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(54) **FIN TUBE HEAT EXCHANGER**

(57) To simultaneously achieve both a heat transfer promoting effect and water drainability by guide fins in a fin tube heat exchanger. A fin tube heat exchanger (1) has heat transfer fins (2) disposed in an air flow and plural heat transfer tubes (3) that are inserted in the heat transfer fins (2) and disposed in a direction substantially orthogonal to a flow direction of the air flow. On the heat transfer fins (2), a set of guide fins (21a, 21 b) and a set of guide fins (21 c, 21 d) arranged straightly from upstream to downstream in the flow direction of the air flow are formed, by cutting and raising, on the heat transfer fin (2) surfaces on both sides of the heat transfer tubes (3). Straight lines (L_1 , L_2) that hypothetically interconnect the guide fins (21a, 21 b) and the guide fins (21 c, 21 d) slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes (3) to rear sides of the heat transfer tubes (3) in the flow direction of the air flow.

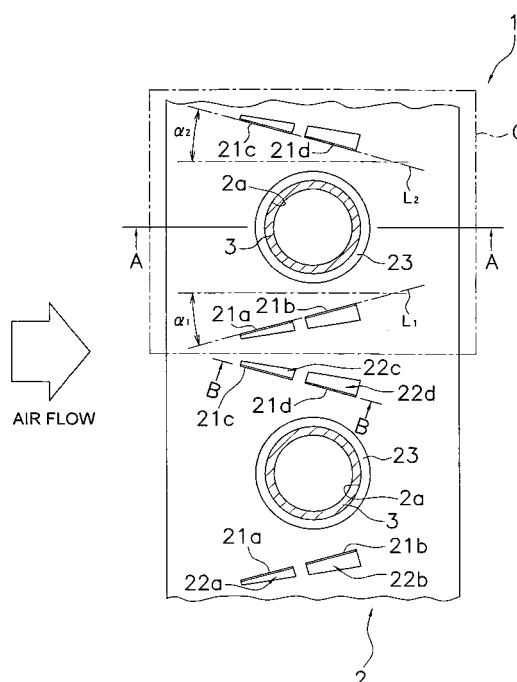


Fig. 1

Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to a fin tube heat exchanger, and in particular to a fin tube heat exchanger having heat transfer fins disposed in an air flow and plural heat transfer tubes that are inserted in the heat transfer fins and disposed in a direction substantially orthogonal to a flow direction of the air flow.

BACKGROUND ART

10 **[0002]** Conventionally, fin tube heat exchangers (i.e., cross fin and tube heat exchangers) having heat transfer fins disposed in an air flow and plural heat transfer tubes that are inserted in the heat transfer fins and disposed in a direction substantially orthogonal to a flow direction of the air flow have been widely used in air conditioners and the like.

15 **[0003]** In such fin tube heat exchangers, as a heat transfer promoting technique for the purpose of reducing dead water regions formed in the portions of the heat transfer tubes in the heat transfer fins downstream in the flow direction of the air flow and for the purpose of renewing the boundary layers in the heat transfer fins, a technique of forming, by cutting and raising and in positions on the heat transfer fin surfaces on both sides of the heat transfer tubes, guide fins that become larger and open upstream in the flow direction of the air flow has been employed (see Patent Document 1).

20 <Patent Document 1>

[0004] Japanese Patent Application Publication (JP-A) No. 61-110889

DISCLOSURE OF THE INVENTION

25 **[0005]** However, when a fin tube heat exchanger in which the aforementioned guide fins are employed is used as an evaporator of a heat medium such as refrigerant which uses air as a heat source such as represented by air conditioners and the like, a problem arises in that drain water occurring due to heat exchange between the air and the heat medium accumulates on the guide fins and increases ventilation resistance. Further, when a fin tube heat exchanger in which the aforementioned guide fins are employed is used as an outdoor heat exchanger configuring an outdoor unit of an air conditioner, a problem arises in that, although sometimes frost occurring on the heat transfer fin surfaces is removed by defrosting operation, water drainability is lowered in this case.

[0006] It is an object of the present invention to simultaneously achieve a heat transfer promoting effect and water drainability by guide fins in a fin tube heat exchanger.

35 **[0007]** A fin tube heat exchanger pertaining to a first invention comprises: heat transfer fins disposed in an air flow; and plural heat transfer tubes that are inserted in the heat transfer fins and disposed in a direction substantially orthogonal to a flow direction of the air flow. On the heat transfer fins, plural guide fins arranged straightly from upstream to downstream in the flow direction of the air flow are formed, by cutting and raising, on the heat transfer fin surfaces on both sides of the heat transfer tubes. Straight lines that hypothetically interconnect the plural guide fins slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes to rear sides of the heat transfer tubes in the flow direction of the air flow

40 **[0008]** In this fin tube heat exchanger, the guide fins are plurally divided from upstream to downstream in the flow direction of the air flow, and the plural guide fins slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes to rear sides of the heat transfer tubes in the flow direction of the air flow, so mainly the effect of renewing the boundary layers can be reliably obtained by the guide fins of the plural guide fins that are disposed on the front sides of the heat transfer fins in the flow direction of the air flow and the effect of reducing dead water regions formed of the rear sides of the heat transfer fins in the flow direction of the air flow can be obtained by the guide fins that are disposed on the rear sides of the heat transfer fins in the flow direction of the air flow, and it can be made easier for drain water occurring on the heat transfer fin surfaces to be drained from gaps between the guide fins. Thus, a heat transfer promoting effect by the guide fins can be obtained without being affected by drain water occurring on the heat transfer fin surfaces.

45 **[0009]** Moreover, because the plural guide fins are straightly arranged from upstream to downstream in the flow direction of the air flow, the guide fins of the plural guide fins that are disposed on the rear sides of the heat transfer fins in the flow direction of the air flow have the same inclination as the guide fins that are disposed on the front sides in the flow direction of the air flow, so not only do they reduce dead water regions formed in portions on the rear sides of the heat transfer tubes in the flow direction of the air flow, but they can prevent new dead water regions from being formed on the backs of the guide fins.

50 **[0010]** As described above, in the fin tube heat exchanger pertaining to the present invention, the effect of promoting

heat transfer by the guide fins can be obtained without being affected by drain water occurring on the heat transfer fin surfaces, and new dead water regions can be prevented from being formed on the backs of the guide fins, so a heat transfer promoting effect and water drainability by the guide fins can be simultaneously achieved.

[0011] A fin tube heat exchanger pertaining to a second invention is the fin tube heat exchanger pertaining to the first invention, wherein the height of each of the guide fins gradually increases downstream in the flow direction of the air flow.

[0012] In this fin tube heat exchanger, by giving each of the guide fins a shape whose height gradually increases downstream in the flow direction of the air flow, vertical vortexes can be created on the back of each of the guide fins, so that the heat transfer promoting effect by the guide fins can be further raised.

[0013] A fin tube heat exchanger pertaining to a third invention is the fin tube heat exchanger pertaining to the first or second invention, wherein a water drainage promoting portion for causing water accumulating between the guide fins that are mutually adjacent on the straight lines to flow downward is formed in the heat transfer fins.

[0014] In this fin tube heat exchanger, the water drainage promoting portion is formed between the guide fins, so the ability of the guide fins to drain water can be further raised.

[0015] A fin tube heat exchanger pertaining to a fourth invention is the fin tube heat exchanger pertaining to the third invention, wherein the water drainage promoting portion is a slit formed between the guide fins that are mutually adjacent on the straight lines.

[0016] A fin tube heat exchanger pertaining to a fifth invention is the fin tube heat exchanger pertaining to the third invention, wherein the water drainage promoting portion is a cutout formed in end portions of the guide fins that are mutually adjacent on the straight lines, which end portions are portions that become lower end portions of the guide fins.

[0017] A fin tube heat exchanger pertaining to a sixth invention is the fin tube heat exchanger pertaining to the third invention, wherein the water drainage promoting portion is a water-conducting rib formed between the guide fins that are mutually adjacent on the straight lines.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG 1 is a cross-sectional diagram of a fin tube heat exchanger pertaining to a first embodiment of the present invention.

FIG 2 is a cross-sectional diagram along A-A of FIG 1.

FIG 3 is a cross-sectional diagram along B-B of FIG 1.

FIG 4 is a diagram showing a fin tube heat exchanger pertaining to a modification of the first embodiment, the diagram showing portion C of FIG 1.

FIG 5 is a diagram showing a fin tube heat exchanger pertaining to a modification of the first embodiment, the diagram showing portion C of FIG 1.

FIG 6 is a diagram showing a fin tube heat exchanger pertaining to a modification of the first embodiment, the diagram showing portion C of FIG 1.

FIG 7 is a cross-sectional diagram of a fin tube heat exchanger pertaining to a second embodiment of the present invention.

FIG 8 is a cross-sectional diagram along A-A of FIG 7.

FIG 9 is a cross-sectional diagram along B-B of FIG 7.

FIG 10 is a diagram showing a fin tube heat exchanger pertaining to a modification of the second embodiment, the diagram showing portion C of FIG 7.

FIG 11 is a diagram showing a fin tube heat exchanger pertaining to a modification of the second embodiment, the diagram showing portion C of FIG 7.

FIG 12 is a diagram showing a fin tube heat exchanger pertaining to a modification of the second embodiment, the diagram showing portion C of FIG 7.

DESCRIPTION OF THE REFERENCE NUMERALS

[0019]

1, 101	Fin Tube Heat Exchangers
2, 102	Heat Transfer Fins
3	Heat Transfer Tube
21a to 21d, 121a to 121f	Guide Fins
32, 35, 132, 133, 136, 137	Slits (Water Drainage Promoting Portions)
42, 43, 142, 143, 144, 145	Cutouts (Water Drainage Promoting Portions)

BEST MODES FOR CARRYING OUT THE INVENTION

[0020] Below, embodiments of a fin tube heat exchanger pertaining to the present invention will be described on the basis of the drawings.

<First Embodiment>

[0021] In FIG 1 to FIG 3, there are shown relevant portions of a fin tube heat exchanger 1 pertaining to a first embodiment of the present invention. Here, FIG 1 is a cross-sectional diagram of the fin tube heat exchanger 1. FIG 2 is a cross-sectional diagram along A-A of FIG 1. FIG 3 is a cross-sectional diagram along B-B of FIG 1.

(1) Basic Configuration of Fin Tube Heat Exchanger

[0022] The fin tube heat exchanger 1 is a cross fin and tube heat exchanger and is mainly disposed with plural plate-shaped heat transfer fins 2 and plural heat transfer tubes 3. The heat transfer fins 2 are disposed so as to be arranged in a plate thickness direction in a state where the planar direction thereof is generally along a flow direction of an air flow such as that of air. Plural through holes 2a are formed in the heat transfer fins 2 at intervals in a direction substantially orthogonal to the flow direction of the air flow. Portions around the through holes 2a serve as annular collar portions 23 that project towards one side in the plate thickness direction of the heat transfer fins 2. The collar portions 23 contact surfaces of the heat transfer fins 2 adjacent in the plate thickness direction that are opposite of surfaces where the collar portions 23 are formed, such that a predetermined interval H is ensured between each of the heat transfer fins 2 in the plate thickness direction. The heat transfer tubes 3 are tube members inside of which a heat medium such as refrigerant flows; the heat transfer tubes 3 are inserted in the plural heat transfer fins 2, which are disposed so as to be arranged in the plate thickness direction, and disposed in a direction substantially orthogonal to the flow direction of the air flow. Specifically, the heat transfer tubes 3 penetrate the through holes 2a formed in the heat transfer fins 2 and tightly contact the inner surfaces of the collar portions 23 as a result of tube expansion work during assembly of the fin tube heat exchanger 1.

[0023] Further, the fin tube heat exchanger 1 of the present embodiment is used in a state where the arranging direction of the plural heat transfer tubes 3 is in a substantially vertical direction. For this reason, the air flow flows so as to cross through the fin tube heat exchanger 1 in a substantially horizontal direction. It will be noted that in the following description, when language such as "upper side" or "upward" and "lower side" or "downward" is used, this will indicate the arranging direction of the heat transfer tubes 3.

(2) Detailed Shape of Heat Transfer Fins

[0024] Next, the detailed shape of the heat transfer fins 2 used in the fin tube heat exchanger 1 of the present embodiment will be described.

[0025] On the heat transfer fins 2, plural (in the present embodiment, two) a set of guide fins 21a and 21 b and a set of guide fins 21c and 21 d arranged straightly from upstream to downstream in the flow direction of the air flow are formed, by cutting and raising, on the heat transfer fin 2 surfaces on both sides of each of the heat transfer fins 3 (i.e., the lower side and the upper side of each of the heat transfer fins 3). Straight lines L_1 and L_2 that hypothetically interconnect the guide fins 21a and 21b and the guide fins 21c and 21 d slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes 3 to rear sides of the heat transfer tubes 3 in the flow direction of the air flow. Here, attack angles α_1 and α_2 that the straight lines L_1 and L_2 form with respect to the flow direction of the air flow are set to be within the range of 10° to 30° .

[0026] Further, each of the guide fins 21a to 21 d is formed such that its height gradually increases downstream in the flow direction of the air flow. In the present embodiment, each of the guide fins 21a to 21 d is substantially trapezoidal or substantially triangular (see FIG 3; FIG 3 is a diagram showing the guide fins 21c and 21d, but the guide fins 21a and 21b also have the same shape) and is formed such that its maximum height h is less than the height H of the collar portions 23. Further, slit holes 22a to 22d that are formed in the heat transfer fins 2 when the guide fins 21a to 21 d are cut and raised are disposed on the far sides of the heat transfer fins 3 with the guide fins 21a to 21 d being interposed therebetween.

(3) Characteristics of Fin Tube Heat Exchanger

[0027] In the fin tube heat exchanger 1 configured as described above, the guide fins formed on both sides of each

of the heat transfer tubes 3 are divided into the plural (in the present embodiment, two) the set of the guide fins 21 a and 21b and the set of the guide fins 21c and 21 d from upstream to downstream in the flow direction of the air flow, and the set of the guide fins 21 a and 21b and the set of the guide fins 21 c and 21 d slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes 3 to the rear sides of the heat transfer fins 2 in the flow direction of the air flow, so mainly the effect of renewing the boundary layers can be reliably obtained by the guide fins 21 a and 21 c of the guide fins 21 a to 21 d that are disposed on the front sides of the heat transfer fins 2 in the flow direction of the air flow and the effect of reducing dead water regions formed on portions of the rear sides of the heat transfer fins 3 in the flow direction of the air flow can be obtained by the guide fins 21b and 21d that are disposed on the rear sides of the heat transfer fins 2 in the flow direction of the air flow, and it can be made easier for drain water occurring on the heat transfer fin 2 surfaces to be drained from between the guide fins 21 a and 21 b and between the guide fins 21 c and 21 d. Thus, a heat transfer promoting effect by the guide fins 21 a to 21 d can be obtained without being affected by drain water occurring on the heat transfer fin 2 surfaces.

[0028] Moreover, because the guide fins 21 a and 21 b and the guide fins 21 c and 21 d are straightly arranged on the straight lines L_1 and L_2 from upstream to downstream in the flow direction of the air flow, the guide fins 21 b and 21 d of the guide fins 21 a to 21 d that are disposed on the rear sides of the heat transfer fins 2 in the flow direction of the air flow have the same inclination as the guide fins 21 a and 21 c that are disposed on the front sides in the flow direction of the air flow, so not only do they reduce dead water regions formed in portions on the rear sides of the heat transfer tubes 3 in the flow direction of the air flow, but they can prevent new dead water regions from being formed on the backs of the guide fins 21 b and 21 d.

[0029] As described above, in the fin tube heat exchanger 1 of the present embodiment, a heat transfer promoting effect by the guide fins 21 a to 21 d can be obtained without being affected by drain water occurring on the heat transfer fin 2 surfaces, and new dead water regions can be prevented from being formed on the backs of the guide fins 21 b and 21 d, so a heat transfer promoting effect and water drainability by the guide fins can be simultaneously achieved.

[0030] Further, in this fin tube heat exchanger 1, by giving each of the guide fins 21 a to 21 d a shape whose height gradually increases downstream in the flow direction of the air flow, vertical vortexes can be formed on the back of each of the guide fins 21 a to 21 d, so the heat transfer promoting effect by each of the guide fins 21 a to 21 d can be further raised.

(4) Modifications

[0031] In the aforementioned fin tube heat exchanger 1, slits 32 and 35 (see FIG 4), cutouts 42 and 43 (see FIG 5), or a water-conducting rib 52 (see FIG 6) serving as a water drainage promoting portion to cause water accumulating between the guide fins 21 a and 21 b and the guide fins 21 c and 21d that are mutually adjacent on the straight lines L_1 and L_2 to flow downward may be formed in order to make it easier for drain water occurring on the heat transfer fin 2 surfaces to be drained from gaps between the guide fins 21 a and 21 b and between the guide fins 21 c and 21 d. Here, FIG 4 to FIG 6 are diagrams showing portion C of FIG 1 when each type of water drainage promoting portion is formed in the heat transfer fins 2.

[0032] First, a case where the slits 32 and 35 are formed in the heat transfer fins 2 will be described using FIG 4. In the present modification, the slits 32 and 35 are formed, so as to cross the straight lines L_1 and L_2 in the vertical direction, in gap portions between the guide fins 21a and 21b that are mutually adjacent on the straight line L_1 and between the guide fins 21c and 21d that are mutually adjacent on the straight line L_2 . Here, the slits 32 and 35 are given a narrow slit width by forming vertical incisions in the heat transfer fins 2, for example, in order to ensure that the slits 32 and 35 do not, as much as possible, affect heat transfer performance. Further, slits 31, 33, 34 and 36 that are the same as the slits 32 and 35 may also be formed in the end portions of the guide fins 21a to 21 d other than the gap portions between the guide fins 21 a and 21 b and between the guide fins 21 c and 21 d.

[0033] Next, a case where the cutouts 42 and 43 are formed in the heat transfer fins 2 will be described using FIG 5. In the present modification, the cutouts 42 and 43 are formed in end portions of the guide fins 21 a and 21 b and the guide fins 21 c and 21 d that are mutually adjacent on the straight lines L_1 and L_2 , which end portions become lower end portions of the guide fins 21a and 21 b and the guide fins 21c and 21 d (i.e., portions that become lower portions of the guide fins 21 a and 21 b and the guide fins 21 c and 21 d along the direction of gravitational force). Specifically, the cutouts 42 and 43 are formed in the lower end portion of the guide fin 21 b and in the lower end portion of the guide fin 21 c. Here, the cutouts 42 and 43 are vertical incisions formed in the lower end portions of the guide fins 21 b and 21 c so as to be communicated with the slits 22b and 22c that are formed when forming the guide fins 21 c and 21 c by cutting and raising. Further, cutouts 41 and 44 that are the same as the cutouts 42 and 43 may also be formed in the end portions of the guide fins 21 a and 21 d other than the portions that become the lower end portions of the guide fins 21 b and 21 c.

[0034] Next, a case where the water-conducting rib 52 is formed on the heat transfer fins 2 will be described using FIG 6. In the present modification, the water-conducting rib 52 is formed, so as to cross the straight lines L_1 and L_2 in the vertical direction, in gap portions between the guide fins 21 a and 21 b that are mutually adjacent on the straight

line L_1 and between the guide fins 21 c and 21 d that are mutually adjacent on the straight line L_2 . Here, the water-conducting rib 52 is a long and narrow projection that extends upward and is formed by pressing the heat transfer fin 2 surfaces, and the water-conducting rib 52 is formed so as to continuously interconnect, in the vertical direction (i.e., in the direction of gravitational force), the gap portion between the guide fins 21a and 21 b and the gap portion between the guide fins 21 c and 21 d. It will be noted that in the vicinities of the heat transfer tubes 3, the water-conducting rib 52 cannot be straightly extended in the vertical direction, so by forming just the portion thereof in the vicinity of the collar portion 23 in a circular arc shape, a state where the water-conducting rib 52 is continuously formed in substantially the direction of gravitational force can be maintained. Further, water-conducting ribs 51 and 53 that are the same as the water-conducting rib 52 may also be formed on the portion on the front side of the guide fins 21a and 21c in the flow direction of the air flow and the portion on the rear side of the guide fins 21 b and 21 d in the flow direction of the air flow other than the gap portion between the guide fins 21 a and 21 b and the gap portion between the guide fins 21c and 21 d.

[0035] As described above, in the fin tube heat exchanger 1 of the present modification, the ability of the heat transfer fins 2 to drain water can be further raised because the slits 32 and 35, the cutouts 42 and 43, or the water-conducting rib 52 serving as a water drainage promoting portion are formed between the guide fins 21 a and 21b that are mutually adjacent on the straight line L_1 of the heat transfer fins 2 and between the guide fins 21 c and 21 d that are mutually adjacent on the straight line L_2 .

<Second Embodiment>

[0036] In FIG 7 to FIG 9, there are shown relevant portions of a fin tube heat exchanger 101 pertaining to a second embodiment of the present invention. Here, FIG 7 is a cross-sectional diagram of the fin tube heat exchanger 101. FIG 8 is a cross-sectional diagram along A-A of FIG. 7. FIG 9 is a cross-sectional diagram along B-B of FIG 7.

(1) Configuration of Fin Tube Heat Exchanger

[0037] The basic configuration of the fin tube heat exchanger 101 is the same as the configuration of the fin tube heat exchanger 1 of the first embodiment except for guide fins 121 a to 121f of later-described heat transfer fins 102. For this reason, description in regard to the basic configuration of the fin tube heat exchanger 101 will be omitted by changing the reference numerals that relate to the heat transfer fins 102 from the 10s to the 100s.

[0038] Next, the detailed shape of the heat transfer fins 102 used in the fin tube heat exchanger 101 of the present embodiment will be described.

[0039] On the heat transfer fins 102, plural (in the present embodiment, three) a set of guide fins 121a, 121b and 121c and a set of guide fins 121 d, 121 e and 121f arranged straightly from upstream to downstream in the flow direction of the air flow are formed, by cutting and raising, on the heat transfer fin 2 surfaces on both sides of each of the heat transfer fins 3 (i.e., the lower side and the upper side of each of the heat transfer fins 3). Straight lines L_1 and L_2 that hypothetically interconnect the guide fins 121a, 121 b and 121 c and the guide fins 121d, 121 e and 121 f slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes 3 to the rear sides of the heat transfer tubes 3 in the flow direction of the air flow. Here, attack angles α_1 and α_2 that the straight lines L_1 and L_2 form with respect to the flow direction of the air flow are set to be within the range of 10° to 30° .

[0040] Further, each of the guide fins 121 a to 121 f is formed such that its height gradually increases downstream in the flow direction of the air flow. In the present embodiment, each of the guide fins 121 a to 121 f is substantially trapezoidal or substantially triangular (see FIG 9; FIG 9 is a diagram showing the guide fins 121d, 121 e and 121f, but the guide fins 121 a, 121 b and 121c also have the same shape) and is formed such that its maximum height h is less than the height H of collar portions 123. Further, slit holes 122a to 122f that are formed in the heat transfer fins 102 when the guide fins 121a to 121 f are cut and raised are disposed on the far sides of the heat transfer fins 3 with the guide fins 121a to 121 f being interposed therebetween.

[0041] As described above, in the fin tube heat exchanger 101 of the present embodiment configured as described above, whereas the guide fins of the fin tube heat exchanger 1 of the first embodiment had a two-division structure comprising the set of the guide fins 21 a and 21 b and the set of the guide fins 21c and 21d, the guide fins here have a three-division structure comprising the set of the guide fins 121a, 121b and 121c and the set of the guide fins 121d, 121e and 121f, so the number of gaps between the guide fins for draining drain water occurring on the heat transfer fin 102 surfaces increases. For this reason, the ability to drain drain water can be raised in comparison to the fin tube heat exchanger 1 of the first embodiment.

(2) Modifications

[0042] In the aforementioned fin tube heat exchanger 101 also, similar to the fin tube heat exchanger 1 of the first embodiment, slits 132, 133, 136 and 137 (see FIG 10), cutouts 142, 143, 144 and 145 (see FIG 11), or water-conducting

ribs 152 and 153 (see FIG 12) serving as a water drainage promoting portion that causes water accumulating between the guide fins 121 a and 121 b, between the guide fins 121b and 121c, between the guide fins 121d and 121e, and between the guide fins 121e and 121f that are mutually adjacent on the straight lines L_1 and L_2 to flow downward may be formed in order to make it easier for drain water occurring on the heat transfer fin 102 surfaces to be drained from gaps between the guide fins 121 a and 121 b, between the guide fins 121 b and 121 c, between the guide fins 121d and 121 e, and between the guide fins 121e and 121f. Here, FIG 10 to FIG 12 are diagrams showing portion C of FIG 7 when each type of water drainage promoting portion is formed in the heat transfer fins 102.

[0043] It will be noted that, because the shapes and the like of the slits, the cutouts and the water-conducting ribs are the same as those of the slits 32 and 35, the cutouts 42 and 43, and the water-conducting ribs 52 pertaining to the modifications of the first embodiment, description thereof will be omitted. Further, in this fin tube heat exchanger 101 also, similar to the fin tube heat exchanger 1 pertaining to the modifications of the first embodiment, slits 131, 134, 135 and 138, cutouts 141 and 146, or water-conducting ribs 151 and 154 may also be formed in portions other than between the guide fins 121 a and 121 b, between the guide fins 121b and 121 c, between the guide fins 121 d and 121 e, and between the guide fins 121e and 121f.

<Other Embodiments>

[0044] Embodiments of the present invention have been described above on the basis of the drawings, but the specific configurations thereof are not limited to these embodiments and are alterable in a range that does not depart from the gist of the invention.

INDUSTRIAL APPLICABILITY

[0045] By utilizing the present invention, a heat transfer promoting effect and water drainability by guide fins can be simultaneously achieved in a fin tube heat exchanger.

Claims

1. A fin tube heat exchanger (1, 101) comprising:

heat transfer fins (2, 102) disposed in an air flow; and
plural heat transfer tubes (3) that are inserted in the heat transfer fins and disposed in a direction substantially orthogonal to a flow direction of the air flow,
wherein

on the heat transfer fins, plural guide fins (21a to 21d, 121 a to 121f) arranged straightly from upstream to downstream in the flow direction of the air flow are formed, by cutting and raising, on the heat transfer fin surfaces on both sides of the heat transfer tubes, and
straight lines (L_1 , L_2) that hypothetically interconnect the plural guide fins slant with respect to the flow direction of the air flow so as to guide the air flow in the vicinities of the heat transfer tubes to rear sides of the heat transfer tubes in the flow direction of the air flow.

2. The fin tube heat exchanger (1, 101) of claim 1, wherein the height of each of the guide fins (21 a to 21d, 121 a to 121f) gradually increases downstream in the flow direction of the air flow.

3. The fin tube heat exchanger (1, 101) of claim 1 or 2, wherein a water drainage promoting portion for causing water accumulating between the guide fins (21a to 21d, 121a to 121f) that are mutually adjacent on the straight lines (L_1 , L_2) to flow downward is formed in the heat transfer fins (2, 102).

4. The fin tube heat exchanger (1, 101) of claim 3, wherein the water drainage promoting portion is a slit (32, 35, 132, 133, 136, 137) formed between the guide fins (21a to 21d, 121a to 121f) that are mutually adjacent on the straight lines (L_1 , L_2).

5. The fin tube heat exchanger (1, 101) of claim 3, wherein the water drainage promoting portion is a cutout (42, 43, 142, 143, 144, 145) formed in end portions (21 a to 21d, 121a to 121f) of the guide fins that are mutually adjacent on the straight lines (L_1 , L_2), which end portions are portions that become lower end portions of the guide fins.

6. The fin tube heat exchanger (1, 101) of claim 3, wherein the water drainage promoting portion is a water-conducting

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rib (52, 151, 154) formed between the guide fins (21a to 21d, 121a to 121f) that are mutually adjacent on the straight lines (L_1 , L_2).

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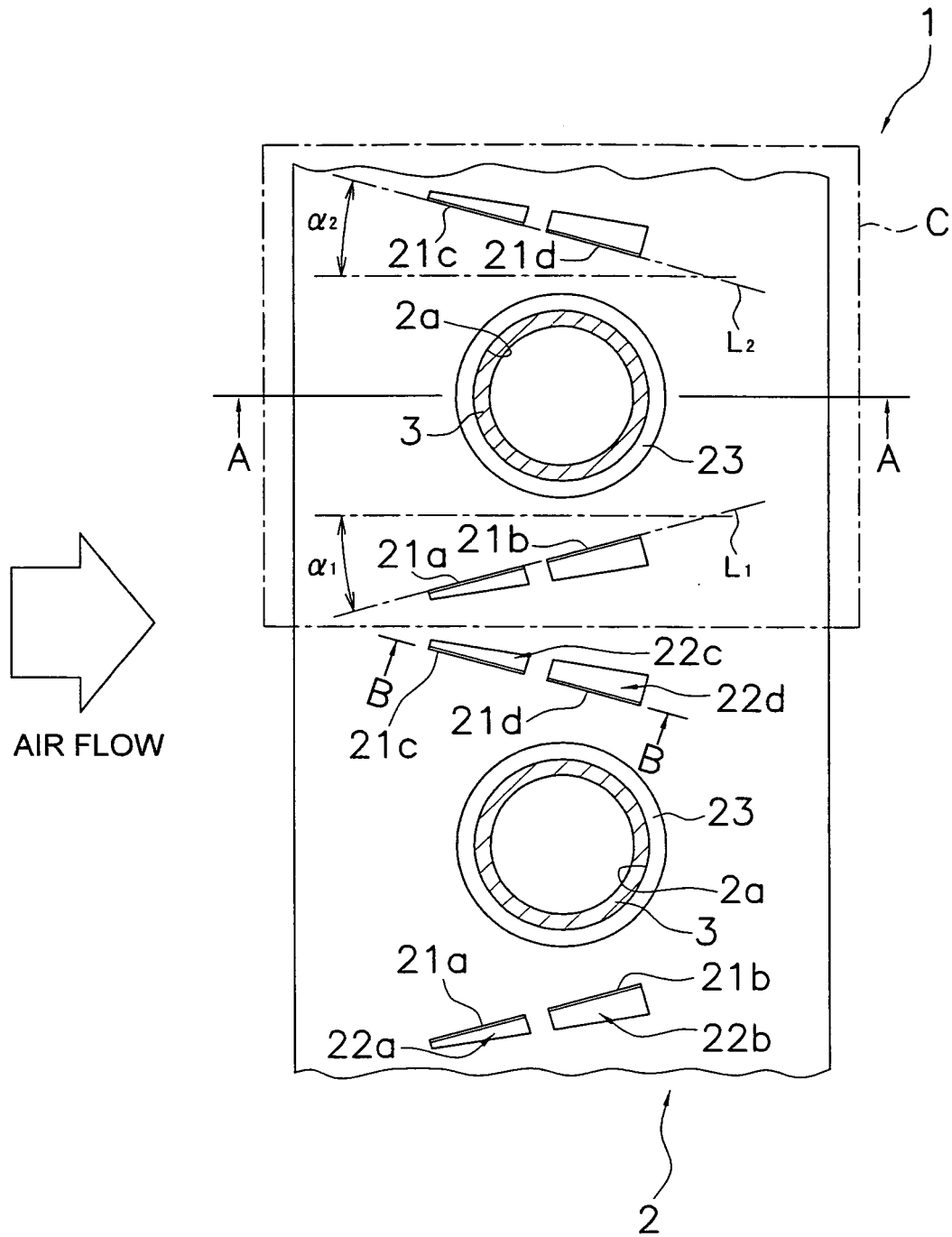


Fig. 1

Fig. 2

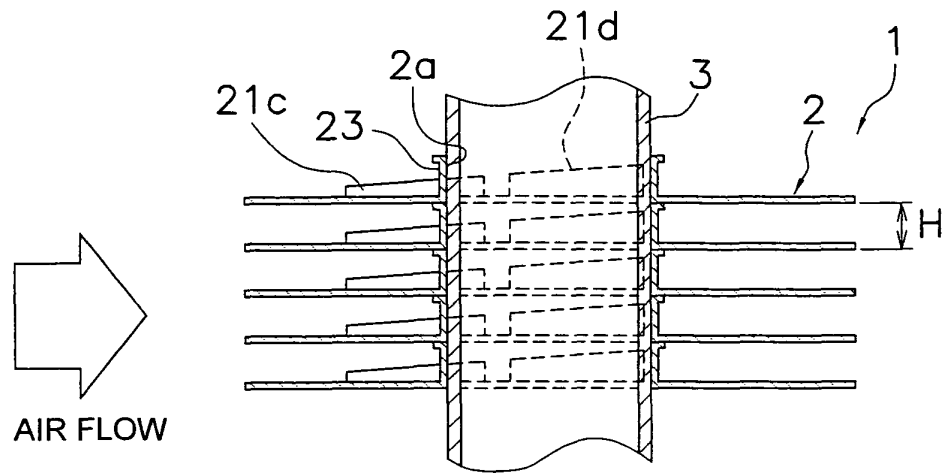


Fig. 3

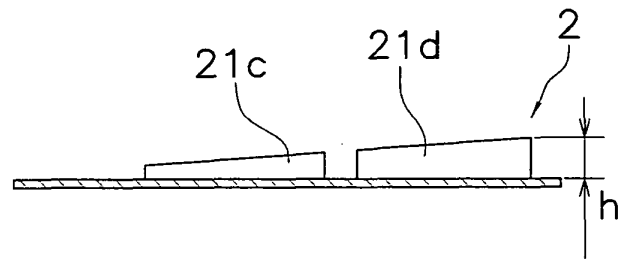


Fig. 4

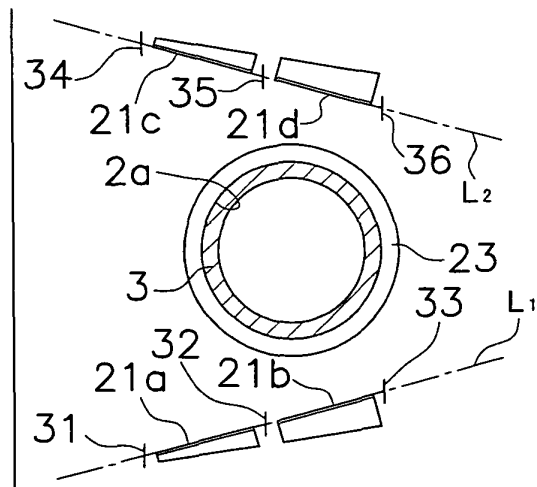


Fig. 5

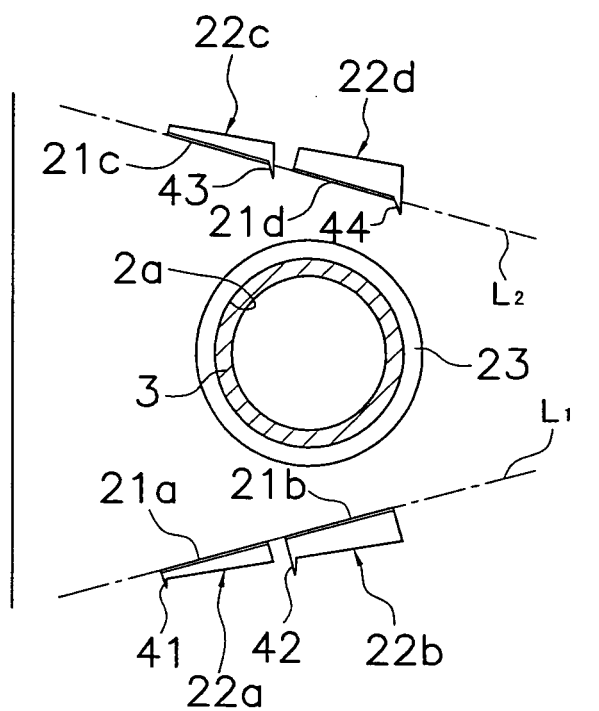
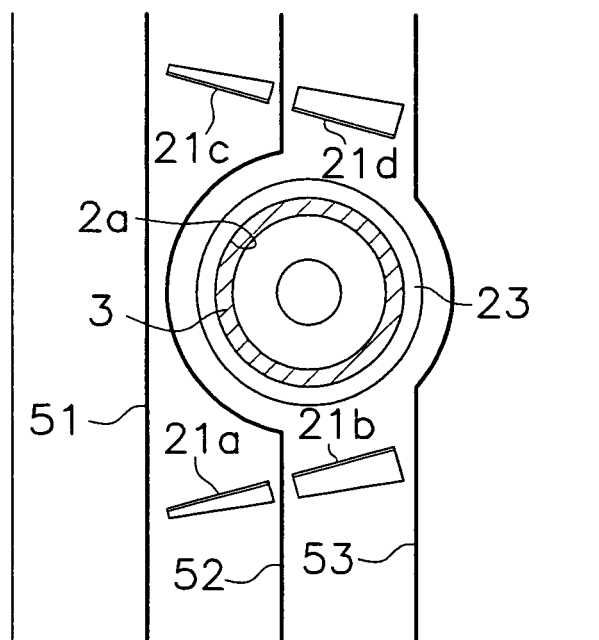


Fig. 6



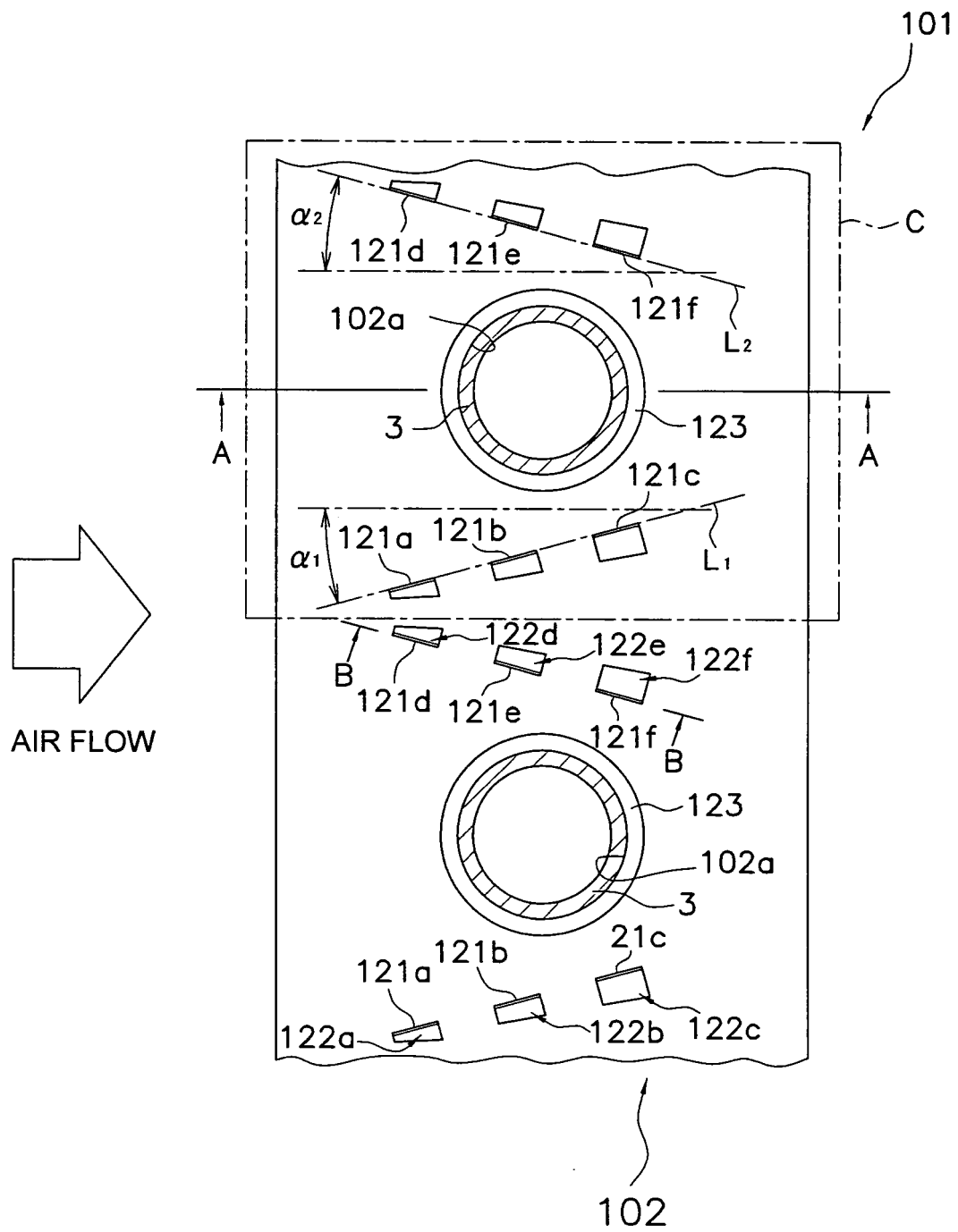


Fig. 7

Fig. 8

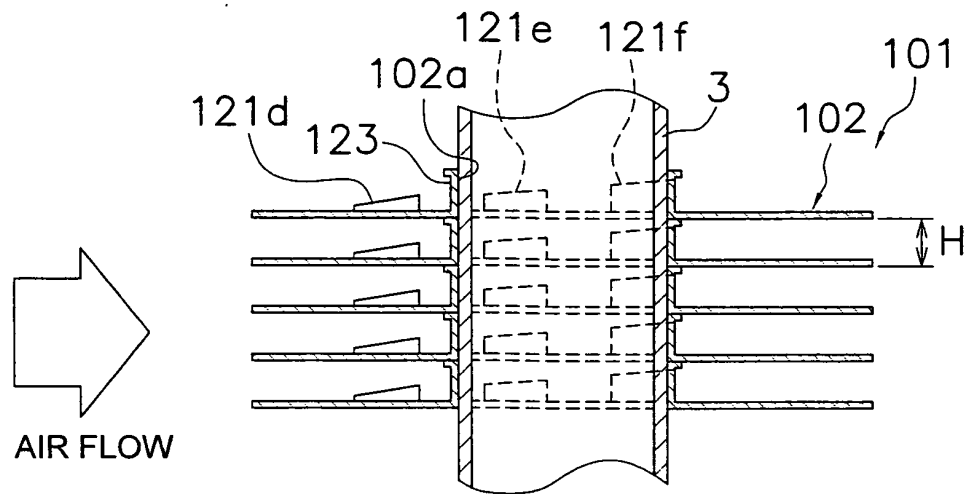


Fig. 9

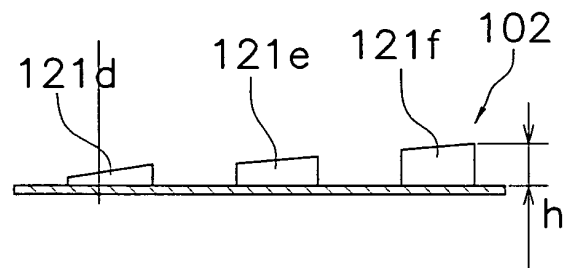


Fig. 10

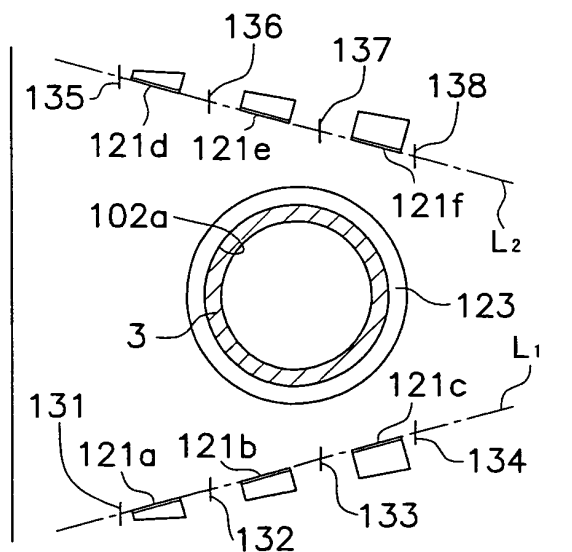


Fig. 11

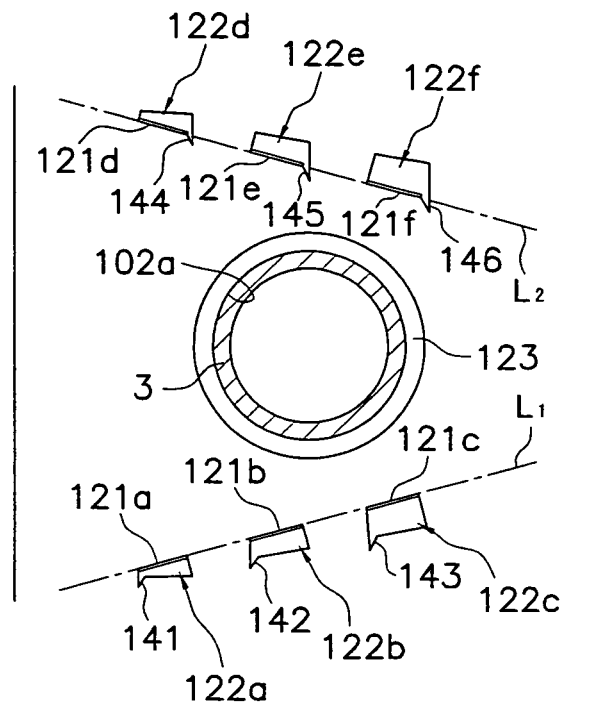
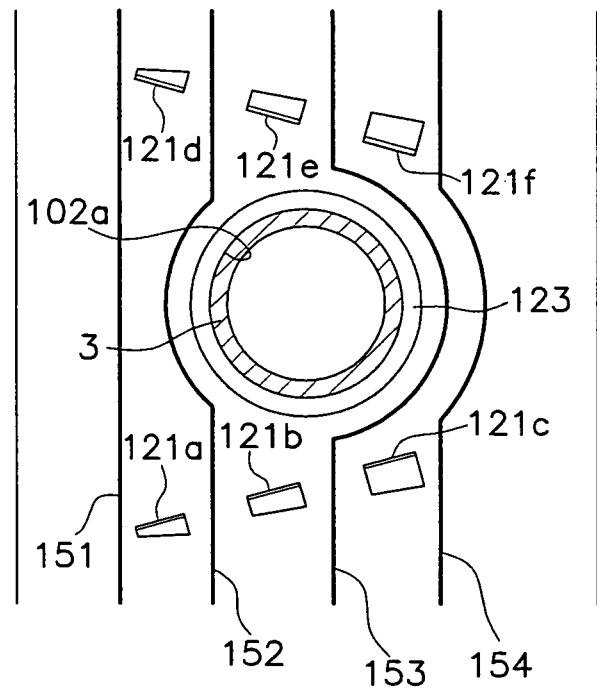


Fig. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/312716

A. CLASSIFICATION OF SUBJECT MATTER

F28F1/32 (2006.01)

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)

F28F1/32

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	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 61-6590 A (Matsushita Electric Industrial Co., Ltd.), 13 January, 1986 (13.01.86), Page 2, upper left column, line 8 to lower left column, line 9; Figs. 1 to 3 (Family: none)	1-6
Y	JP 2-259393 A (Toshiba Corp.), 22 October, 1990 (22.10.90), Page 3, upper left column, line 4 to lower left column, line 12; Figs. 1 to 3 (Family: none)	1-6

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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Date of the actual completion of the international search
14 July, 2006 (14.07.06)Date of mailing of the international search report
25 July, 2006 (25.07.06)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/312716

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-89876 A (Samsung Electronics Co., Ltd.), 10 April, 1998 (10.04.98), Par. Nos. [0021], [0030]; Figs. 1 to 4 & US 5890532 A1 & KR 210073 B & CN 1172238 A & IT 97730402 A	3-6
Y	JP 10-332291 A (Mitsubishi Heavy Industries, Ltd.), 15 December, 1998 (15.12.98), Par. Nos. [0010] to [0012]; Fig. 1 (Family: none)	5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 61110889 A [0004]