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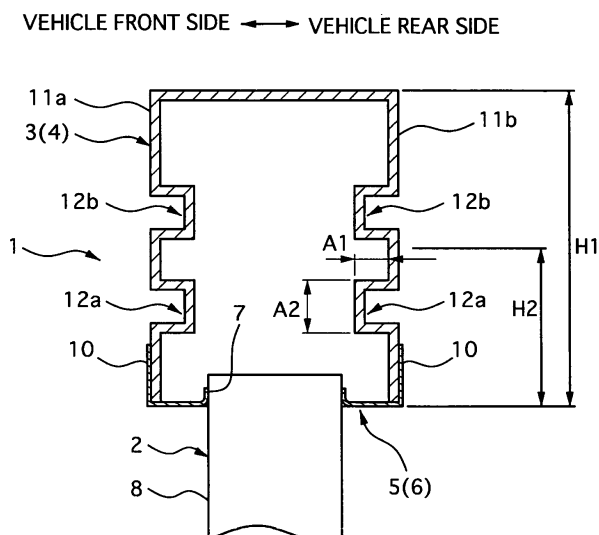
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(54) **TANK STRUCTURE OF HEAT EXCHANGER**

(57) In a tank structure of a heat exchanger 1 where end portions of a plurality of tubes 8 are inserted in and fixed to a tube plate 5, 6 of a tank 3, 4 that is made of aluminum material, a bead 12a is provided at a position

of a tube 8 side heading from a half position of a height H of a side wall portions 11a and 11b of the tank 3, 4 to extend in a direction perpendicular to a longitudinal direction of the tubes 8.

FIG. 2



Description**[TECHNICAL FIELD]**

[0001] The present invention relates to a tank structure of a heat exchanger such as a radiator that is adapted for a motor vehicle.

[BACKGROUND OF THE INVENTION]

[0002] Japanese Patent Applications Laid-Open Publication No. 2005 - 299989 and No. 2005 - 326100 disclose a technology of conventional tank structures of heat exchangers in which both end portions of a plurality of tubes are inserted into and fixed to a bottom portion of a tank that is made of aluminum material.

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

[0003] The conventional inventions, however, have a problem in that they cannot improve coolability of the heat exchangers, because the tubes of the heat exchangers are limited to thin ones for the reason that the tanks thereof could have been deformed to expand outwardly due to thermal shock generated when each tube thereof thermally expands and contracts in a longitudinal direction thereof.

[0004] The present invention is made to solve the above-described problem, and its object is to provide a tank structure of a heat exchanger that can prevent a tank from being deformed due to thermal shock generated when each tube of a heat exchanger thermally expands and contracts in a longitudinal direction thereof.

[MEANS FOR SOLVING THE PROBLEMS]

[0005] According to a first aspect of the present invention there is provided a tank structure of a heat exchanger in which end portions of a plurality of tubes are inserted in and fixed to a bottom portion of a tank that is made of aluminum material, where the tank structure is characterized in that a bead is provided at a position of a tube side heading from a half position of a height of a side wall portion of the tank to extend in a direction perpendicular to a longitudinal direction of the tubes.

[0006] According to a second aspect of the present invention there is provided a tank structure of a heat exchanger in which end portions of a plurality of tubes are inserted in and fixed to a bottom portion of a tank that is made of aluminum material, where the tank structure is characterized in that the tank is formed like a vessel to open toward the tubes, a tube plate is fixed to an opening peripheral portion of the tank, in a state where the tube plate and the opening peripheral portion are overlapped with each other, to form a bottom portion of the tank, and $W1 \geq 2 \times 1.5$, where $W1$ is a plate thickness of the tank

and $W2$ is a plate thickness of the tube plate.

[EFFECT OF THE INVENTION]

[0007] In the first invention, the tank structure of the heat exchanger, in which the end portions of the plurality of tubes are inserted in and fixed to the bottom portion of the tank that is made of aluminum material, has the bead that is provided at the position of the tube side heading from the half position of the height of the side wall portion of the tank to extend in the direction perpendicular to the longitudinal direction of the tubes. Therefore, the tank can be prevented from being deformed due to thermal shock generated when the tubes of the heat exchanger thermally expand and contract. In addition, a flow amount of flowing medium in the tank can be uniformed.

[0008] In the second invention, the tank structure of the heat exchanger, in which the end portions of the plurality of tubes are inserted in and fixed to the bottom portion of the tank that is made of aluminum material, has the tank that is formed like the vessel to open toward the tubes. The tube plate is fixed to the opening peripheral portion of the tank, in the state where the tube plate and the opening peripheral portion are overlapped with each other, to form the bottom portion of the tank, and $W1 \geq 2 \times 1.5$, where $W1$ is the plate thickness of the tank and $W2$ is the plate thickness of the tube plate. Therefore, each tube can be allowed to thermally expand and contract in a longitudinal direction thereof, and necessary rigidity of the tank can be ensured.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0009] 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 rear view showing a tank structure of a heat exchanger of a first embodiment according to the present invention;

FIG 2 is a cross sectional view taken along a line S2 - S2 in FIG 1;

FIG. 3 is a perspective cross sectional view taken along a line S2 - S2 in FIG 1;

FIG 4 is a cross sectional view showing a tank structure of a heat exchanger of a second embodiment according to the present invention;

FIG 5 is a cross sectional view showing a tank structure of a heat exchanger of a third embodiment according to the present invention; and

FIG. 6 is a view showing a tank structure of a heat exchanger of the other embodiment according to the present invention.

[DESCRIPTION OF REFERENCE NUMBERS]

[0010]

P1	vehicle mounting pin
R1, R2	reinforcement member
1	heat exchanger
2	core part
3, 4	tank
5, 6	tube plate
7	burring hole
8	tube
9	fin
10	outer circumferential wall portion
11, 12	bead
13	inlet port
14	outlet port
20	tube plate
21	opening peripheral portion of the tube plate
22	a part of a seat surface of the tube of the tube plate
23	opening peripheral portion of the tank
24	a part of the bead of the tank
25	skirt-like shaped portion
30	tank
31	skirt-like shaped portion

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0011] Hereinafter, embodiments according to the present invention will be described with reference to the accompanying drawings.

[FIRST EMBODIMENT]

[0012] Hereinafter, a first embodiment according to the present invention will be described.

Incidentally, the first embodiment in a case where a heat exchanger is applied to a radiator will be described.

FIG. 1 is a rear view showing a tank structure of a heat exchanger of the first embodiment according to the present invention, FIG. 2 is a cross sectional view taken along a line S2 - S2 in FIG. 1, and FIG 3 is a perspective cross sectional view of the same.

[0013] First, an entire construction of the first embodiment will be described.

As shown in FIG. 1, a heat exchanger 1 of the first embodiment includes a core part 2, and a pair of tanks 3 and 4 that are arranged above and below the core part 2, respectively.

The core part 2 is composed of a pair of tube plates 5 and 6, a plurality of tubes 8 and a plurality of corrugated fins 9, where the tube plates 5 and 6 are formed like a tray to each open in a direction opposite to a tube 8 side, the tubes 8 have both end portions that are inserted into and fixed to burring holes 7, shown in FIG. 2, of the corresponding tube plates 5 and 6, and the corrugated fins 9 are disposed between the adjacent tubes 8.

In addition, both end portions of the tube plates 5 and 6 are connected with each other to add to the strength thereof through a pair of reinforcement members R1 and R2, respectively.

[0014] As shown in FIG 2 and FIG. 3, both of the tanks 3 and 4 are formed like a vessel to open toward the tube 8 side, and opening peripheral portions thereof are stuck up and joined with inner sides of outer peripheral wall portions 10 of the corresponding tube plates 5 and 6, respectively, to be formed like a box, so that the tanks 3 and 4 are provided with bottom portions, respectively.

[0015] In addition, near the bottom portions of side wall portions 11a and 11b of the tank 3(4), beads 12a are provided to extend in a direction perpendicular to the longitudinal direction of the tubes 8 in a state where the beads 12a sink toward an interior of the tank 3(4). This considerably increases the rigidity of the tank 3(4) in a height direction thereof.

Incidentally, the dimensions of the depth A1 and the height A2 of the beads 12a may be set appropriately. Further, the beads 12a are formed in the state where they sink inwardly from the side wall portions 11a and 11b of the tank 3(4) in the first embodiment, while they may be formed to project outwardly therefrom.

[0016] Further, beads 12b similar to the beads 12a are formed above the beads 12a, which further increases the rigidity of the tank 3(4).

[0017] Incidentally, the plate thickness of the tank 3(4) of the first embodiment is set to be 1.8 mm, and the plate thickness of the tube plate 5(6) is set to be 1.0 mm.

[0018] In addition, the tank 3 is provided with an inlet port 13 that projects rearward in a state where it is fluidically communicated with the interior of the tank 3. On the other hand, the tank 4 is provided with an outlet port 14 in a state where it is fluidically communicated with the interior of the tank 4.

Further, each tank 3, 4 is provided at its both end portions with vehicle mounting pins P1 that projects in a vertical direction.

[0019] Incidentally, in the heat exchanger 1 of the first embodiment, all of construction parts thereof are made of aluminum material, and at least one sides of joining portions of the construction parts are provided with a clad layer (a brazing sheet) of brazing filler material. The construction parts are heat-treated in a not-shown heat furnace to be integrally joined in a state where they are temporally assembled with each other.

[0020] Next, the operation of the first embodiment will be described.

The thus-constructed heat exchanger 1 is installed on a motor vehicle in a state where the vehicle mounting pins P1 are fixed on a not-shown radiator core support through mount members that are made of elastic material. The inlet port 13 and the outlet port 14 are connected with connecting pipes of a not-shown engine side.

[0021] The high-temperature flowing medium, which flows in the tank 3 through the inlet port 13 from the engine side, is cooled down due to heat transfer by air flow gen-

erated when the motor vehicle is running or air flow generated by a not-shown electric motor fan, while the flow medium flows through the core part 2. Then it flows in the tank 4, and it is discharged toward the engine through the outlet port 14. Thus, the heat exchanger 1 functions as a radiator.

[0022] Meantime, in the conventional inventions, the tanks could have been deformed to expand due to the thermal shock that is generated when each tubes of the heat exchanger thermally expands and contracts in the longitudinal direction thereof. This does not allow the tubes to be formed thin, and as a result the improvement in coolability of the heat exchanger cannot be realized.

[0023] Conversely, in the first embodiment, the beads 12a are formed near bottom portions of the side wall portions 11a and 11b of the tanks 3 and 4 to extend in the direction perpendicular to the longitudinal direction of the tubes 8 as described above, so that they can especially reinforce peripheral portions of the bottom portions of the tanks 3 and 4, thereby preventing the tanks 3 and 4 from being deformed due to the thermal shock that is generated when the tubes 8 expand and contract in the longitudinal direction.

Therefore, the tubes 8 can be formed thin, thereby improving the coolability of the heat exchanger 1.

[0024] In addition, the plate thickness of the tank 3(4) is set to be equal to or larger than that of the tube plate 5(6), so that the stress concentration at the tank 3(4) can be decreased by absorbing and dispersing the thermal shock mainly by the tube plate 5(6). Therefore, the durability thereof can be improved.

[0025] Further, in the first embodiment, the opening peripheral portions of the tanks 3 and 4 are joined with the inner side of the outer peripheral wall portions 10 of the tube plates 5 and 6, respectively, in the state where they are overlapped with each other, so that the rigidity of these joined portions can be considerably and desirably increased.

[0026] Incidentally, as shown in FIG 2, experiment results show that desired effect can be obtained in a case where the beads 12a are provided within an area H2 of the tube 8 side heading from a half position of the height H1 of the side wall portions 11a and 11b of the tank 3 (4).

[0027] In the first embodiment, the bottom portions of the tanks 3 and 4 consist of the tube plates 5 and 6, respectively, and accordingly the height H1 of the wall portion of the tank includes the height (the plate thickness) of the tube plate 5, 6.

In other word, the height H1 of the side wall portions of the tank accurately means the height from a tank-side root portion of the tube 8 to upper wall portions of the tank, and it is preferable that the beads 12a be set nearer the tube 8 side of the tank.

[0028] In addition, it is proved that the durability against the thermal expansion and contraction of the tubes 8 in the longitudinal direction can be improved by setting a relationship of $W1 \geq W2 \times 1.5$, where W1 is the plate thickness of the tank 3(4) and W2 is the plate thickness

of the tube plate 5(6).

[0029] In the first embodiment, the beads 12a are formed and the plate thicknesses are set to satisfy the relationship of $W1 \geq W2 \times 1.5$, where W1 is the plate thickness of the tank 3(4) and W2 is the plate thickness of the tube plate 5(6). Nevertheless, according to configurations of the tanks and requested specifications of thermal shock, the plate thicknesses may be set to satisfy $W1 \geq W2 \times 1.5$, and no bead may be provided on the tank. On the other hand, only a bead may be provided without satisfying the above relationship, or they may be constructed like the first embodiment.

[0030] In addition, the conventional inventions have a problem in that a flow amount of flowing medium flowing through the tubes cannot be uniformed because a flow distribution thereof in the tank 3 tends to incline toward a vicinity of the inlet outlet port 13.

[0031] Conversely, in the first embodiment, the flowing medium, which flows in the tank 3 through the inlet port 13, can be easily flow in the longitudinal direction in the tank 3 along the beads 12a and 12b. Therefore, the flowing medium can uniformly flow in the tubes 8 from the tank 3, thereby further improving the coolability of the heat exchanger 1.

[0032] In addition, the tank 4 is also formed with the beads 12a and 12b, and accordingly it can obtain the effects similar to those of the tank 3. There is no possibility of the increase in flow resistance.

[0033] Next, the effects of the first embodiment will be described.

As explained above, in the first embodiment, the tank structure of the heat exchanger 1, in which the end portions of the plurality of tubes 8 are inserted into and fixed to the tube plates 5 and 6 of the tanks 3 and 4 that are made of the aluminum material, has the beads 12a that extend in the direction perpendicular to the longitudinal direction of the tubes 8, being arranged at the position of the tube 8 side heading from the half position of the height H1 of the side wall portions 11a and 11b of the tank 3(4). Therefore, the tank 3(4) can be prevented from being deformed due to the thermal shock that is generated when the tubes 8 of the heat exchanger 1 thermally expand and contract in the longitudinal direction thereof, and the flow amount of the flowing medium in the tank 3 can be uniformed.

[0034] In addition, the tank 3(4) is formed like the vessel, and its opening peripheral portion are joined with the tube pate 5(6), in the state where they are overlapped with each other to be formed like the box, so that the bottom portion of the tank 3(4) can be formed. In addition, the plate thicknesses are set to satisfy the relationship of $W1 \geq W2 \times 1.5$, where W1 is the plate thickness of the tank 3(4) and W2 is the plate thickness of the tube plate 5(6). Therefore, it can allow the tubes 8 to thermally expand and contract in the longitudinal direction, ensuring necessary rigidity of the tank 3(4).

[SECOND EMBODIMENT]

[0035] Hereinafter, a second embodiment according to the present invention will be described.

In the second embodiment, parts and portions similar to those of the first embodiment are indicated by the same reference numbers, and their explanation will be omitted, while only their different parts will be described.

[0036] FIG. 4 is a cross sectional view illustrating a tank structure of a heat exchanger of the second embodiment.

[0037] As shown in FIG. 4, in the second embodiment, a tube plate 20 that is formed like a tray to open toward a tube 8 side is employed instead of the tube plate 5(6) that is formed like the first embodiment. In addition, the tube plate 20 is press-fitted in an opening peripheral portion 23 of a tank 3(4), and they are joined with each other by brazing in a state where they are overlapped with each other. These constructions are different from the first embodiment.

[0038] Specifically, an opening peripheral portion 21 and a part 22 of seat surfaces, for the tubes 8, of the tube plate 20 are fixed by brazing with a skirt-like shaped portion 25 that has a cross section like an L-letter shape formed by the opening peripheral portion 23 of the tank 3(4) and a part 24 of beads 12a, in a state where they are surface-contacted with the skirt-like shaped portion 25, when the tube plate 20 are press-fitted in the tank 3(4).

[0039] Therefore, the second embodiment can obtain the following effects in addition to those of the first embodiment. Contact areas of the tubes 8 and the tank 3(4) can be increased, thereby being well brazed with each other and increasing the rigidity of their peripheral portions.

[0040] In addition, the tube plate 20 and the tank 3(4) can be positioned relative to each other by contacting the part 22 of the seat surfaces of the tubes 8 with the part 24 of the bead 12 when the tube plate 20 is press-fitted in the tank 3(4). Therefore, they can be brazed with each other, being assembled with high accuracy.

[THIRD EMBODIMENT]

[0041] Herein after, a third embodiment according to the present invention will be described.

In the third embodiment, parts and portions similar to those of the second embodiment are indicated by the same reference numbers, and their explanation will be omitted, while only their different parts will be described.

[0042] FIG. 5 is a cross sectional view illustrating a tank structure of a heat exchanger of the third embodiment.

[0043] As shown in FIG 5, in the third embodiment, the beads 12a and 12b, which are explained in the first embodiment, are removed, and it employs a tank 50, which is shaped like a vessel to open toward tubes 8. In addition, a tube plate 20 and a skirt-like shaped portion 31 are fixed with each other by brazing in a state where the tube

plate 20 is press-fitted in an inner side of the skirt-like shaped portion 31, where the tube plate 20 is constructed as explained in the second embodiment, and the skirt-like shaped portion 31 has a cross section formed like an L-letter shape and is formed around an opening peripheral portion thereof. These constructions are different from the second embodiment.

[0044] Specifically, the opening peripheral portion 21 of the tube plate 20 and a part of seat surfaces of the tubes 8 are fixed with the skirt-like shaped portion 31 of the tank 3(4) by brazing in a state where they are surface-contacted with the inner side of the skirt-like portion 31, when the tube plate 20 is press-fitted in the tank 3(4).

[0045] Similarly to the second embodiment, in the third embodiment, the tube plate 20 and the tank 3(4) can be well brazed due to the increase in the contact area thereof, thereby obtaining necessary rigidity of the peripheral portions.

[0046] As the embodiments have been explained, but the present invention is not limited to the embodiments, and its design changes and modifications are contained in the present invention as long as they do not depart from the subject of matter of the present invention.

For example, the heat exchanger employs the radiator in the embodiments, while it may employ a general heat exchanger such as an intercooler.

[0047] In addition, as shown in FIG 6, it may employ a tank 41 that has a cross section shaped like a U-letter to open in a front and back direction of a motor vehicle, its opening portion being closed up by a lid plate 40. In this case, a bead 42, which is formed similarly to the first embodiment, may be provided on a portion near a bottom portion of a tank 41 on one side wall portion 41 of side the wall portions 41a and 41b of the tank 41, and a portion near a bottom portion of the other side wall portion 41b thereof may be overlapped with the lid plate 40, in order to increase the rigidity of a peripheral portion near the bottom portion of the tank 41.

Claims

1. A tank structure of a heat exchanger in which end portions of a plurality of tubes are inserted in and fixed to a bottom portion of a tank that is made of aluminum material, the tank structure **characterized in that** a bead is provided at a position of a tube side heading from a half position of a height of a side wall portion of the tank to extend in a direction perpendicular to a longitudinal direction of the tubes.
2. The tank structure of the heat exchanger according to the claim 1, wherein the tank is formed like a vessel to open toward the tubes, and wherein a tube plate, which is formed like a tray to open toward the tubes, forms the bottom portion of the tank

by being fixed to a skirt-like shaped portion which has a cross section shaped like an L-letter and is formed around an opening peripheral portion of the tank in a state where the tube plate is press-fitted in to be overlapped with an inner side of the skirt-like shaped portion. 5

3. A tank structure of a heat exchanger in which end portions of a plurality of tubes are inserted in and fixed to a bottom portion of a tank that is made of aluminum material, the tank structure **characterized in that** 10
- the tank is formed like a vessel to open toward the tubes, wherein
- a tube plate is fixed to an opening peripheral portion of the tank, in a state where the tube plate and the opening peripheral portion are overlapped with each other, to form a bottom portion of the tank, and wherein 15
- $W1 \geq W2 \times 1.5$, where W1 is a plate thickness of the tank and W2 is a plate thickness of the tube plate. 20

4. The tank structure of the heat exchanger according to claim 3, wherein 25
- the tank is formed like a vessel to open toward the tubes, and wherein
- a tube plate, which is formed like a tray to open toward the tubes, forms the bottom portion of the tank by being fixed to a skirt-like shaped portion which has a cross section shaped like an L-letter and is formed around an opening peripheral portion of the tank in a state where the tube plate is press-fitted in to be overlapped with an inner side of the skirt-like shaped portion. 30

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FIG. 1

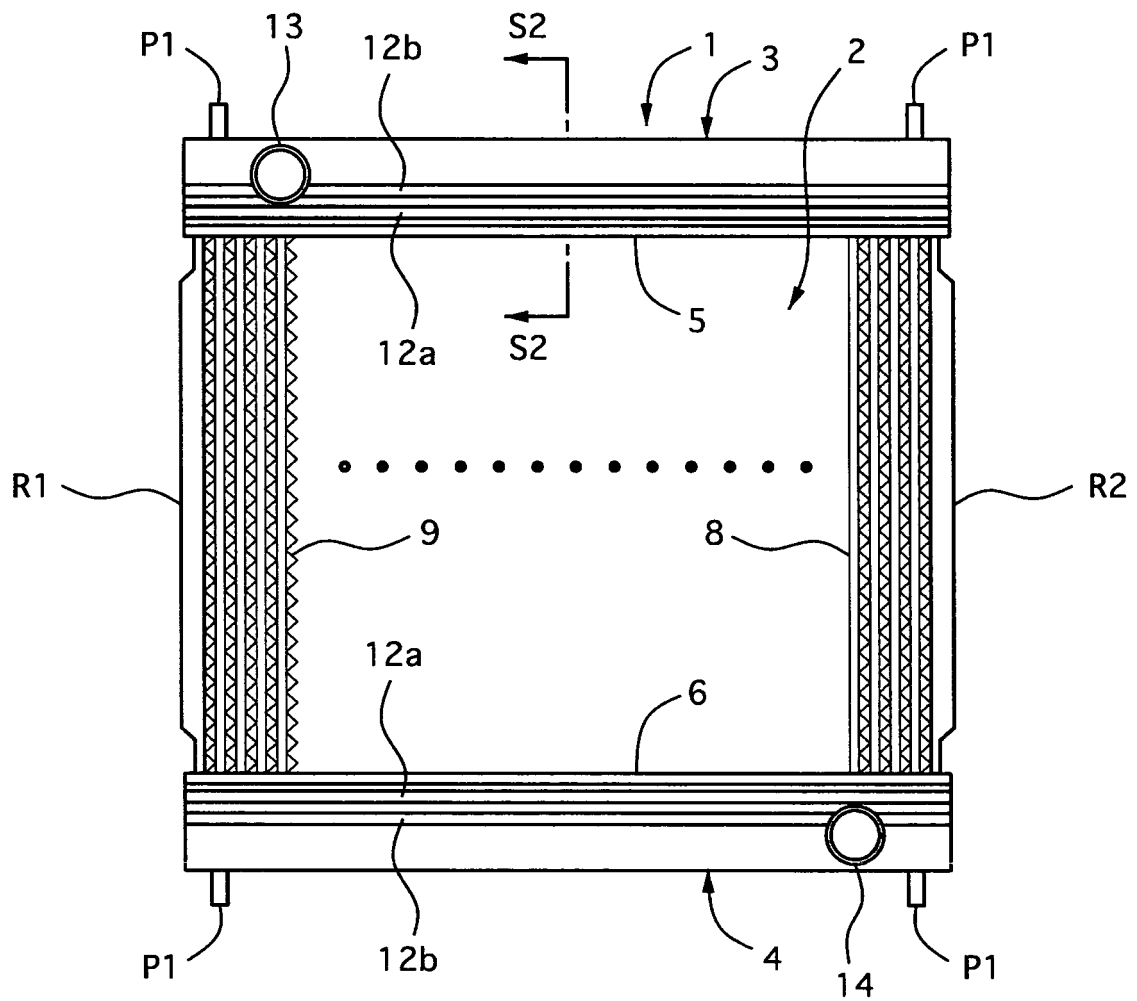


FIG. 2

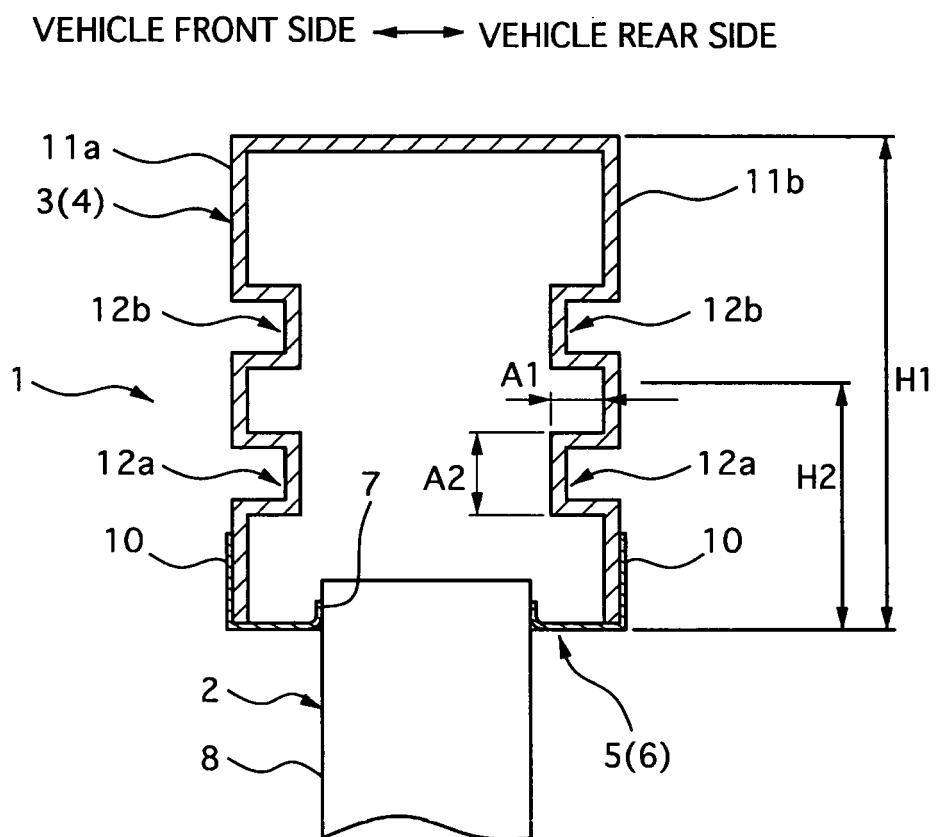


FIG. 3

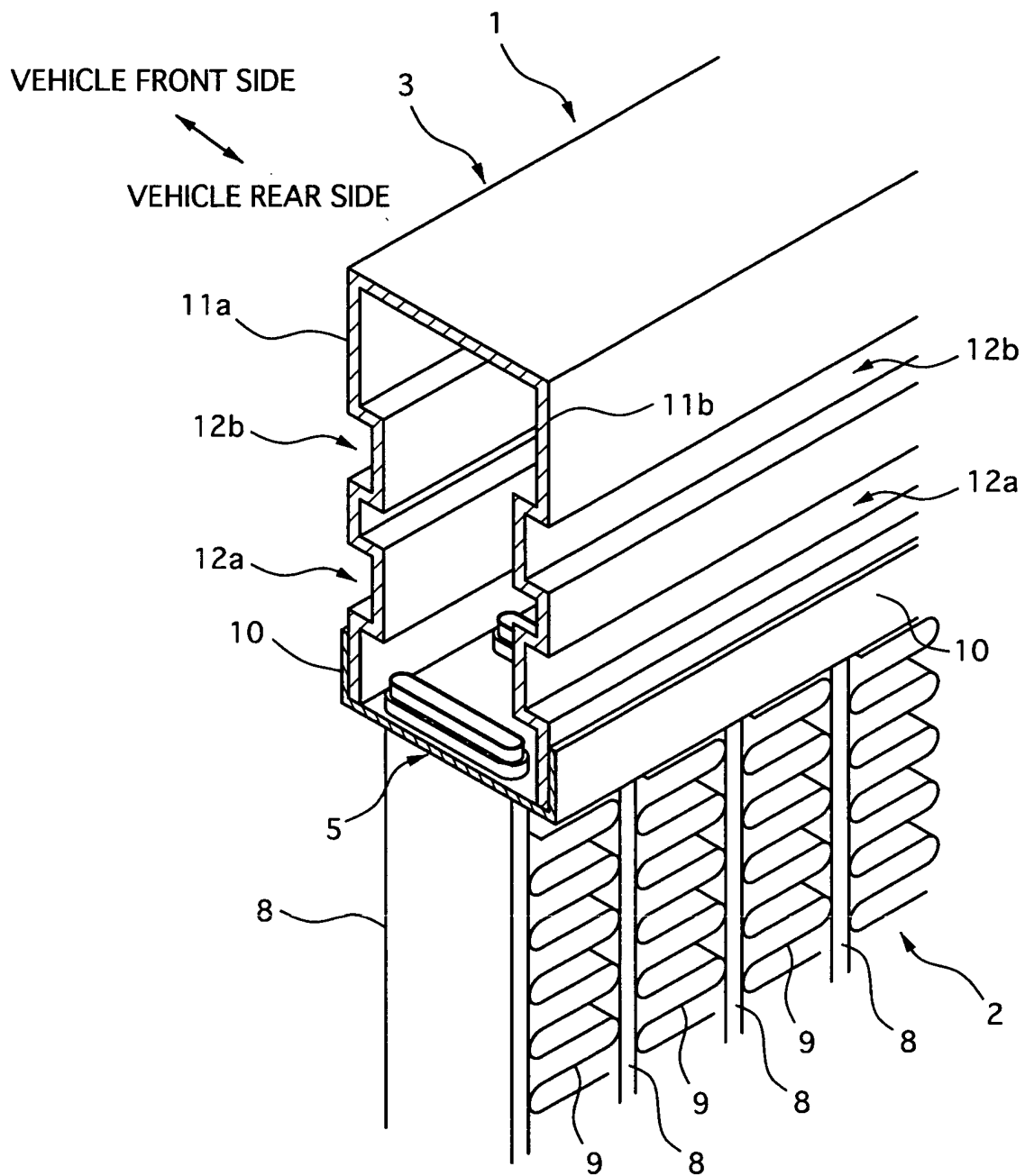


FIG. 4

VEHICLE FRONT SIDE ↔ VEHICLE REAR SIDE

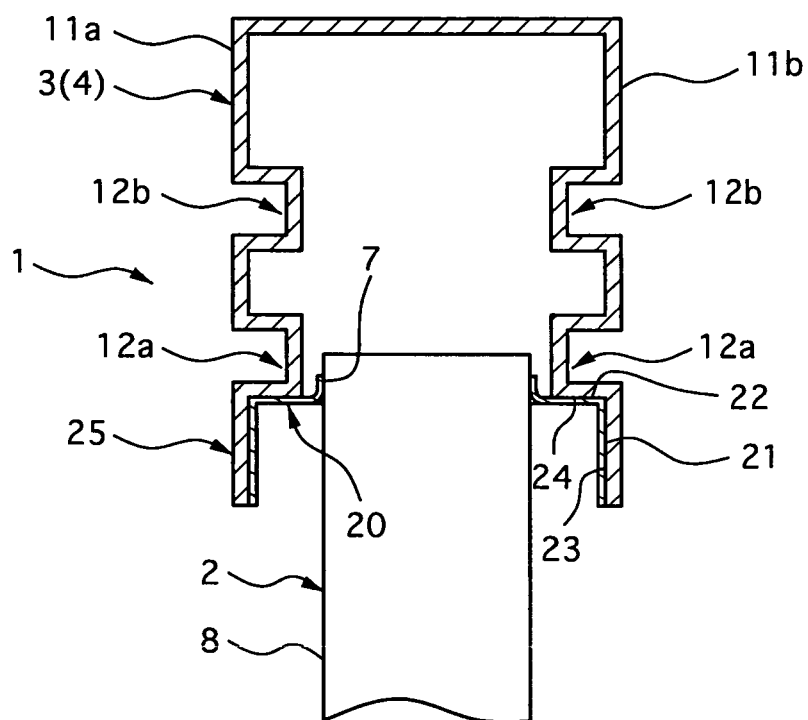


FIG. 5

VEHICLE FRONT SIDE ↔ VEHICLE REAR SIDE

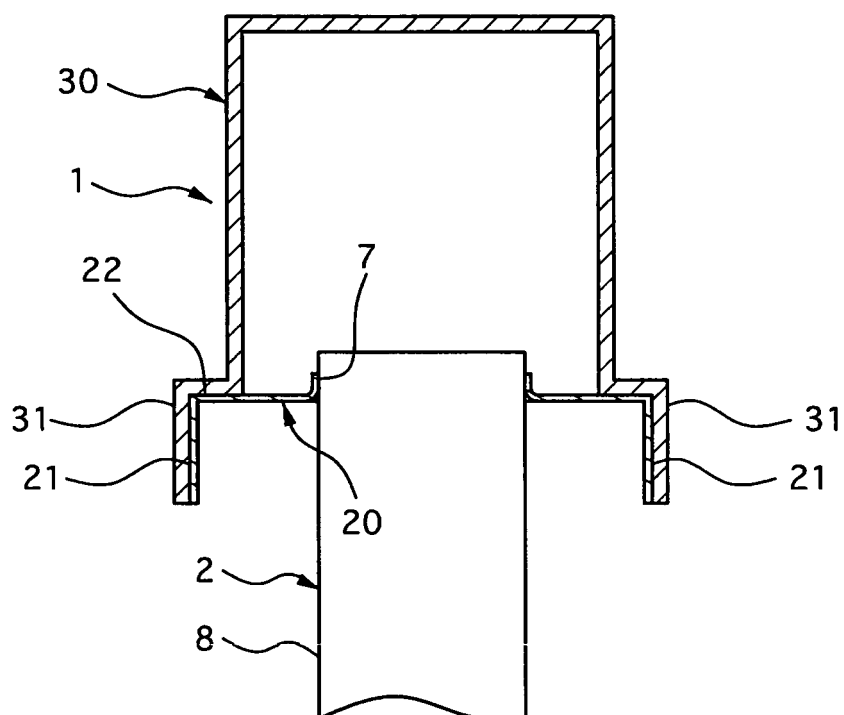
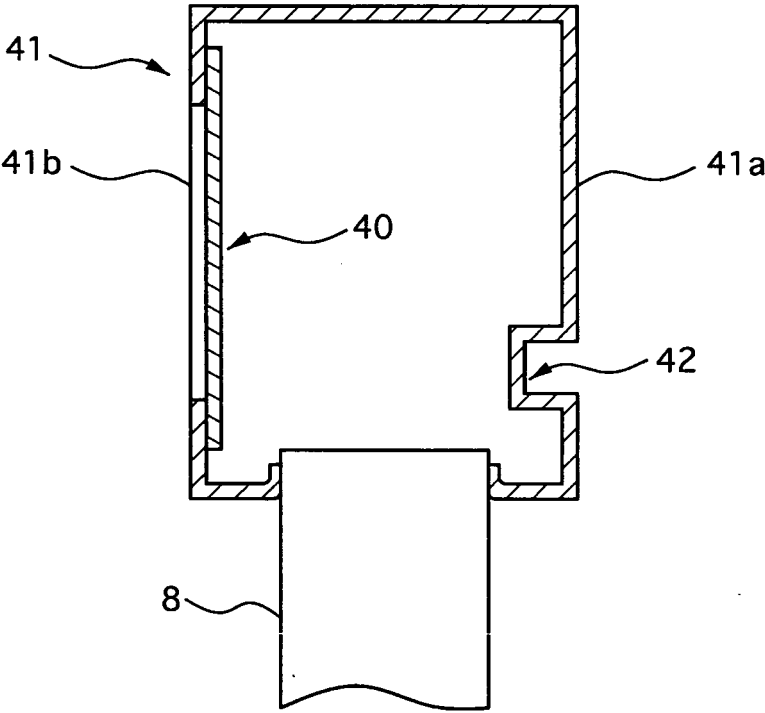


FIG. 6

VEHICLE FRONT SIDE ↔ VEHICLE REAR SIDE



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/065500

A. CLASSIFICATION OF SUBJECT MATTER

F28F9/02 (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)

F28F9/02

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	JP 9-126684 A (Halla Climate Control Corp.),	1
Y	16 May, 1997 (16.05.97), Par. Nos. [0035] to [0043]; Figs. 5 to 12 & KR 165225 B1 & US 5867899 A	2
Y	JP 2005-345037 A (T.RAD Co., Ltd.), 15 December, 2005 (15.12.05), Par. No. [0011]; Fig. 2 (Family: none)	2, 4
X	JP 2004-219044 A (Denso Corp.),	3
Y	05 August, 2004 (05.08.04), Fig. 2 & US 2005/0051315 A1 & DE 010360472 A1	4

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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
18 October, 2007 (18.10.07)Date of mailing of the international search report
30 October, 2007 (30.10.07)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/065500

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

A matter common to the invention in claim 1 (hereafter, referred to as "the specific invention") and the invention in claim 3 is "the tank structure of the heat exchanger in which the ends of the tubes are inserted into and fixed to the bottom parts of the aluminum tanks". However, it is apparent that the common matter makes no contribution over the prior art.

There is no same or corresponding technical features in those portions other than the matter common to the specific invention and the invention in claim 3.

(continued to extra sheet)

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
the

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/065500

Continuation of Box No.III of continuation of first sheet (2)

Since the invention in independent claim 3 and the invention in claim 4 referring to claim 3 do not have a common matter considered to be a special technical feature in the meaning of the second sentence of PCT rule 13.2 in regard to the specific invention, any technical relation in the meaning of PCT rule 13 cannot be found out.

The result of search reveals that the specific invention is not novel since it is disclosed in the paragraphs [0035] to [0043] of Japanese Patent Laid-open No. 9-126684.

Therefore, since the specific invention makes no contribution over the prior art, there is no special technical feature in the matter for specifying the specific invention in the meaning of the second sentence of PCT rule 13.2.

Consequently, the invention in independent claim 3 and the invention in claim 4 referring to that claim do not have a common matter considered to be a special technical feature in the meaning of the second sentence of PCT rule 13.2 in regard to the specific invention, and therefore, any technical relation in the meaning of PCT rule 13 cannot be found out.

As a result, the inventions in claims 1-4 do not fulfill the requirement of unity of invention.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2005299989 A [0002]
- JP 2005326100 A [0002]