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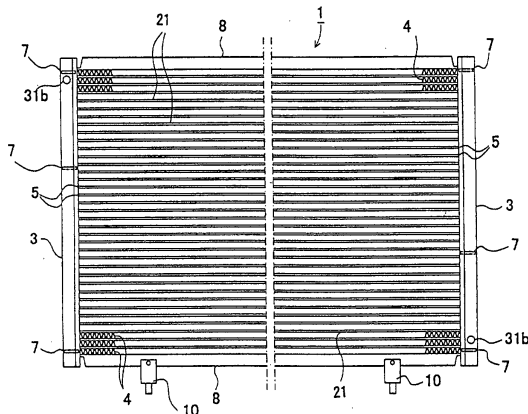
HEAT EXCHANGER

(57) A heat exchanger having tubes 21 for flowing a medium and tanks 3 each formed of an end plate 32 having tube insertion holes 5 for connection of the tubes and a tank plate 31 connected to the end plate, which are assembled and brazed in a heating furnace, wherein the tank plate 31 is formed of a plate provided with brazing materials R1, R2, and at least one of the tank plate 31 and the end plate 32 is provided with separator portions 311, 321 not provided with the brazing material for prevention of the brazing material from outflowing. The

tank 3 has partition plates 7 for dividing the interior, the inner surface of at least one of the tank plate 31 and the end plate 32 is clad with the brazing material, and the partition plates 7 are formed of a bare material not clad with a brazing material.

And, the end plate 32 has the brazing material clad on its one surface only, and the ends of the fins 4 and the surface of the end plate 32 not clad with the brazing material are opposed to each other at the time of brazing.

FIG.1



Description

TECHNICAL FIELD

[0001] The present invention relates to a heat exchanger used for a heat-exchange cycle which is mounted on vehicles and the like.

BACKGROUND ART

[0002] It is generally known that a heat exchanger configuring a heat-exchange cycle mounted on vehicles or the like is, for example, a radiator, a condenser, an evaporator or the like.

[0003] For example, the condenser has a plurality of flat tubes and a plurality of fins alternately stacked, the ends of the tubes inserted in the tube insertion holes of tanks, and integrally bonded by a brazing material which is clad to the tanks and tubes in a heating furnace. The condenser performs heat exchange of the medium flowing through the tanks and tubes with the open air. Partition plates are disposed within the tanks to change a flowing direction of the medium. The tanks may be provided with a brazing material on the outer surfaces of the tanks to connect accessories such as a connector or the like.

[0004] The heat exchanger used for the heat-exchange cycle for vehicles is desired to be light-weighted. Therefore, respective members configuring the heat exchanger are considered to be made of a material having a thickness as thin as possible with safety taken into consideration. Generally, the brazing material contains silicon (Si) and, when the brazing material melts in a heating furnace, it forms an Al-Si eutectic liquid phase with aluminum (Al) or an aluminum alloy, which is a material forming the tubes and the tanks, to braze the respective members.

[0005] The Al-Si eutectic liquid phase has a liquidus temperature lower than that of the aluminum or aluminum alloy configuring the tubes and the like. Therefore, when an excessive amount of brazing material flows to the tubes having a thickness thinner than that of the tanks in the heating furnace, the Al of the tube surface reacts with the excessive amount of brazing material to form a large amount of Al-Si eutectic liquid phase. This may result in a disadvantage in that a hole is formed in the tubes, erosion is caused or the like. The erosion is a phenomenon in which the melted brazing material erodes a base metal.

[0006] Accordingly, the present invention provides a heat exchanger with high safety which prevents an excessive amount of brazing material from flowing to the tubes and has an appropriate amount of brazing material used to braze the respective members.

[0007] The heat exchanger used for a condenser or the like of a car air conditioner has its core configured by alternately stacking a plurality of tubes and fins and a pair of tanks connected for communication with both

ends of the stacked tubes. A block member is attached to the top and bottom ends of both tanks, an inlet joint for introduction of a medium is attached to an appropriate portion of one of the tanks, and an outlet joint for discharging the medium is attached to an appropriate portion of the other tank.

[0008] Partition plates for dividing the tank interiors are disposed at required positions in the tanks so that the medium flows to meander between the inlet joint and the outlet joint.

[0009] The above-described tanks each generally has a substantially cylindrical shape and is formed to have a single body or a two-split type body which is formed by assembling members having a substantially semicircular cross section. Between the members forming the two-split type tank, one having holes for connection of the ends of the tubes is called the end plate and the other is called the tank plate. This two-split type tank has advantages in that the holes for connection of the ends of the tubes are readily formed and the partition plates are easily attached.

[0010] It was necessary to accurately fit the dimensions of the partition plates to the inside surface of the tank so not to have any gap between the inside wall of the tank and the partition plates because such a gap allows the medium partly bypass through the gap and degrades the performance.

[0011] But, the two-split type tank often has a complex sectional shape at the junction of the end plate and the tank plate, and it was hard to match the dimensions of the partition plates.

[0012] Under the circumstances described above, an object of the present invention is to provide a heat exchanger having two-split type tanks and high airtightness which is free from leakage of a medium between the inside surface of the tank and the partition plates without strictly controlling the dimensions of the partition plates.

[0013] As described above, the heat exchanger such as a radiator or an evaporator of the refrigeration cycle is configured by alternately stacking a plurality of tubes and a plurality of fins to form a core and connecting the ends of the tubes to the tanks.

[0014] The medium is taken into the inside through the inlet joint formed on the tank, passed through the tubes while conducting heat exchange by the heat conducted to the core and discharged to the outside through the outlet joint formed on the tank. A fan may be disposed on the outside of the heat exchanger to send air to the core.

[0015] Besides, this type of heat exchanger is produced by assembling respective aluminum or aluminum alloy members and heating the assembly in a furnace to be brazed into one body.

[0016] In view of the heat-exchanging performance of such a heat exchanger, a gap between the fins and the tank is desired to be as small as possible. Because, if the gap between the fins and the tank is large, air leaks

through the gap, and the heat-exchanging performance drops.

[0017] But, there is a problem that, when the fins and the end plates are approached to one another, the brazing material melted from the tank at the time of brazing reaches the ends of the fins, and the ends of the fins are melted by erosion.

[0018] In other words, the fins are thin and their ends have a disadvantage of easily causing unnecessary erosion because of an effect of the brazing material.

[0019] The present invention was achieved under the circumstances as described above, and it is to provide a heat exchanger which effectively avoids the ends of fins from being eroded by a brazing material.

DISCLOSURE OF THE INVENTION

[0020] The invention described in Claim 1 is a heat exchanger which has tubes for flowing a medium and a tank comprising an end plate having tube insertion holes for connecting the tubes and a tank plate connected to the end plate and formed by assembling the respective members and brazing the members for connection in a heating furnace; wherein the tank plate is formed of a plate provided with a brazing material, and at least one of the tank plate and the end plate is provided with a separator portions not having a brazing material for prevention of a brazing material from outflowing.

[0021] Thus, the heat exchanger is formed of two members of the tank plate and the end plate, and at least one of the end plate and the tank plate is provided with the separator portion for prevention of the brazing material from outflowing, so that the molten brazing material is prevented from moving by the separator portion within the heating furnace.

[0022] Generally, the molten brazing material flows along the brazing material disposed on the members in the heating furnace and guided into the gaps formed when the members are assembled. An excessive amount of molten brazing material is especially accumulated in the gaps between the tubes and the tube insertion holes to form a large amount of Al-Si eutectic liquid phase, and erosion tends to occur on the tubes in contact with the tube insertion holes.

[0023] According to the invention, the separator portion which is not provided with the brazing material and prevents the brazing material from outflowing is disposed on at least one of the tank plate and the end plate, so that the separator portion prevents the brazing material from flowing, and an excessive amount of brazing material is prevented from flowing to the tubes. Therefore, erosion of the tubes configuring the heat exchanger can be prevented, and a highly safe heat exchanger can be provided.

[0024] For example, even if the molten brazing material flows over the separator portion in the heating furnace, a flowing amount of the molten material to the tubes can be reduced by the separator portion, and the

flow of the excessive amount of brazing material to the tubes can be prevented.

[0025] The invention described in Claim 2 relates to the invention according to Claim 1, wherein the separator portion is disposed on a surface of the end plate which is in contact with the tank plate.

[0026] For example, when the tank plate is formed to have a substantially U-shaped cross section and the outer surface of the end plate is contacted with the inside of the U-shaped opening to configure the tubular tank, the edges of the end plate is contacted with the tank plate. The separator portion not having the brazing material is disposed on one surface of the edges of the end plate contacted with the tank plate. In the heating furnace, the separator portion prevents the brazing material disposed on the tank plate from flowing. Therefore, an excessive amount of brazing material does not flow to the tubes, and the tubes can be brazed for connection into the tube insertion holes of the end plate with an appropriate amount of brazing material.

[0027] The invention described in Claim 3 relates to the invention according to Claim 2, wherein the tank plate has the brazing material disposed on its surface which becomes at least the inner surface of the tank, and the end plate has the brazing material disposed on its surface which becomes the inner surface of the tank.

[0028] Thus, even when the brazing material is disposed on the surface of the tank plate which becomes the inside of the tank and the surface of the end plate which becomes the inside of the tank, the separator portion prevents the brazing material disposed on the tank plate from flowing and prevents an excessive amount of brazing material from flowing to the tubes in the heating furnace.

[0029] The invention described in Claim 4 relates to the invention according to any one of Claims 1 to 3, wherein the tank plate is provided with the separator portion on its surface which is in contact with the end plate.

[0030] For example, even when the brazing material is disposed on the surface of the tank plate which becomes the outside of the tank, the separator portion prevents the brazing material disposed on the tank plate from flowing and prevents an excessive amount of brazing material from flowing to the tubes.

[0031] The invention described in Claim 5 relates to the invention according to any one of Claims 1 to 4, wherein the tank is provided with a partition plate within it, and the tank is formed by assembling the tank plate and the end plate while positioning by the partition plate.

[0032] Thus, the tank formed of two members, the tank plate and the end plate, has the tank plate and the end plate positioned by the partition plate disposed within the tank, so that the tank plate and the end plate can be prevented from displacing.

[0033] The invention described in Claim 6 relates to the invention according to any one of Claims 1 to 5, wherein the heat exchanger uses tubes which are

formed of a plate.

[0034] When the tubes are formed of a plate, the tubes which can secure the required pressure resistance can be formed even if the plate is thin. Thus, when the tubes formed of a thin plate is used, the heat exchanger can be light-weighted.

[0035] And, even when the thin tubes are used, the separator portion prevents the brazing material from flowing, so that an excessive amount of brazing material does not outflow to the tubes. Therefore, erosion resulting from the outflowing of an excessive amount of brazing material to the tubes can be prevented from occurring, and a highly safe heat exchanger can be provided.

[0036] The invention described in Claim 7 relates to the invention according to any one of Claims 1 to 6, wherein the tubes have slits on the outer surfaces of the tubes which are in contact with tube insertion holes of the end plate.

[0037] As described above, when the tubes have the slits, the molten brazing material in the heating furnace is introduced into the slits. In other words, the brazing material flows through the gaps between the tube insertion holes and the tubes and is drawn into the slits. Therefore, the tubes and the end plate are joined with an appropriate amount of brazing material, and defective brazing can be avoided.

[0038] The invention described in Claim 8 relates to a heat exchanger having tubes for flowing a medium and tanks to which ends of the tubes are connected, wherein the tanks are formed by brazing an end plate which is formed with holes for connection of the ends of the tubes, a tank plate connected to the end plate, and a partition plate for dividing the interior, and a brazing material is clad to the inner surface of at least one of the tank plate and the end plate, and the partition plate is formed of a bare material which is not clad with a brazing material.

[0039] Conventionally, when the partition plate clad with the brazing material was used, the molten brazing material on the inner surface of the tank became integral with the molten brazing material of the partition plate at the time of brazing, attracted by gravitation or capillary phenomenon and outflow to another portion along the partition plate. Therefore, the brazing material for brazing the partition plate became short in amount, and the partition plate was apt to be brazed defectively.

[0040] According to the present invention, since the partition plate is a bare material which is not clad with the brazing material, the molten brazing material on the inner surface of the tank when brazing hardly outflows along the unwet partition plate. As a result, the brazing material for brazing the partition plate does not become short, and the partition plates can be brazed adequately even if there are some gaps between the inner surface of the tank and the partition plate.

[0041] Therefore, the medium does not leak between the inner surface of the tank and the partition plate even if the dimensions of the partition plate are not controlled

strictly as before, and a highly airtight heat exchanger can be provided.

[0042] The invention described in Claim 9 relates to the invention according to Claim 8, wherein the tubes have slits formed on the surfaces.

[0043] The present invention is particularly effective for a heat exchanger having tubes which have slits in the surface.

[0044] When the tubes have the slits in the surface, the brazing material melted on the inner surface of the tank at the time of brazing is drawn into the slits by capillarity phenomenon and outflow to the tubes. Therefore, the brazing material for brazing the partition plate became short, and the partition plate was apt to be brazed defectively.

[0045] According to the invention, even if the brazing material on the inner surface of the tank outflows to the tubes, the brazing material does not outflow along the partition plates as before, so that an outflow amount is substantially reduced, the brazing material for brazing the partition plate does not become short, and the partition plate can be brazed adequately.

[0046] The invention described in Claim 10 relates to the invention according to Claim 9, wherein the tubes are formed of a plate material.

[0047] The present invention is particularly effective for a heat exchanger having the tubes which are formed of a plate material.

[0048] So-called roll forming tubes which are formed of a plate material have partitions in their interiors formed by bending a plate material to have a corrugated shape, and slits are formed in the surface. Therefore, the brazing material melted on the inner surface of the tank at the time of brazing is drawn into the slits by capillary phenomenon and outflows to the tubes. Therefore, the brazing material for brazing the partition plate became short, and the partition plate was brazed defectively.

[0049] According to the present invention, even when the brazing material on the inner surface of the tank outflows to the tubes, the brazing material does not flow along the partition plate as before, so that an outflowing amount is substantially reduced. Thus, the brazing material for brazing the partition plates does not become short, and the partition plate can be brazed adequately.

[0050] The invention described in Claim 11 is a heat exchanger having a core which is formed by stacking tubes and fins and tanks to which the ends of the tubes are connected, and performing heat exchange by a medium flowing through the tubes by heat conducted to the core, wherein the tanks have an end plate which is formed with holes for connection of the tubes and a tank plate to which the end plate is attached, the heat exchanger is formed by assembling and brazing the tubes, the fins, the end plate and the tank plate in a furnace, the end plate has a brazing material clad on its one surface only, and the ends of the fins are opposed to a surface of the end plate not clad with the brazing material

at the time of brazing.

[0051] By configuring as described above, erosion of the ends of the fins by the brazing material can be avoided efficiently.

[0052] In other words, the ends of the fins have a disadvantage that unnecessary erosion is apt to be caused by an influence of the brazing material. But, according to the present invention, the brazing material melted from the tank can be prevented from being brought to the ends of the fins, and such a disadvantage can be avoided.

[0053] Besides, it is desirable that the fins and the tanks are mutually approached as close as possible in view of the heat-exchange performance of the core. Especially, when air is sent to the core, air leaks through the gap between the fins and the tanks if it is large. In this connection, the present invention has no possibility of causing erosion at the ends of the fins even if the fins and the tanks are close to each other. And, the heat exchanger is configured quite rationally.

[0054] The invention described in Claim 12 relates to the invention according to Claim 11, wherein the ends of the fins have a minimum distance of 2.0 mm or less from the surface of the end plate which is not clad with the brazing material.

[0055] By configuring as described above, the heat-exchange performance of the core can be secured adequately.

[0056] In other words, if the gap between the fins and the tanks is large, it causes lowering of the heat-exchange performance, but the present invention sets the upper limit of the gap to 2.0 mm in order to prevent the heat-exchange performance from lowering.

[0057] The invention described in Claim 13 relates to the invention according to Claim 11, wherein the ends of the fins are in contact with the surface of the end plate which is not clad with the brazing material.

[0058] By configuring as described above, the heat-exchange performance of the core can be secured adequately.

[0059] In other words, if the gap between the fins and the tanks is large, the heat-exchange performance is lowered, but the present invention has them mutually contacted to prevent the heat-exchange performance from lowering.

BRIEF DESCRIPTION OF THE DRAWINGS

[0060]

Fig. 1 is a top view showing a general structure of a heat exchanger according to an embodiment of the present invention.

Fig. 2 is an exploded perspective view showing a structure of a tank according to an embodiment of the invention.

Fig. 3 is a sectional view of a tank to which a tube is attached according to an embodiment of the in-

vention.

Fig. 4 is an end face view of a tube according to an embodiment of the invention.

Fig. 5 is a partially enlarged view of the end face of the tube shown in Fig. 4.

Fig. 6 is a sectional view showing a tank to which a tube is attached according to an embodiment of the invention.

Fig. 7 is a sectional view showing a tank to which a tube is attached according to an embodiment of the invention.

Fig. 8 is a front view showing a general structure of a heat exchanger according to an embodiment of the invention.

Fig. 9 is an exploded perspective view showing a structure of a tank according to an embodiment of the invention.

Fig. 10 is a transverse sectional view showing a tank according to an embodiment of the invention.

Fig. 11 is a vertical sectional view showing a tank according to an embodiment of the invention.

Fig. 12 is a cross sectional view showing a tank according to an embodiment of the invention.

Fig. 13 is a perspective view showing a tube according to an embodiment of the invention.

Fig. 14 is a front view showing a heat exchanger according to an embodiment of the invention.

Fig. 15 is an exploded perspective view showing the main portion of a heat exchanger according to an embodiment of the invention.

Fig. 16 is an explanatory view showing a tank and a fin according to an embodiment of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0061] Embodiments of the invention will be described in detail with reference to the accompanying drawings.

[0062] Fig. 1 is a top view showing a general structure of a heat exchanger 1.

[0063] The heat exchanger 1 shown in Fig. 1 shows an example of a condenser. The heat exchanger 1 has tubes 21 and fins 4 alternately stacked and both ends of the tubes 21 inserted and connected to tube insertion holes 5 of a pair of tanks 3. Partition plates 7 for dividing a medium passage which is formed of the tanks 3 and the tubes 21 are disposed within the tanks 3. The openings of the tanks 3 are sealed with the partition plates 7. The tanks 3 are provided with an outflow/inflow ports 31b for feeding or discharge of the medium to/from the heat exchanger 1. A side plate 8 is disposed on either side of the stacked tubes 21 and fins 4. The side plate 8 on the bottom end of the heat exchanger 1 is provided with mounting members 10 for mounting the heat exchanger 1 on a vehicle body.

[0064] The heat exchanger 1 has the above-described members assembled and integrally brazed by a brazing material disposed on the respective members

in a heating furnace.

[0065] Fig. 2 is a perspective view showing the tank 3. Fig. 2 is an exploded perspective view of the tank 3 which is comprised of a tank plate 31, an end plate 32 and the partition plate 7.

[0066] The tank 3 is formed to have a tubular shape by attaching the outside face of the end plate 32 to a U-shape open inside face of the tank plate 31 which is formed to have a U-shaped cross section. The end plate 32 is formed with the tube insertion holes 5 into which the tubes 21 are inserted.

[0067] The tank plate 31 and the end plate 32 are positioned by the partition plate 7 which is disposed within the tank 3 to configure the tubular tank 3. The tank plate 31 of this embodiment is provided with an attachment hole 31a for attachment of the partition plate 7 and the outflow/inflow port 31b for the medium. The partition plate 7 has a projection 7a for insertion into the attachment hole 31a and notches 7b for engagement of the end plate 32. Specifically, the projection 7a of the partition plate 7 is inserted into the attachment hole 31a of the tank plate 31 to attach the partition plate 7 to the tank plate 31. Then, the end plate 32 is attached to fit the inside surface of the U-shaped opening of the tank plate 31. Then, the edges of the end plate 32 are connected to the notches 7b of the partition plate 7, and the tank plate 31 and the end plate 32 are positioned to enable to assemble the tank 3.

[0068] Fig. 3 is a sectional view of the tank 3 having the tube 21 assembled.

[0069] As shown in Fig. 3, the tank plate 31 is formed with a brazing material R1 on its surface which becomes the outer surface of the tank 3 and a brazing material R2 on its surface which becomes the inner surface of the tank 3. The brazing material R1 disposed on the outer surface of the tank plate 31 is a brazing material for attaching an accessory such as the connector 4 to the tank 3, and the brazing material R1 is a brazing material for attaching the partition plate 7 to be disposed within the tank 3.

[0070] The end plate 32 is formed with a brazing material R3 on its surface which becomes the inner surface of the tank 3. The brazing material R3 is a brazing material for attaching the tube 21 and also the partition plate 7.

[0071] The end plate 32 has its surfaces which are in contact with the tank plate 31 determined as separator portions 321 which are not provided with a brazing material and prevents the brazing material from outflowing. The separator portions 321 prevent flowing of the brazing material R2 which is disposed on the inside of tank plates 31 within the heating furnace.

[0072] Generally, the molten brazing material in the heating furnace flows along the brazing material which is clad to the plate. The end plate 32 of this embodiment is provided with the separator portions 321 which are not provided with a brazing material and prevent the brazing material from outflowing, so that the flow of the

brazing material R2 disposed on the inner surface of the tank plate 31 in the heating furnace is prevented by the separator portions 321 and it does not flow to the end plate 32. Even if the molten brazing material R2 flows over the separator portions 321, its flowing amount becomes smaller than when the separator portions 321 are not disposed.

[0073] The tank plate 31 has its surfaces which are in contact with the end plate 32 determined as separator portions 311 which are not provided with a brazing material. The brazing material R1 disposed on the outer surface of the tank plate 31 is prevented its flow by the separator portions 311 in the heating furnace and does not flow to reach the end plate 32.

[0074] Therefore, the tube 21 is brazed for connection to the tube insertion hole 5 of the end plate 32 with an appropriate amount of brazing material, and the occurrence of erosion which may result from an excessive amount of brazing material flowing to the tube 21 can be prevented.

[0075] Fig. 4 is a diagram showing an end face of the tube 21. As shown in Fig. 4, the tube 21 used for the heat exchanger 1 of this embodiment is formed of a plate by roll forming for forming the tube 21 by sequentially bending the plate. In the drawing, 21a indicates medium passages, 21b beads, and 21c a junction.

[0076] When the tube is formed by the roll forming, the tube 21 can be formed of a thin plate. In the heat exchanger 1 of this embodiment, an excessive amount of brazing material does not flow toward the tube in the heating furnace even though the tube 21 is thin, and the tube 21 can be prevented from having a hole, and the occurrence of erosion can be prevented. Therefore, the heat exchanger 1 can be made light in weight, and the safety of the heat exchanger 1 can be improved.

[0077] Fig. 5 is a partially enlarged view of the end face of the tube 21. As shown in Fig. 5, the tube 21 is provided with the beads 21b which divides the interior of the tube 21 to provide the medium passages 21a by bending a plate. When the beads 21b are formed by bending the plate, slits 21d are formed on the outer surfaces of the tube 21. In the heating furnace, the brazing material R3 disposed on the end plate 32 melts and drawn into the slits 21d. Therefore, the molten brazing material flowing through the tube 21 and the tube insertion hole 5 of the end plate 32 does not remain in the gap between the tube 21 and the tube insertion hole 5 but flows to the slits 21d, and the tube 21 and the end plate 32 are connected by an appropriate amount of brazing material.

[0078] Fig. 6 is a sectional view of the tank 3 to show another embodiment.

[0079] In this embodiment, the tank plate 31 has the brazing material R1 formed on its surface which forms the outside of the tank 3 as shown in Fig. 6. The end plate 32 is provided with a brazing material R4 on its surface which forms the outside of the tank 3 and the brazing material R3 on its surface which forms the in-

side.

[0080] In this embodiment, the tank plate 31 is provided with the separator portions 311 for prevention of leakage of the brazing material from outflowing on its surfaces which are in contact with the end plate 32 and not provided with a brazing material. The separator portions 311 prevent the flow of the brazing material R1 disposed on the outer surface of the tank plate 31. Therefore, an excessive amount of brazing material does not flow to reach the tube insertion hole 7 of the end plate 31.

[0081] It is not limited to this embodiment, but it is possible to configure the tank by disposing the brazing material on the partition plate itself and not disposing the brazing material on the inside surface of the end plate or the tank plate.

[0082] Fig. 7 is a sectional diagram of a tank 30 to show another embodiment.

[0083] In this embodiment, an end plate 33 is attached from the outside of a U-shaped opening of the tank plate 31 having a U-shaped cross section as shown in Fig. 7. The tank plate 31 has the brazing material R1 disposed on its surface which becomes the outer surface of the tank 30 and the brazing material R2 disposed on its surface which becomes the inner surface of the tank 30. And, the end plate 33 has a brazing material R5 disposed on its surface which becomes the outer surface of the tank 30.

[0084] The tank plate 31 is provided with the separator portions 311 on its surfaces which are in contact with the end plate 33 and not provided with the brazing material. The end plate 33 has its two surfaces which are contacted with the tank plate 31, namely the surface which becomes the inner surface of the tank 30 and the edges of the end plate 33, which are designated as separator portions 331, 332.

[0085] Therefore, the separator portions 311, 331, 332 prevent flow of the brazing materials R1 and R2 disposed on the tank plate 31. Therefore, outflow of an excessive amount of brazing material is prevented by the separator portions 311, 331, 332, and the tube 21 and the end plate 31 are brazed for connection with an appropriate amount of brazing material.

[0086] Next, another embodiment of the invention will be described.

[0087] Fig. 8 is a front view showing a general structure of the heat exchanger 1. This heat exchanger 1 is a condenser for a car air conditioner. The heat exchanger 1 is configured of a core 2, which is configured by alternately stacking a plurality of tubes 21, 21 and fins 4, 4, and a pair of tanks 3, 3 into which both ends of the plurality of tubes 21, 21 are inserted. Within the tanks 3, 3, partition plates 7, 7 are disposed to divide the insides of the tanks 3, 3. Upper and lower openings of the tanks 3, 3 are sealed by block members 6, 6, and a pair of side plates 8, 8 are disposed on top and bottom of the core 2 for reinforcement. Besides, the tank 3, 3 are provided with an inlet joint 41 and an outlet joint 42 for introduction and discharge of the medium.

[0088] The upper and lower openings of the tanks 3, 3 may be sealed by partition plates 7, 7 without using the block members 6, 6.

[0089] Those component members of the heat exchanger 1 are made of an aluminum alloy and assembled, then connected into one body by brazing in a furnace.

[0090] Fig. 9 is an exploded perspective view showing the tank 3. The tank 3 is a two-split type tank which is comprised of a tank plate 31 and an end plate 32.

[0091] The tank 3 has the outer periphery of the end plate 32 contacted with the inner surface of a U-shaped opening of the tank plate 31 which has a U-shaped cross section to form the tubular tank 3. The end plate 32 is formed with tube insertion holes 5, 5 into which tubes are inserted.

[0092] The tank plate 31 and the end plate 32 are positioned by the partition plate 7 disposed within the tank 3, so that the tank plate 31 and the end plate 32 are attached in position.

[0093] The tank plate 31 of this embodiment is provided with an attachment hole 31a into which the partition plate 7 is attached and an outflow/inflow port 31b for connection of an inlet joint 41 or an outlet joint 42. And, the partition plate 7 is provided with a projection 7a which is inserted into the attachment hole 31a and notches 7b, 7b for engagement with the end plate 32.

[0094] To assemble the tank 3, the projection 7a of the partition plate 7 is first inserted into the attachment hole 31a of the tank plate 31 to attach the partition plate 7 to the tank plate 31. Then, the end plate 32 is assembled to be attached to the inner surface of a U-shaped opening of the tank plate 31 so the edges of the end plate 32 are engaged with the notch 7b of the partition plate 7, and the tank plate 31 and the end plate 32 can be positioned to assemble the tank 3.

[0095] Fig. 10 is a cross sectional view of the tank 3 having the tube 21 assembled.

[0096] As shown in Fig. 10, the tank plate 31 is provided with the brazing material R1 on its surface which becomes the outer surface of the tank 3 and the brazing material R2 on its surface which becomes the inner surface of the tank 3. The brazing material R1 disposed on the surface of the tank plate 31 which becomes the outer surface is a brazing material for bonding accessories such as the inlet joint 41 and the outlet joint 42 to the tank 3, and the brazing material R2 is a brazing material for bonding the partition plate 7 within the tank 3 and for bonding the tank plate 31 and the end plate 32.

[0097] And, the end plate 32 is provided with the brazing material R3 on its surface which becomes the inner surface of the tank 3. The brazing material R3 is a brazing material for connecting the tube 21 to the tube insertion hole 5 and for connecting the partition plate 7.

[0098] Fig. 11 is a partially vertical sectional view showing the tank.

[0099] As shown in Fig. 11, the outer and inner surfaces of the tank plate 31 are clad with the brazing ma-

materials R1, R2, and the partition plate 7 is formed of a bare material not clad with the brazing material.

[0100] According to this embodiment, the partition plate 7 is not clad with the brazing material, so that the brazing materials R2, R3 melted during the brazing hardly outflow along the partition plate 7 which is not wet. As a result, the brazing material for brazing the partition plate does not become short, and the partition plate 7 can be brazed adequately even if there is a gap between the inner surfaces of the tank plate 31 and the end plate 32 and the partition plate 7.

[0101] Therefore, a highly airtight heat exchanger which is free from a leakage of the medium between the inner surface of the tank and the partition plate 7 without strictly controlling the dimensions of the partition plate 7 as before.

[0102] Fig. 12 is a cross sectional view of the tank 3 to show another embodiment.

[0103] In this embodiment, the tank plate 31 is provided with the brazing material R1 on its surface which becomes the outer surface of the tank 3 as shown in Fig. 12. The brazing material R1 is a brazing material for connecting accessories such as the inlet joint 41 and the outlet joint 42 to the tank 3.

[0104] The end plate 32 has the brazing material R3 disposed on its surface which becomes the inner surface of the tank 3 and the brazing material R4 disposed on its surface which becomes the outer surface. The brazing material R3 disposed on the surface which becomes the inner surface of the end plate 32 is a brazing material for attaching the tube 21 to the tube insertion hole 5 and for attaching the partition plate 7 disposed within the tank 3, and the brazing material R4 is a brazing material for connecting the tube 21 to the tube insertion hole 5 and for connecting the tank plate 31 and the end plate 32.

[0105] Thus, even when the brazing material R3 is clad to the end plate 32 and not clad to the tank plate 31 on the inner surface of the tank 3, the partition plate 7 can be brazed without forming a gap because the molten brazing material R3 enters the gap between the inner surface of the tank plate 31 and the side surface of the partition plate 7 by capillary phenomenon.

[0106] Fig. 13 is a perspective view of the tube 21 to show another embodiment.

[0107] The tube 21 of this embodiment is a so-called roll forming tube which is formed by roll forming a plate material, and a plurality of passages 21a, 21a for flowing a medium are formed within it.

[0108] The tube 21 is formed with partitions by bending a plate material into a corrugated shape to form a plurality of beads 21b, 21b, folding in two and bonding to have the beads 21b, 21b inside, and mutually contacting the beads 21b, 21b. Slits 21d are formed in the surface of the tube 21 by the beads 21b, 21b and the junction 21c.

[0109] Therefore, the heat exchanger 1 using the tubes 21 tends to suffer from a shortage of the brazing

material for brazing the partition plate 7 and defective brazing of the partition plate 7 because the molten brazing material on the inner surface of the tank 3 at the time of brazing is taken into the slits 21d, 21d by capillary phenomenon and outflows to the tubes 21.

[0110] But, when the partition plate 7 is determined to be a bare material, the brazing material does not outflow along the partition plate 7 as before even if the brazing material on the inner surface of the tank 3 flows to the tube 21, so that an outflow amount is considerably reduced, the brazing material for brazing the partition plate 7 does not become short, and the partition plate 7 can be brazed adequately.

[0111] In the above embodiment, the condenser has been described as an example, but the invention is not limited to it, and the object of the invention can be achieved for an evaporator or a heater core.

[0112] Then, another embodiment of the invention will be described.

[0113] The heat exchanger 1 of this embodiment is a radiator of a refrigeration cycle for a car air conditioner mounted on an automobile and provided with the core 2 which is formed by alternately stacking a plurality of tubes 21 for flowing a medium (namely, refrigerant) and a plurality of fins 4 and a pair of tanks 3 to which both ends of the tubes 21 are connected as shown in Fig. 14 and Fig. 15 and is configured to perform heat exchange between the medium and air flowing to the core 2 by heat conducted to the core 2.

[0114] A side plate 8 as a reinforcing member is disposed on the upper and lower sides of the core 2. Ends of each side plate 8 are supported by the tanks 3.

[0115] Besides, the tank 3 is provided with the inlet joint 41 for introducing the medium and the outlet joint 42 for discharging the medium, and the medium flows into the tank 3 through the inlet joint 41, flows through the tubes 21 while performing heat exchange and is discharged to the outside of the tank 3 through the outlet joint 42.

[0116] Each tank 3 is substantially cylindrical with its both ends blocked by the block member 6 and the interior divided by the partition plates 7 at prescribed intervals, and the medium is reciprocated for a plurality of times between the tanks 3.

[0117] The tube 21 is formed flat by extrusion forming or roll forming of a plate. Its interior is divided into a plurality of sections in order to provide a prescribed pressure resistant performance. Fins 4 of this embodiment are formed of a clad material which has its front and rear sides clad with an appropriate amount of brazing material required for brazing with the tubes and is roll-formed into a corrugated shape. Its wave pitch is approximately 1.6 mm to 3.0 mm. And, many louvers which are not shown are disposed at necessary portions of the fins 4.

[0118] Besides, each tank 3 of this embodiment is configured by attaching the end plate 32 to the tank plate 31. The tank plate 31 and the end plate 32 are formed by cutting and press-forming a plate having a required

thickness.

[0119] The tank plate 31 is a semicircular cylindrical member, and the end plate 32 is a member having a plurality of tube insertion holes 5 into which the ends of the tubes 21 are inserted for attachment. The tube insertion holes 5 are formed in series at prescribed intervals in the longitudinal direction of the tank 3.

[0120] The end plate 32 is inserted between both ends of the tank plate 31 for attachment to the tank plate 31. An inserted amount of the end plate 32 is restricted by the partition plates 7.

[0121] Bent pieces 31c for holding the end plate 32 and wall sections 31d which are protruded toward the core 2 are disposed in parallel at both ends of the tank plate 31. The bent pieces 31c and the wall sections 31d are alternately disposed at prescribed intervals along the longitudinal direction of the tank 3.

[0122] The end plate 32 is fixed by positioning on the tank plate 31 and bending the bent pieces 31c. The bent pieces 31c are bent by a caulking jig or the like.

[0123] And, the tubes 21, fins 4, tank plate 31, end plate 32, inlet joint 41, outlet joint 42, side plate 8, block member 6 and partition plate 7 which configure the heat exchanger 1 are members formed of aluminum or aluminum alloy, assembled by a jig, and brazed into one body by heating the assembly in a furnace. The brazing material and flux required for brazing are disposed on required portions of the respective members before the heating process.

[0124] As shown in Fig. 16, the tank plate 31 has a brazing material F clad on both surfaces in this embodiment. The end plate 32 has the brazing material F clad on its one surface only, and the end of the fin 4 and the surface of the end plate 32 not clad with the brazing material are opposed to each other when brazing.

[0125] The brazing material F which is clad to the tank plate 31 and the end plate 32 brazes the tank plate 31 and the end plate 32 and also brazes the tube 21, the inlet joint 41, outlet joint 42, the block member 6 and the partition plate 7.

[0126] And, when the end of the fin 4 and the surface of the end plate 32 not clad with the brazing material are opposed, even if the brazing material F clad to the tank plate 31 and the end plate 32 melts, the brazing material F does not reach the end of the fin 4, and unnecessary erosion at the end of the fin 4 can be avoided.

[0127] Therefore, the above configuration can make the gap between the fin 4 and the tank 3 as small as possible, and the heat exchange performance of the core 2 can be improved.

[0128] Especially, it is determined in this embodiment that the fin 4 has a length which is slightly smaller than the gap between the tanks 3, a minimum distance G between the end of the fin 4 and the surface of the end plate 32 not clad with the brazing material is 2.0 mm or less at the ends of all the fins 4 of the heat exchanger 1.

[0129] But, some of the ends of the fins 4 may come into contact with the surface of the end plate 32 not clad

with the brazing material. And, some of the ends of the fins 4 may have a minimum distance G of 2.0 mm or more depending on some dimensional error.

[0130] The minimum distance G is a distance of the minimum one of the gaps. Specifically, the end plate 32 of this embodiment has a sectional shape which swells toward the core 2, and the minimum distance G is a distance between the center of the end of the fin 4 and the swelled top of the tank plate 32.

[0131] By configuring as described above, leakage of air from the gap between the fin 4 and the tank 3 can be remedied, and the heat exchange performance of the core can be secured satisfactorily.

[0132] The minimum distance G between the end of the fin 4 and the surface of the end plate 32 not clad with the brazing material is determined to be 2.0 mm or less in this embodiment, but it is desirably 1.0 mm or less in order to remedy the air leak.

[0133] It may also be configured that the fin 4 has a length slightly larger than the gap of the tanks 3, and the fin 4 is compressed slightly to assemble, so to contact the ends of all fins 4 of the heat exchanger 1 to the surface of the end plate 32 not clad with the brazing material.

[0134] By configuring as described above, the air leak from the gap between the fin 4 and the tank 3 can be remedied more securely.

[0135] As described above, the heat exchanger of this embodiment efficiently avoids the ends of the fins from being eroded by the brazing material and is preferably used as a radiator of the refrigeration cycle. And, the configuration of this embodiment can also be applied to another heat exchanger such as an evaporator, a car radiator or the like.

INDUSTRIAL APPLICABILITY

[0136] The present invention is a heat exchanger generally used for a refrigeration cycle of car and home air conditioner and the like, and particularly suitable for a radiator, a condenser, an evaporator and the like.

Claims

1. A heat exchanger which has tubes for flowing a medium and a tank comprising an end plate having tube insertion holes for connecting the tubes and a tank plate connected to the end plate, and is formed by assembling the respective members and brazing the members for connection in a heating furnace; wherein:

the tank plate is formed of a plate provided with a brazing material, and
at least one of the tank plate and the end plate is provided with a separator portion not having a brazing material for prevention of the brazing

material from outflowing.

2. The heat exchanger according to Claim 1, wherein the separator portion is disposed on a surface of the end plate which is in contact with the tank plate. 5
3. The heat exchanger according to Claim 2, wherein:

the tank plate has the brazing material disposed on its surface which becomes at least the inner surface of the tank, and 10

the end plate has the brazing material disposed on its surface which becomes the inner surface of the tank. 15
4. The heat exchanger according to any one of Claims 1 to 3, wherein the tank plate is provided with the separator portion on its surface which is in contact with the end plate. 20
5. The heat exchanger according to any one of Claims 1 to 4, wherein:

the tank is provided with a partition plate within it, and 25

the tank is formed by assembling the tank plate and the end plate while positioning by the partition plate.
6. The heat exchanger according to any one of Claims 1 to 5, wherein the heat exchanger uses tubes which are formed of a plate. 30
7. The heat exchanger according to any one of Claims 1 to 6, wherein the tubes have slits on the outer surfaces of the tubes which are in contact with tube insertion holes of the end plate. 35
8. A heat exchanger having tubes for flowing a medium and tanks to which ends of the tubes are connected, wherein: 40

the tanks are formed by brazing an end plate which is provided with holes for connection of the ends of the tubes, a tank plate connected to the end plate, and a partition plate for dividing the interior, and 45

a brazing material is clad to the inner surface of at least one of the tank plate and the end plate, and the partition plate is formed of a bare material which is not clad with a brazing material. 50
9. The heat exchanger according to Claim 8, wherein the tubes have slits formed on the surfaces. 55
10. The heat exchanger according to Claim 9, wherein the tubes are formed of a plate material.

11. A heat exchanger having a core which is formed by stacking tubes and fins, and tanks to which the ends of the tubes are connected, and performing heat exchange by a medium flowing through the tubes by heat conducted to the core, wherein:

the tanks have an end plate which is provided with holes for connection of the tubes and a tank plate to which the end plate is attached, the heat exchanger is formed by assembling and brazing the tubes, the fins, the end plate and the tank plate in a furnace, the end plate has a brazing material clad on its one surface only, and the ends of the fins are opposed to a surface of the end plate not clad with the brazing material at the time of brazing.

12. The heat exchanger according to Claim 11, wherein the ends of the fins have a minimum distance of 2.0 mm or less from the surface of the end plate which is not clad with the brazing material.
13. The heat exchanger according to Claim 11, wherein the ends of the fins are in contact with the surface of the end plate which is not clad with the brazing material.

FIG. 1

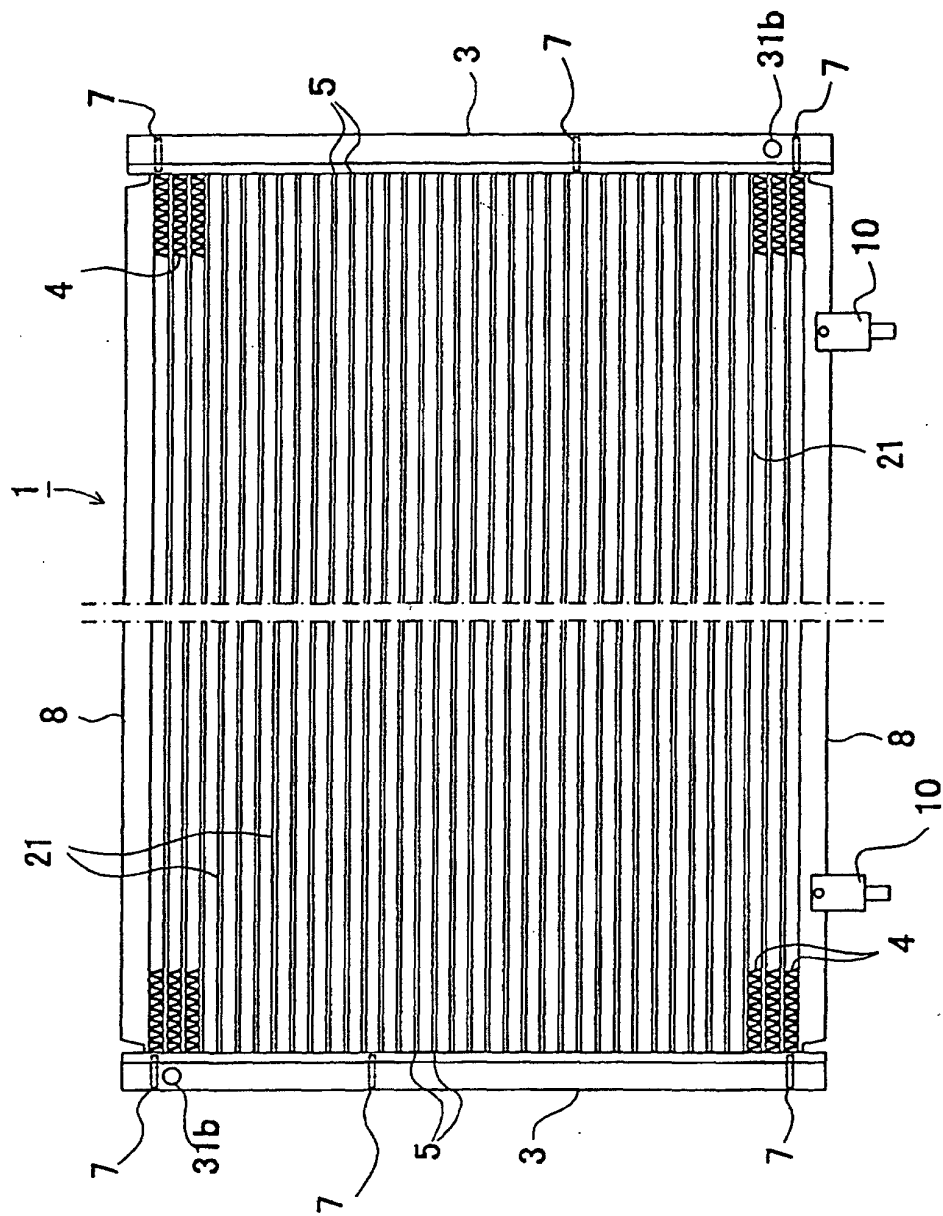


FIG.2

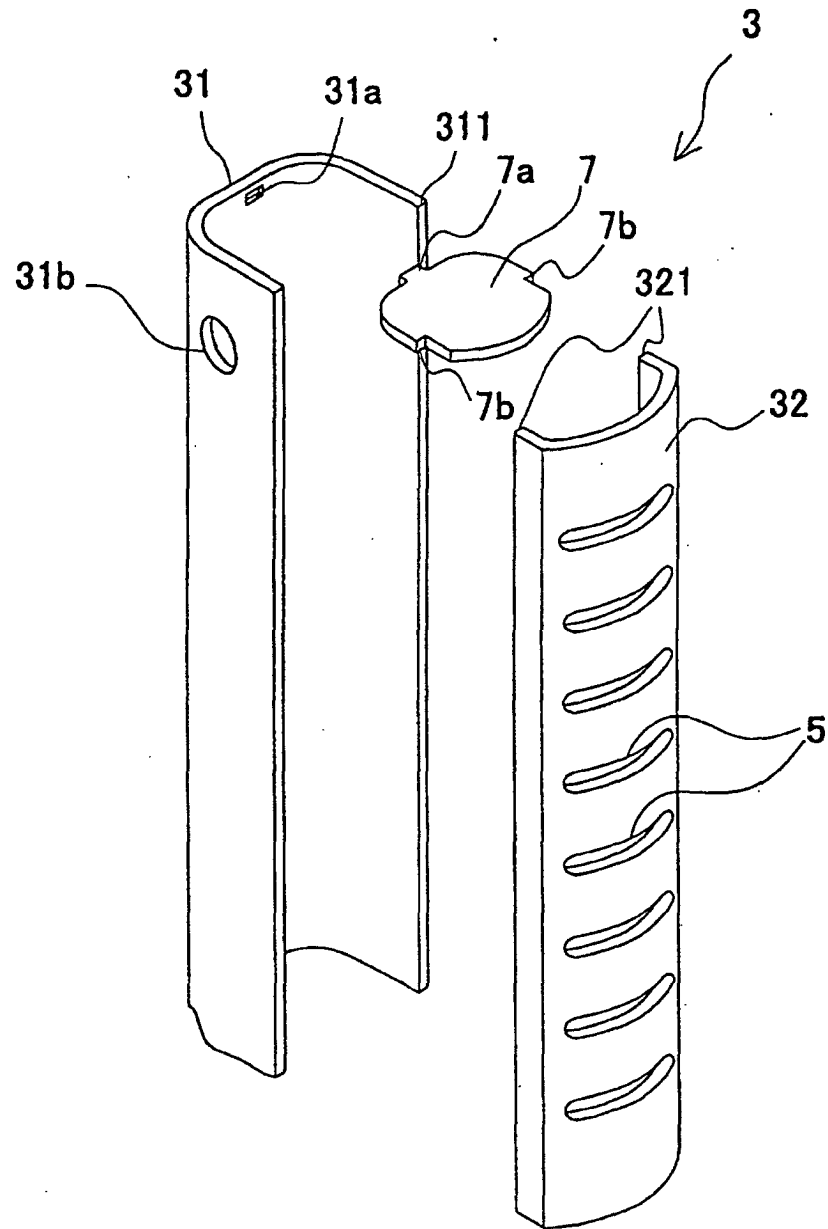


FIG. 3

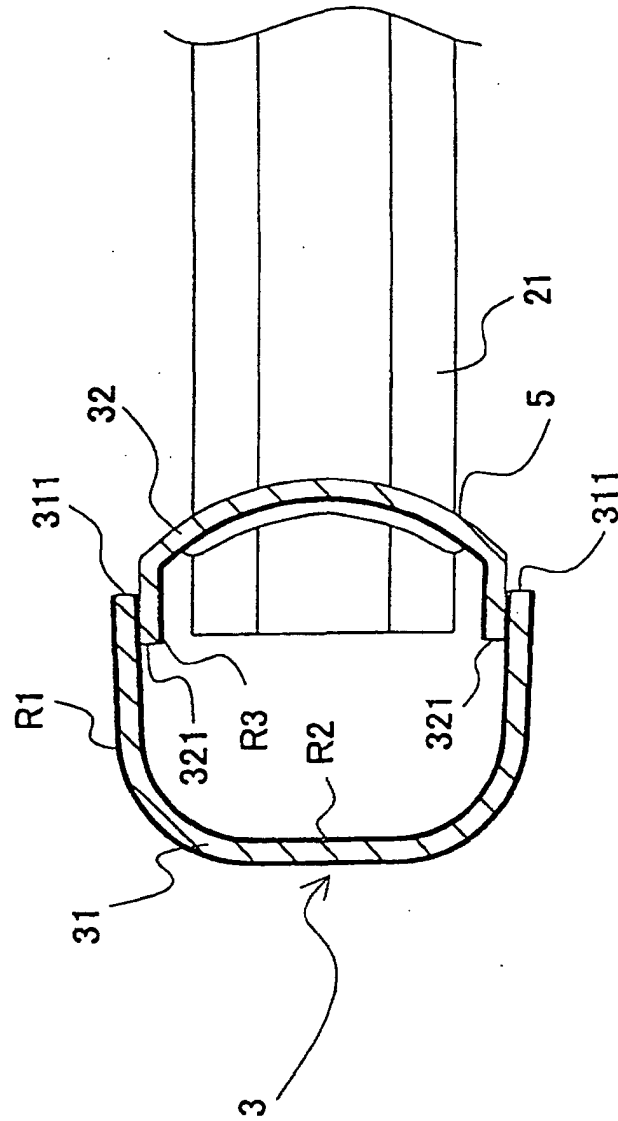


FIG. 4

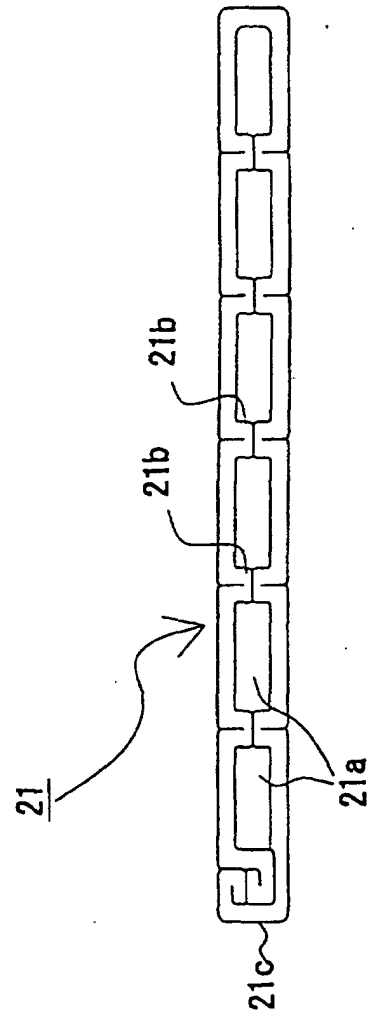


FIG. 5

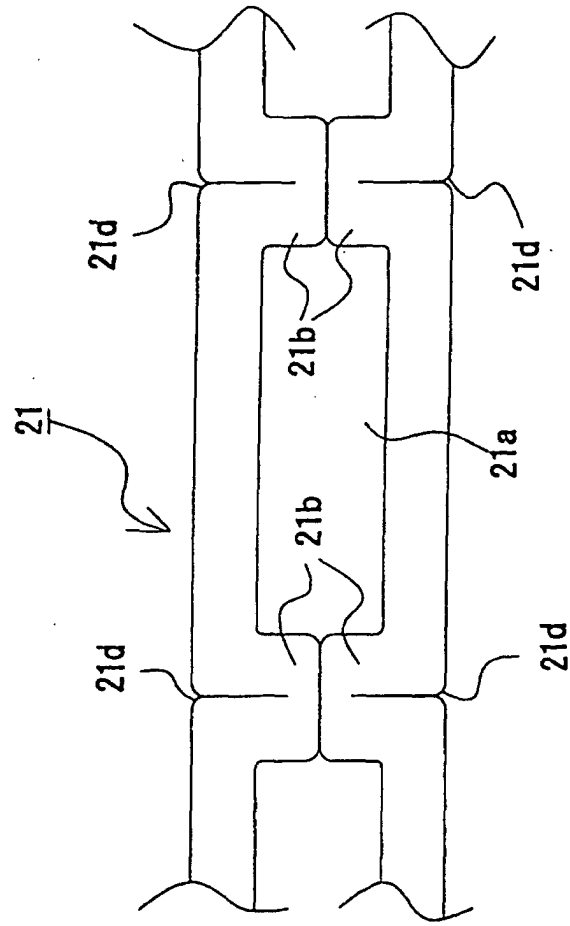


FIG. 6

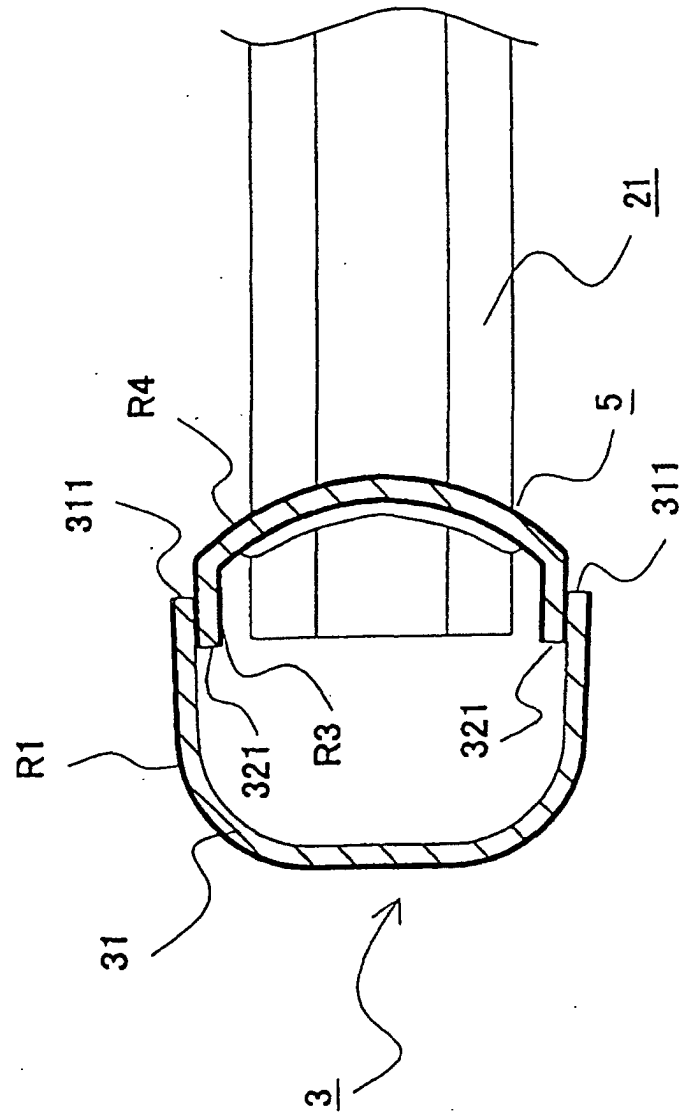
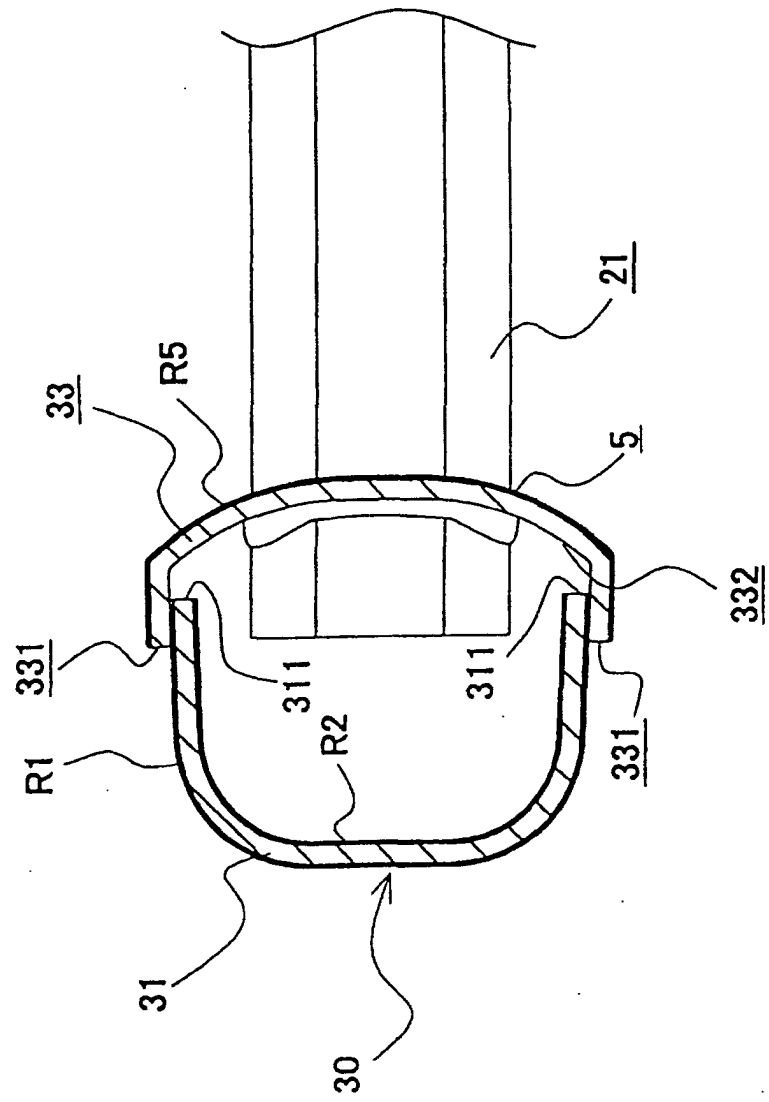


FIG. 7



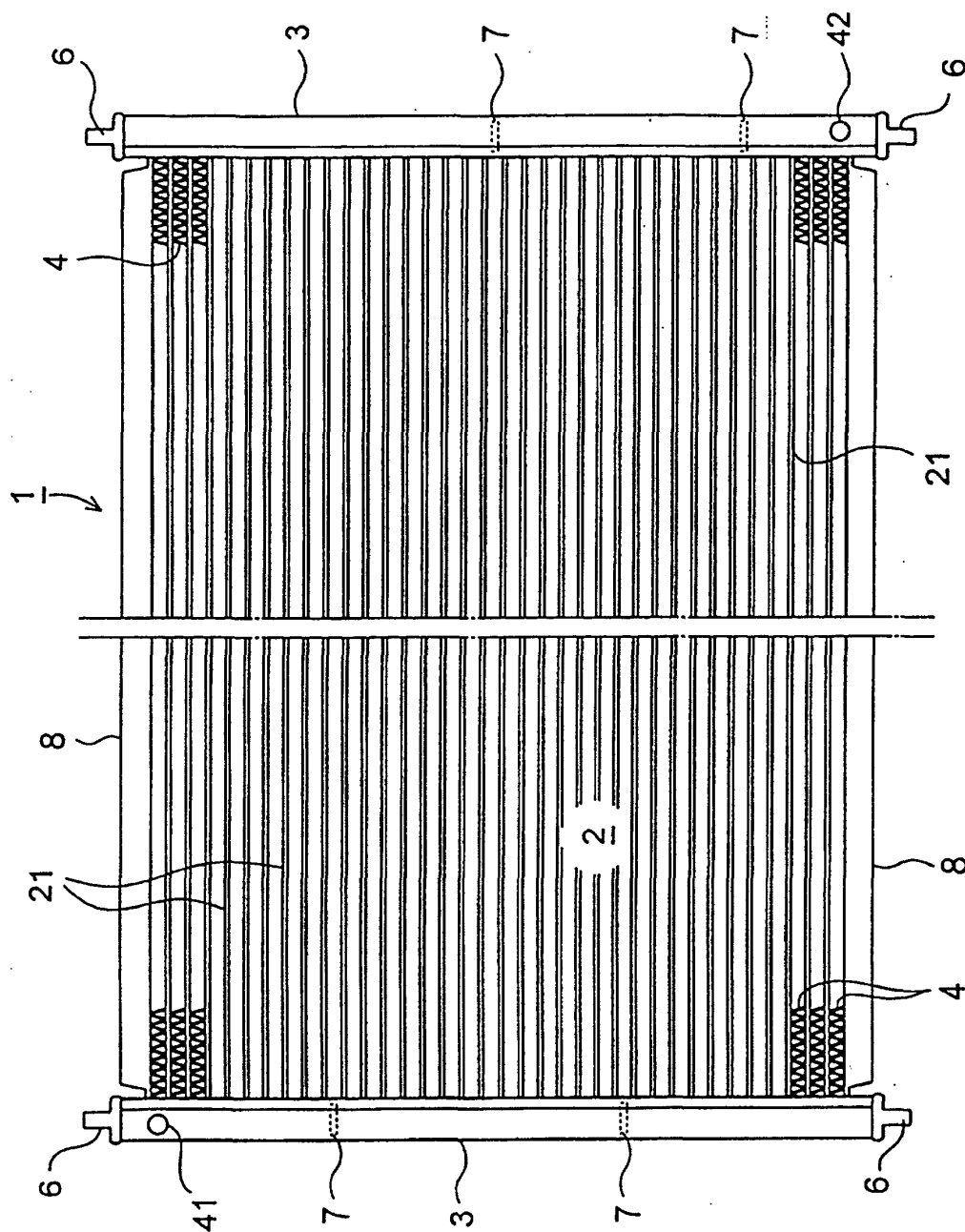


FIG. 8

FIG. 9

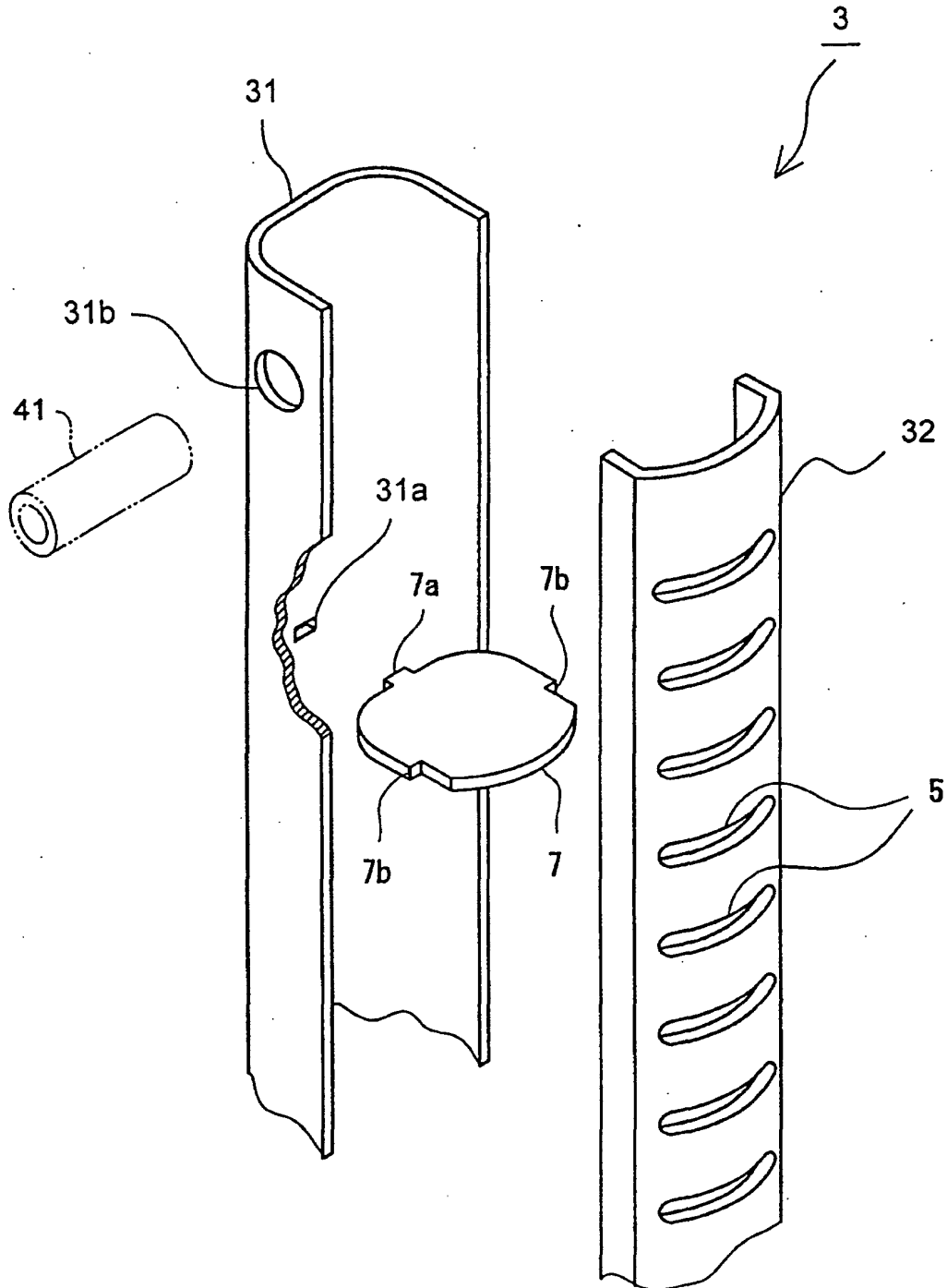


FIG. 10

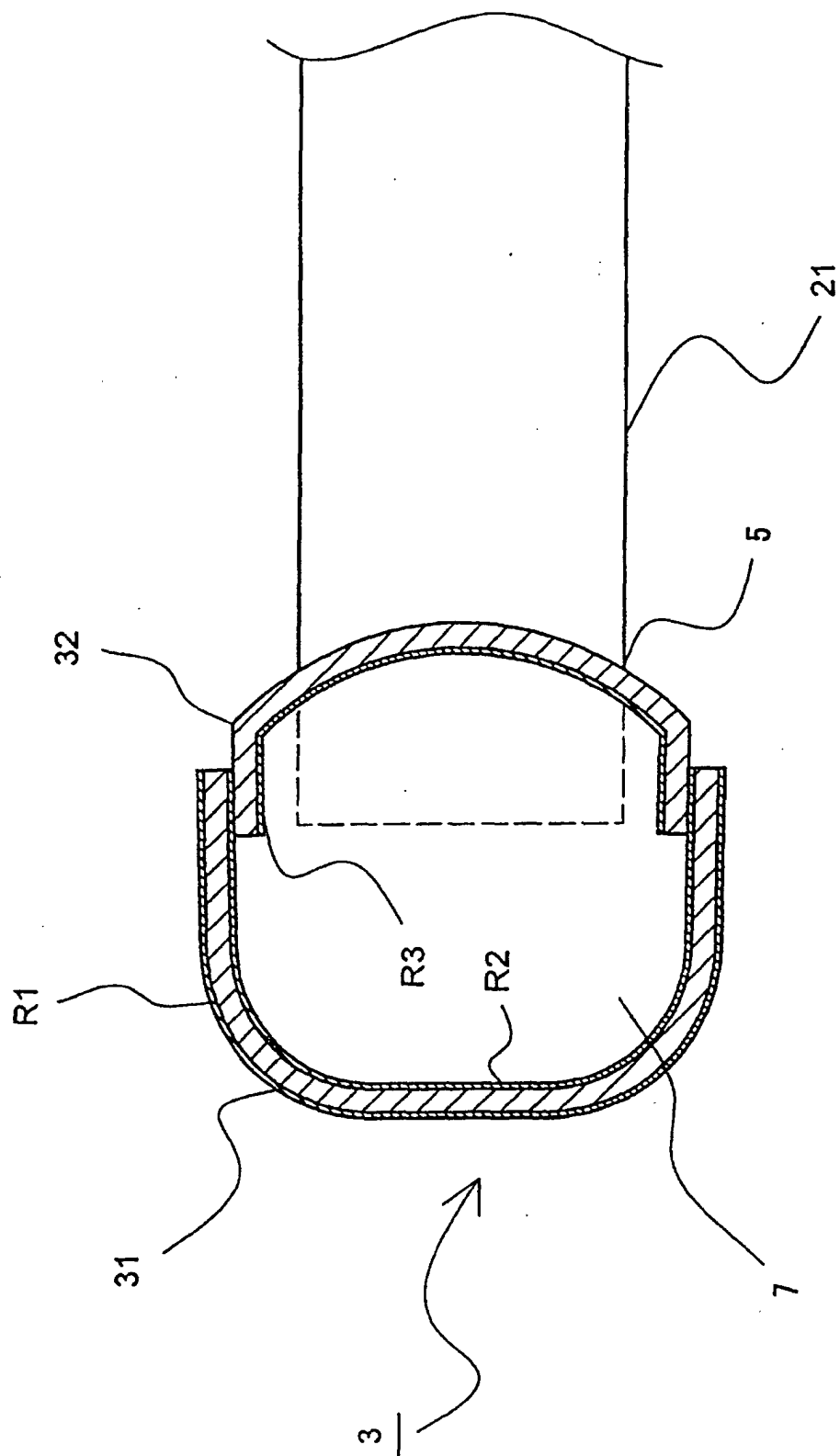


FIG. 11

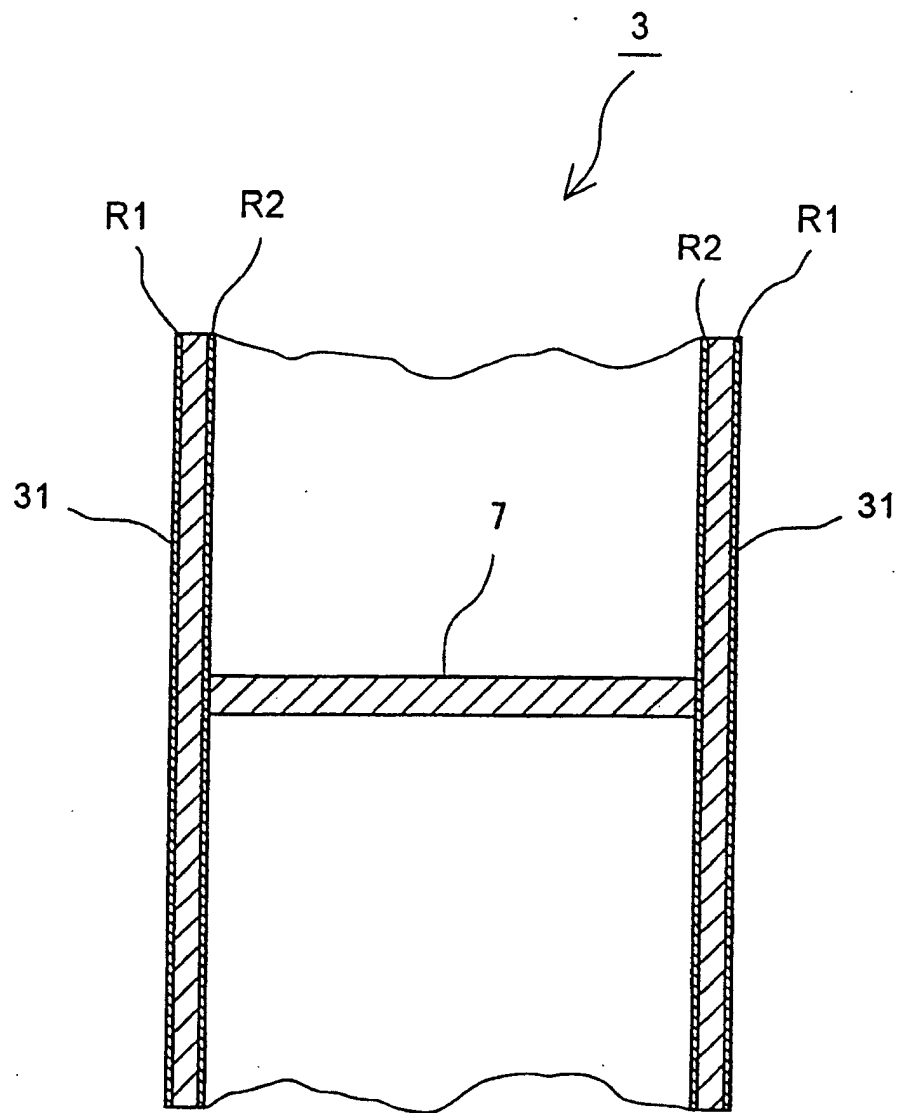


FIG. 12

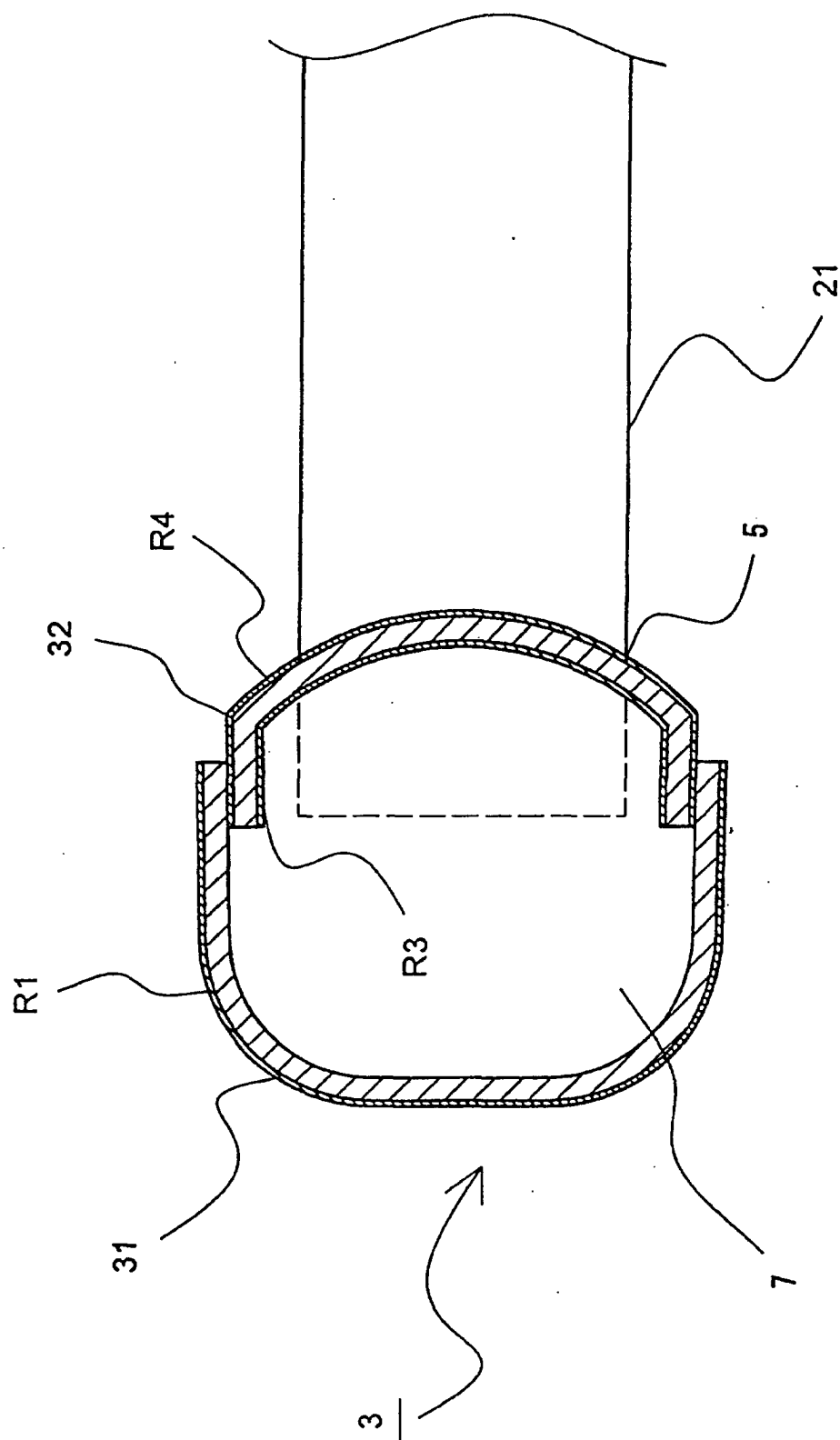


FIG. 13

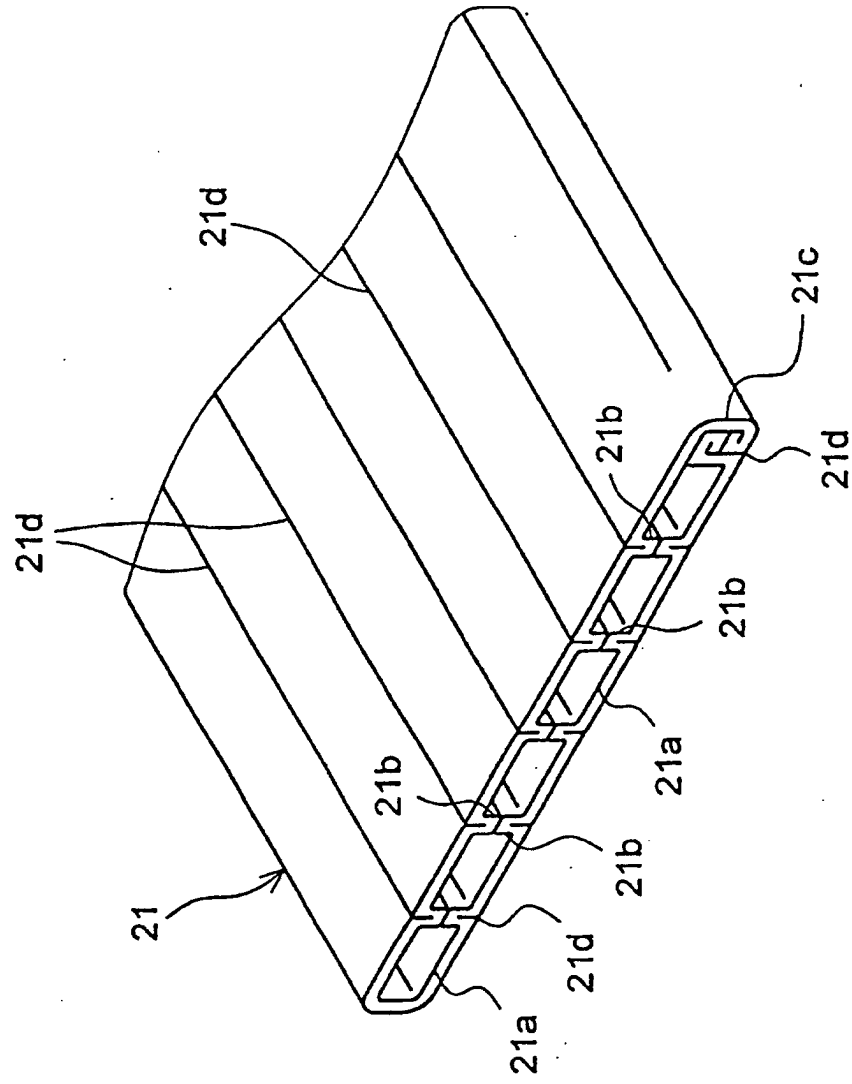


FIG. 14

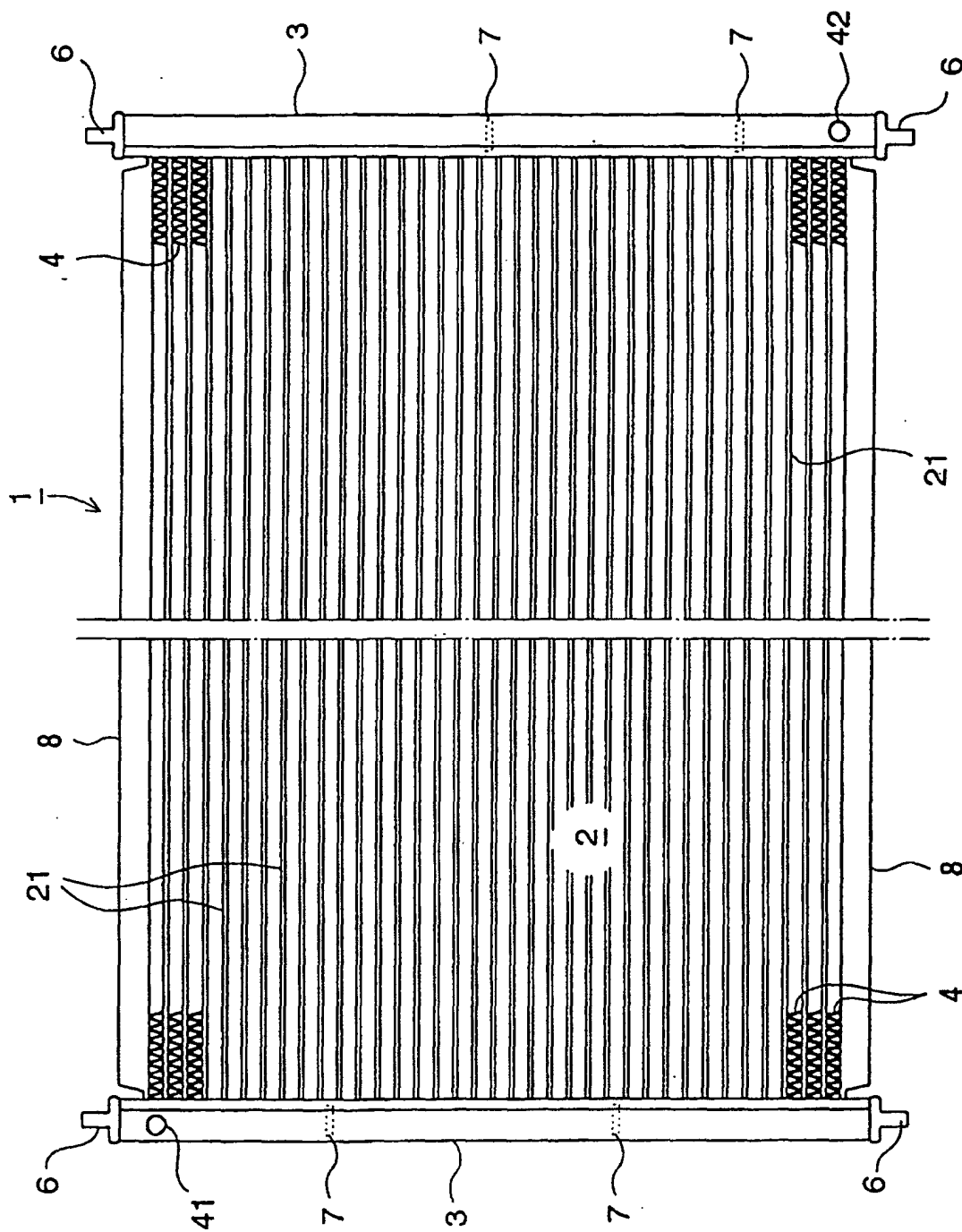


FIG. 15

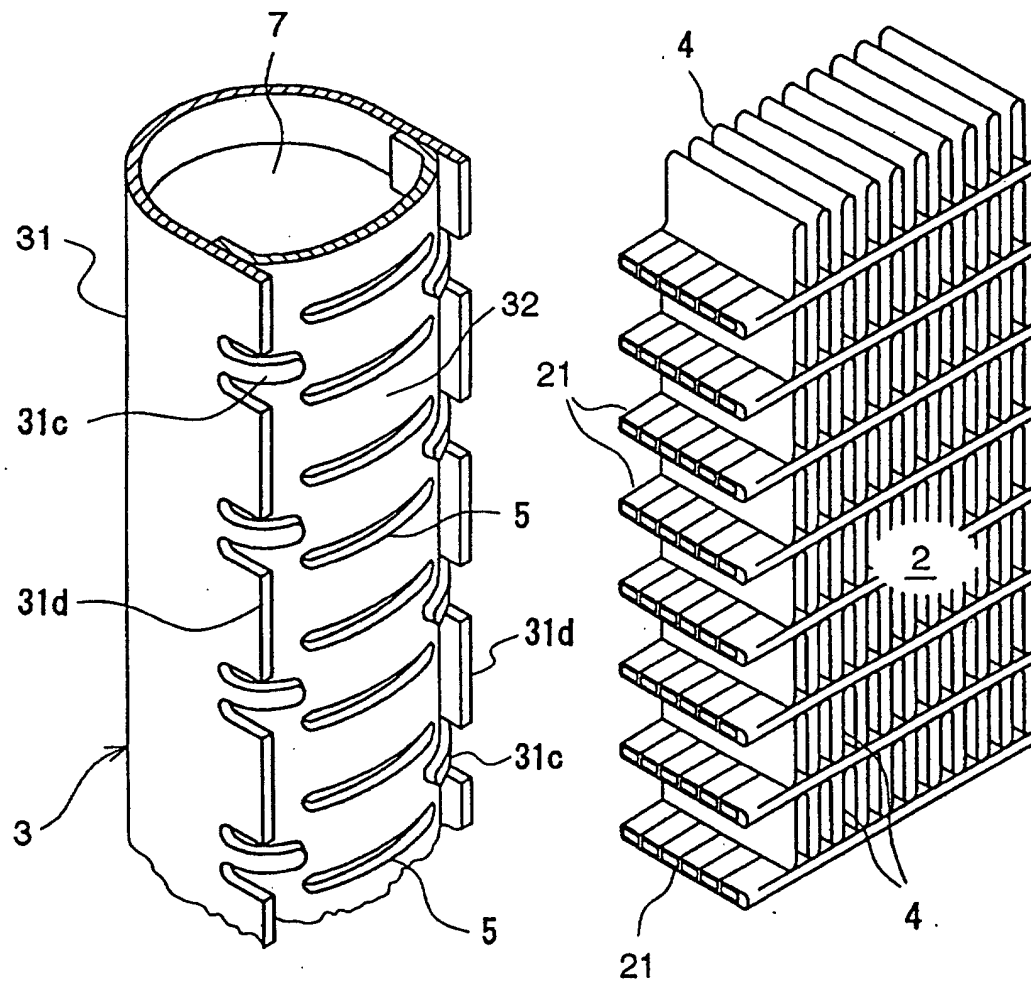
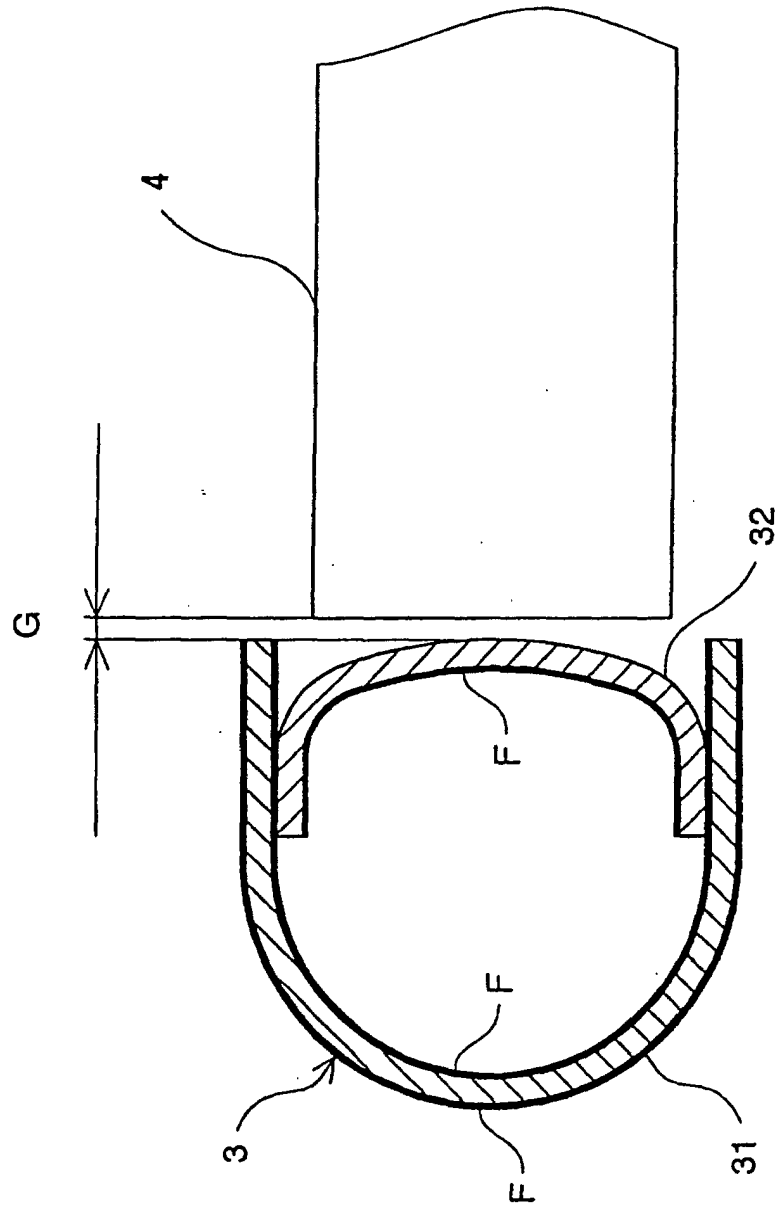


FIG.16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/00196

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl⁷ F28F9/02, F28F1/30

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)

Int.Cl⁷ F28F9/02, F28F1/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

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 Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 92194/1992 (Laid-open No. 55073/1994) (Calsonic Corp.), 26 July, 1994 (26.07.94), All pages (Family: none)	1, 2, 4, 8 3, 5-7
Y	JP 9-196594 A (Mitsubishi Heavy Industries, Ltd.), 31 July, 1997 (31.07.97), All pages (Family: none)	9-13, 5-10
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 2710/1992 (Laid-open No. 61684/1993) (Japan Climate Systems Corp.), 13 August, 1993 (13.08.93), All pages (Family: none)	6, 7, 10

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

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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

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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

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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
09 April, 2002 (09.04.02)Date of mailing of the international search report
23 April, 2002 (23.04.02)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/00196

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 5-180589 A (Showa Aluminum Corp.), 23 July, 1993 (23.07.93), All pages (Family: none)	7, 9, 10

Form PCT/ISA/210 (continuation of second sheet) (July 1998)