1-8
A	JP 2002-350077 A (Calsonic Kansei Corp.), 04 December, 2002 (04.12.02), Full text; all drawings	1-8

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

EP 1 985 957 A1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/JP2007/051494

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		EP 1164345 A1	2001.12.19
		WO 01/44741 A1	2001.06.21
JP 2002-350077 A	2002.12.04	(Family: none)	
JP 2005-257104 A	2005.09.22	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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- JP 11173784 A [0002]
- JP 2000018880 A [0002]
- JP 2002350077 A [0002]
- JP 2003083691 A [0002]
- JP 2005257104 A [0002]