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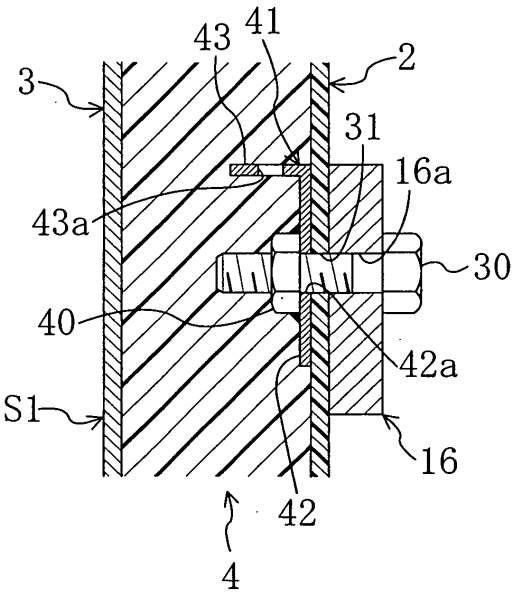
(54) STRUCTURE OF CASING FOR REFRIGERATION DEVICE AND METHOD OF PRODUCING THE CASING

(57) A component mounting plate (**s1**) of a casing for a refrigeration system includes an inner sub-plate (**2**), an outer sub-plate (**3**) and a heat insulating layer (**4**) filled with a heat insulating material, such as urethane. The inner sub-plate (**2**) is formed with a mounting hole (**31**) through which a mounting bolt (**30**) for mounting a component (**16**) to the inner sub-plate (**2**) passes. The heat insulating layer (**4**) contains a nut (**40**) disposed to correspond to the mounting hole (**31**) and an L-piece (**41**) disposed to correspond to the mounting hole (**31**) and including an extension (**43**) and a seat (**42**) with the nut (**40**) welded thereto. The L-piece is disposed in the heat insulating layer (**4**) with the seat (**42**) in contact with the inner sub-plate (**2**) and the extension (**43**) extending towards the outer sub-plate (**3**).

FIG. 3



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Description

Technical Field

[0001] This invention relates to casing structures for refrigeration systems and methods for producing such casings.

Background Art

[0002] Reefer containers are conventionally known that are transported while storing and cooling materials, such as food products, in their casings. The casing of such a reefer container has a structure that can ensure air tightness in the interior and heat insulation between the interior and outside of the casing (see, for example, Patent Document 1).

[0003] The casing of a reefer container disclosed in Patent Document 1 has a heat insulating layer of expandable synthetic resin formed between a metal outer sub-casing and an integrally molded inner sub-casing made of synthetic resin, thereby ensuring air tightness and heat insulating property of the casing interior.

Patent Document 1: Published Japanese Patent Application No. H08-337285

Disclosure of the Invention

Problems to Be Solved by the Invention

[0004] In the refrigeration system disclosed in Patent document 1, components for cooling the interior are mounted to the inner sub-casing.

[0005] Specifically, as shown in Figure **8**, the inner sub-casing (**2**) is formed with a mounting hole (**31**) through which a mounting bolt (**30**) for mounting a component (**16**) to the inner sub-casing (**2**) passes. In addition, the heat insulating layer (**4**) contains a nut (**40**) disposed to correspond to the mounting hole (**31**) and threadedly engageable with the mounting bolt (**30**). The nut (**40**) is covered with a receptacle mold (**101**) filled with a resin adhesive (**100**), and attached to the inner sub-plate (**2**) by an adhesion force of the adhesive (**100**). Therefore, if the adhesion force of the adhesive (**100**) is uneven, the nut (**40**) might be detached from the inner sub-plate (**2**) and come loose during screwing of the mounting bolt (**30**) thereinto.

[0006] Furthermore, in a method for producing the casing equipped with the nut (**40**), part of the inner sub-plate (**2**) surrounding the mounting hole is first sanded and the sanded surface is then rinsed with an organic solvent. Subsequently, the nut (**40**) is put on the sanded surface and temporarily retained by a temporal bolt. Thereafter, the resin adhesive (**100**) is prepared and the nut (**40**) is covered with the receptacle mold (**101**) filled with the prepared adhesive (**100**). The adhesive (**100**) is cured over about 12 hours to fix the nut (**40**). Furthermore, in a final step, the temporal bolt is screwed off and an expandable heat insulating material, such as urethane, is charged into the space between the inner and outer sub-plates (**2**, **3**) to form the heat insulating layer (**4**). Therefore, a large number of processing steps including sanding, rinsing and adhesive mixing are needed. In addition, the time taken to cure the adhesive is long, resulting in a long production time.

[0007] The present invention has been made in view of the foregoing points and, therefore, an object of the present invention is a casing for a refrigeration system in which a heat insulating layer between inner and outer sub-plates contains a nut threadedly engageable with a mounting bolt for a component, wherein the fixing force of the nut can be stabilized, the casing production process can be simplified and the casing production time can be reduced.

Means to Solve the Problems

[0008] A first aspect of the invention is directed to a casing structure for a refrigeration system which includes an outer sub-plate (**3**), an inner sub-plate (**2**) and a heat insulating layer (**4**) formed between the outer sub-plate (**3**) and the inner sub-plate (**2**) and made of a heat insulating material and in which the inner sub-plate (**2**) is formed with a mounting hole (**31**) through which a mounting bolt (**30**) for a component (**16**) passes. The casing structure further includes a nut (**40**) disposed in the heat insulating layer (**4**) to correspond to the mounting hole (**31**) in the inner sub-plate (**2**) and threadedly engaged on the mounting bolt (**30**). In addition, the casing structure further includes a turning stop piece (**41**) having the nut (**40**) secured thereto, including a seat (**42**) in contact with the inner sub-plate (**2**) and an extension (**43**) extending from the seat (**42**) towards the outer sub-plate (**3**) and disposed in the heat insulating layer (**4**) to correspond to the mounting hole (**31**) in the inner sub-plate (**2**).

[0009] In the first aspect of the invention, since the nut (**40**) is secured to the turning stop piece (**41**), the contact area with the inner sub-plate (**2**) is increased by the seat (**42**) of the turning stop piece (**41**) as compared with the case where only the nut (**40**) is brought into contact with the inner sub-plate (**2**). Furthermore, since the turning stop piece (**41**) includes the extension (**43**), resistance from the heat insulating material to the seat (**42**) and the extension (**43**) in the heat insulating layer (**4**) is used to prevent that the nut (**40**) drops out of the position corresponding to the mounting hole (**31**) and comes loose during screwing of the mounting bolt (**30**) thereinto.

[0010] A second aspect of the invention is the casing structure for the refrigeration system according to the first aspect of the invention, wherein the seat (**42**) of the turning stop piece (**41**) is formed into a flat plate extending orthogonally to the mounting bolt (**30**).

[0011] In the second aspect of the invention, the seat (**42**) is surely brought into contact with the inner sub-plate (**2**) to prevent loosening and dropping of the nut (**40**).

[0012] A third aspect of the invention is the casing

structure for the refrigeration system according to the second aspect of the invention, wherein the extension (**43**) of the turning stop piece (**41**) is formed by being bent from one side of the seat (**42**) in the axial direction of the mounting bolt (**30**).

[0013] In the third aspect of the invention, since the extension (**43**) of the turning stop piece (41) is substantially orthogonal to the inner sub-plate (**2**), the resisting force of the heat insulating material surely acts on the extension (**43**) in the heat insulating layer (**4**). Furthermore, since the turning stop piece (**41**) is formed not by especially attaching the extension (**43**) to the seat (**42**) but by simply bending the seat (**42**), this reduces the number of parts constituting the turning stop piece (**41**) and simplifies the processing of the turning stop piece (**41**).

[0014] A fourth aspect of the invention is an example of the casing structure for the refrigeration system according to the third aspect of the invention, wherein the turning stop piece (**41**) is an L-piece (**41**) formed in an L-shaped cross section.

[0015] A fifth aspect of the invention is the casing structure for the refrigeration system according to the first aspect of the invention, wherein the seat (**42**) of the turning stop piece (**41**) is formed with a through hole (**42a**) through which the mounting bolt (**30**) passes, and the nut (**40**) is welded to the turning stop piece (**41**) so that the threaded hole (**40a**) of the nut (**40**) corresponds to the through hole (**42a**).

[0016] In the fifth aspect of the invention, the nut (**40**) is welded to the turning stop piece (**41**) to surely fix it to the turning stop piece (**41**). Furthermore, since the mounting bolt (**30**) is threadedly engaged in the nut (**40**) through the seat (**42**) of the turning stop piece (**41**), the seat (**42**) functions as a washer for the nut (**40**).

[0017] A sixth aspect of the invention is the casing structure for the refrigeration system according to the first aspect of the invention, wherein the seat (**42**) of the turning stop piece (**41**) is formed with a fitting hole (**42b**) for fixing the nut (**40**) to the seat (**42**) by fitting the nut (**40**) into the fitting hole (**42b**).

[0018] In the sixth aspect of the invention, since the turning stop piece (**41**) and the nut (**40**) are fixed to each other without being welded to each other, the step of securing the seat (**42**) to the turning stop piece (**41**) is simplified.

[0019] A seventh aspect of the invention is the casing structure for the refrigeration system according to the first aspect of the invention, wherein the extension (**43**) of the turning stop piece (**41**) is formed with a charging hole (**43a**) for the heat insulating material.

[0020] In the seventh aspect of the invention, since during charging of the heat insulating material the heat insulating material is charged through the extension (**43**) of the turning stop piece (**41**), a void-free, uniform heat insulating layer can be formed.

[0021] An eighth aspect of the invention is directed to a method for producing a casing for a refrigeration system which includes an outer sub-plate (**3**), an inner sub-plate (**2**) and a heat insulating layer (**4**) formed between the outer sub-plate (**3**) and the inner sub-plate (**2**) and in which the inner sub-plate (**2**) is formed with a mounting hole (**31**) through which a mounting bolt (**30**) for a component (**16**) passes.Furthermore, the method includes a temporarily retaining step of putting, between the outer sub-plate (**3**) and the inner sub-plate (**2**), a nut (**40**) threadedly engageable on the mounting bolt (**30**) and a turning stop piece (**41**) including a seat (**42**) with the nut (**40**) secured thereto and an extension (**43**) extending from the seat (**42**) in the axial direction of the mounting bolt (**30**), while bringing the seat (**42**) of the turning stop piece (**41**) into contact with the inner sub-plate (**2**), and threadedly engaging a temporal bolt (**45**) through the mounting hole in the inner sub-plate (**2**) into the nut to retain the temporal bolt (**45**) to the inner sub-plate (**2**). The method further includes a heat insulating step of charging a heat insulating material between the outer sub-plate (**3**) and the inner sub-plate (**2**) to form a heat insulating layer (**4**). The method further includes a component mounting step of removing the temporal bolt (**45**) and mounting a component (**16**) to the inner sub-plate (**2**) by threadedly engaging the mounting bolt (**30**) in the nut (**40**).

[0022] In the eighth aspect of the invention, since the nut (**40**) is secured to the turning stop piece (**41**), the heat insulating layer (**4**) is formed, after the temporal retention of the nut (**40**), with the heat insulating material closely charged in the part around the nut (**40**) and the turning stop piece (**41**). As a result, the nut (**40**) is fixed in the heat insulating layer (**4**) by resistance acting on the seat (**42**) and the extension (**43**) of the turning stop piece (**41**). Furthermore, since there is no need to attach the nut (**40**) with an adhesive unlike the known art, this eliminates the need to carry out some processing steps including treatment to the part of the inner sub-plate (**2**) surrounding the mounting hole (**31**) and adhesive mixing, which simplifies the casing production process. In addition, since there is no need to cure an adhesive, this reduces the casing production time.

Effects of the Invention

[0023] According to the first aspect of the invention, since the nut (**40**) is secured to the turning stop piece (**41**), the contact area with the inner sub-plate (**2**) can be increased by the seat (**42**) of the turning stop piece (**41**) as compared with the case where only the nut (**40**) is brought into contact with the inner sub-plate (**2**). In addition, since the turning stop piece (**41**) includes the extension (**43**), a resisting force that the seat (**42**) and the extension (**43**) receive from the heat insulating material in the heat insulating layer (**4**) can be used to prevent that the nut (**40**) comes loose during screwing of the mounting bolt (**30**) thereinto and drops out of the position corresponding to the mounting hole (**31**). Thus, the fixing force in mounting a component (**16**) can be stabilized.

[0024] According to the second aspect of the invention, since the seat (**42**) of the turning stop piece (**41**) is formed into a flat plate extending orthogonally to the mounting bolt (**30**), the seat (**42**) can be surely brought into contact with the inner sub-plate (**2**), which prevents loosening and dropping of the nut (**40**).

[0025] According to the third aspect of the invention, since the extension (**43**) of the turning stop piece (**41**) is formed by being bent from one side of the seat (**42**) in the axial direction of the mounting bolt (**30**), the extension (**43**) of the turning stop piece (**41**) is substantially orthogonal to the inner sub-plate (**2**). As a result, the resisting force of the heat insulating material can surely be exerted on the extension (**43**) in the heat insulating layer (**4**).

[0026] Furthermore, since there is not need to especially attach the extension (**43**) to the seat (**42**) in forming the turning stop piece (**41**), this reduces the number of parts constituting the turning stop piece (**41**) and simplifies the processing of the turning stop piece (**41**).

[0027] According to the fourth aspect of the invention, since the turning stop piece (**41**) is an L-piece (**41**) formed in an L-shaped cross section, the resistance of the heat insulating material can surely be exerted on the extension (**43**).

[0028] According to the fifth aspect of the invention, since the seat (**42**) of the turning stop piece (**41**) is formed with a through hole (**42a**) through which the mounting bolt (**30**) passes and the nut (**40**) is welded to the turning stop piece (**41**) so that the threaded hole (**40a**) of the nut (**40**) corresponds to the through hole (**42a**), the nut (**40**) can surely be fixed to the turning stop piece (**41**).

[0029] Furthermore, since the mounting bolt (**30**) is threadedly engaged in the nut (**40**) through the seat (**42**) of the turning stop piece (**41**), the seat (**42**) functions as a washer for the nut (**40**), which stabilizes the fastening force between the nut (**40**) and the mounting bolt (**30**).

[0030] According to the sixth aspect of the invention, since the nut (**40**) is fixed to the seat (**42**) of the turning stop piece (**41**) by fitting the nut (**40**) into the fitting hole (**42b**) in the seat (**42**), this eliminates the need for welding or any other joining work of the nut (**40**) to the seat (**42**) of the turning stop piece (**41**). Therefore, the step of securing the seat (**42**) to the turning stop piece (**41**) can be simplified.

[0031] According to the seventh aspect of the invention, since the extension (**43**) of the turning stop piece (**41**) is formed with a charging hole (**43a**) for the heat insulating material, the heat insulating material is charged through the extension (**43**) of the turning stop piece (**41**) during charging of the heat insulating material. Thus, the heat insulating layer (**4**) can be uniformly formed with no void. Furthermore, since the heat insulating material is closely charged also around the extension (**43**), the resisting force of the heat insulating material surely acts on the extension (**43**), which prevents loosening and dropping of the nut (**40**).

[0032] According to the eighth aspect of the invention, since the nut (40) is secured to the turning stop piece (**41**) and the heat insulating layer (**4**) is formed, after the temporal retention of the nut (**40**), with the heat insulating material closely charged in the part around the nut (**40**) and the turning stop piece (**41**), the nut (**40**) can be fixed in the heat insulating layer (**4**) using a resisting force acting on the seat (**42**) and the extension (**43**) of the turning stop piece (**41**).

[0033] Furthermore, since there is no need to attach the nut (**40**) with an adhesive unlike the known art, this eliminates the need to carry out some processing steps including treatment to the part of the inner sub-plate (**2**) surrounding the mounting hole (**31**) and adhesive mixing, which simplifies the casing production process. In addition, since there is no need to cure an adhesive, this reduces the casing production time.

Brief Description of Drawings

[0034]

[Fig. 1] Figure **1** is a perspective view showing the structure of a reefer container according to Embodiment 1.

[Fig. 2] Figure **2** is a cross-sectional view taken along the line A-A of Figure **1**, showing a component mounting plate of the reefer container according to Embodiment 1.

[Fig. 3] Figure **3** is a cross-sectional view of a necessary part of the component mounting plate in Embodiment 1, illustrating a mounting structure of an in-container component.

[Fig. 4] Figure **4** is a perspective view showing the structure of an L-piece in Embodiment 1 and a nut secured to the L-piece.

[Fig. 5] Figure **5** is a view showing a production process for the component mounting plate of the reefer container according to Embodiment 1.

[Fig. 6] Figure **6** is a cross-sectional view of a component mounting plate in Embodiment 2, illustrating a mounting structure of an in-container component.

[Fig. 7] Figure **7** is a cross-sectional view of a component mounting plate in a modification of Embodiment 2, illustrating a mounting structure of an in-container component.

[Fig. 8] Figure **8** is a cross-sectional view of a casing showing a known art, in which a nut is fixed to an inner sub-plate with an adhesive.

List of Reference Numerals

[0035]

2	inner sub-plate
3	outer sub-plate
4	heat insulating layer
10	refrigeration system
11	casing
30	mounting bolt

31 mounting hole
40 nut
40a threaded hole
41 L-piece (turning stop piece)
42 seat
42a through hole
42b fitting hole
43 extension
43a charging hole
45 temporal bolt

Best Mode for Carrying Out the Invention

[0036] Embodiments of the present invention will be described below in detail with reference to the drawings.

[0037] <Embodiment 1>

As shown in Figure **1**, Embodiment 1 of the invention is an application to a reefer container (**10**). The reefer container (**10**) includes a casing (**11**) and is transported by a container ship or a container car while cooling materials stored in the casing (**11**).

[0038] As shown in Figure **1**, the casing (**11**) comprises a top plate (**t**), a base plate (**b**) and four side plates (**s1**, **s2**, **s3**, **s4**) and is formed in the shape of a substantially rectangular parallelepiped. The side plate (**s1**) located at the left front of the casing (**11**) as viewed in Figure **1** is a component mounting plate (**s1**). Mounted to the component mounting plate (**s1**) are cooling components for cooling the interior of the container.

[0039] Figure **2** is a cross-sectional view taken along the line A-A of Figure **1**, showing the component mounting plate (**s1**). As shown in Figure **2**, each of the plates (**t**, **b**, **s1**, **s2**, ...) constituting the casing comprises an inner sub-plate (**2**), an outer sub-plate (**3**) and a heat insulating layer (**4**). The inner sub-plate (**3**) is a 3mm thick synthetic resin plate integrally formed from a synthetic resin material. The outer sub-plate (**3**) is a 3mm thick metal plate obtained by forming a metal, such as an aluminium alloy, in the shape of a plate. The heat insulating layer (**4**) is provided between the inner sub-plate (**2**) and the outer sub-plate (**3**) and formed by charging an expandable heat insulating material, such as urethane, between the inner sub-plate (**2**) and the outer sub-plate (**3**). The plates (**t**, **b**, **s2**, **s3**, **s4)** excluding the component mounting plate (**s1**) are formed into flat plates.

[0040] The lower part of the component mounting plate (**s1**) bends towards the interior of the container (**10**). Thus, an outside recess (**5**) is formed on the outside of the container **(10)** and in the lower part of the component mounting plate (**s1**), while an inside recess (**6**) is formed on the inside of the container (**10**) and in the upper part of the component mounting plate (**s1**). The outside recess (**5**) of the component mounting plate (**s1**) contains a compressor (**20**), a condenser (**14**) and an expansion mechanism (**22**). The inside recess (**6**) of the above side plate contains an evaporator (**16**). These components are connected via unshown refrigerant pipes to constitute a refrigerant circuit operating in a vapor compression refrigeration cycle. The outside recess (**5**) of the component mounting plate (**s1**) further contains a fan (**18**) for feeding outside air to the condenser (**14**), while the inside recess (**6**) of the component mounting plate (**s1**) further contains an internal fan (**19**) for feeding in-container air to the evaporator (**16**).

[0041] Next, the structure of the component mounting plate (**s1**), which is a feature of the invention, is described in detail with reference to the mounting structure for the evaporator (**16**) shown in Figures **3** and **4**.

[0042] As shown in Figures **3** and **4**, the inner sub-plate (**2**) of the component mounting plate (**s1**) has a mounting hole (**31**) formed therein. The mounting hole (**31**) is for the purpose of passing therethrough a mounting bolt (**30**) for mounting a component. For example, 40 mounting holes (**31**) are formed in the inner sub-plate (**2**) according to the number of in-container components and the number of mounting bolts (**30**).

[0043] The heat insulating layer (**4**) contains nuts (**40**) disposed to correspond to the mounting holes (**31**) and L-pieces (**41**) disposed to correspond to the mounting holes (**31**) and having their respective nuts (**40**) secured thereto. As shown in Figures **3** and **4**, each L-piece (**41**) is formed by bending one side of a metal flat plate made such as of an iron sheet or a galvanized steel sheet substantially at right angles and includes a seat (**42**) and an extension (**43**). In other words, the seat (**42**) of the L-piece (**41**) is formed into a flat plate and the extension (**43**) thereof extends substantially orthogonally from the seat (**42**). The L-piece (**41**) constitutes a turning stop piece for preventing the nut (**40**) from turning and dropping down in the heat insulating layer (**4**).

[0044] The seat (**42**) of the L-piece (**41**) has a through hole (**42a**), while the extension (**43**) thereof has charging holes (**43a**) for a heat insulating material. The seat (**42**) is for the purpose of passing the mounting bolt (**30**) therethrough. The charging holes (**43a**) are, in charging an expandable heat insulating material, for the purpose of allowing the heat insulating material to smoothly flow therethrough and thereby forming a heat insulating layer with no void.

[0045] Used as the L-piece (**41**) in this embodiment is a piece having a thickness of 1.2 mm and including an extension (**43**) of 8 mm extension length formed by bending one side of a 40 x 40 mm square metal flat plate. The L-piece (**41**) is not particularly limited in dimensions and the dimensions are preferably selected appropriately according to the size of the nut (**40**) used and the type of heat insulating material used.

[0046] The nut (**40**) is welded to the seat (**42**) of the L-piece (**41**) so that the threaded hole (**40a**) of the nut (**40**) corresponds to the through hole (**42a**) in the seat (**42**) of the L-piece (**41**) and that the nut (**40**) and the extension (**43**) are directed in the same direction with respect to the seat (**42**).

[0047] The L-piece (**41**) is disposed to allow the seat (**42**) to come into contact with the inner sub-plate (**2**) so that the through hole (**42a**) in the seat (**42**) corresponds

to the mounting hole (**31**) in the inner sub-plate (**2**) and that the extension (**43**) extends towards the outer sub-plate (**3**). Thus, in the heat insulating layer (**4**), the threaded hole (**40a**) of the nut (**40**) corresponds via the through hole (**42a**) in the seat (**42**) of the L-piece (**40**) to the mounting hole (**31**) in the inner sub-plate (**2**).

[0048] According to these configurations, the evaporator (**16**) is mounted to the component mounting plate (**s1**) by. passing the mounting bolt (**30**) through a bolt insertion hole (**16a**) formed such as in the flange of the evaporator (**16**) and threadedly engaging the mounting bolt (**30**) into the nut (**40**) through the mounting hole (**31**) in the inner sub-plate (**2**) and the through hole (**42a**) in the seat (**42**) of the L-piece (**41**).

[0049] - Operational Behavior -

Next, a description is given of the operational behavior of the reefer container (**10**).

[0050] When the operation of the reefer container (**10**) starts, refrigerant is discharged from the compressor (**20**) disposed in the outside recess (**5**) and flows into the condenser (**14**). The refrigerant in the condenser (**14**) releases heat to outside air fed to the condenser (**14**) by the external fan (**18**) to condense into liquid refrigerant. The liquid refrigerant then passes through the expansion mechanism (**22**) to reduce its pressure and then flows into the evaporator (**16**) in the inside recess (**6**). The refrigerant in the evaporator (**16**) takes heat from in-container air fed to the evaporator (**16**) by the internal fan (**19**) to evaporate and thereby cool the in-container air. Then, the evaporated refrigerant returns to the compressor (**20**). In this manner, the interior of the reefer container (**10**) is cooled.

[0051] - Production Method -

Next, a description is given of a method for producing the component mounting plate (**s1**) of the casing (**11**) with reference to Figure **5**.

[0052] First, in a preparation step, mounting holes (**31**) are formed in the inner sub-plate (**2**) and the inner sub-plate (**2**) is then opposed to the outer sub-plate (**3**).

[0053] Next, the method proceeds to a temporarily retaining step for nuts (**40**). In the temporarily retaining step, a temporal bolt (**45**) is put through each mounting hole (**31**) in the inner sub-plate (**2**) from the opposite side to the outer sub-plate (**3**). Then, the temporal bolt (**45**) is threadedly engaged into a nut (**40**) through the through hole (**42a**) in the seat (**42**) of the associated L-piece (**41**) to which the nut (**40**) is welded. Thus, the seat (**42**) is brought into contact with the inner sub-plate (**2**) and the nut (**40**) and the L-piece (**41**) are temporarily retained to direct the extension (**43**) of the L-piece (**41**) towards the outer sub-plate (**3**).

[0054] Thereafter, the method proceeds to a heat insulating step of forming a heat insulating layer (**4**) between the outer sub-plate (**3**) and the inner sub-plate (**2**). In the heat insulating step, an expandable heat insulating material, such as urethane, is charged between the outer sub-plate (**3**) and the inner sub-plate (**2**). In this case, the heat insulating material is previously mixed with a foaming aid. At the start of charging, the heat insulating material is in liquid form and, as shown in the arrows in Figure **5**, flows in arbitrary directions between the outer sub-plate (**3**) and the inner sub-plate (**2**). When reaching each position where the nut (**40**) and the L-piece (**41**) are mounted, the heat insulating material flows through the charging holes (**43a**) in the extension (**43**) of the L-piece (**41**). Thus, the heat insulating material is charged closely between the inner sub-plate (**2**) and the outer sub-plate (**3**) and expands to form a heat insulating layer (**4**). Furthermore, the heat insulating material also flows in a small amount into a narrow gap (**2a**) between the seat (**42**) of the L-piece (**41**) and the inner sub-plate (**2**).

[0055] When the expanded heat insulating material cures, the method proceeds to a component mounting step. In the component mounting step, each temporal bolt (**45**) is first removed. In this case, since the heat insulating material such as urethane is initially in liquid form and has adhesiveness, the L-piece (**41**) is adhered to the inner sub-plate (**2**) by a small amount of heat insulating material having flowed in the gap (**2a**) between the seat (**42**) of the L-piece (**41**) and the inner sub-plate (**2**). In addition, since the part of the heat insulating layer (**4**) surrounding the extension (**43**) is closely filled with the expanded and cured heat insulating material, the extension (**43**) undergoes a resisting force of the heat insulating material in the heat insulating layer (**4**). Therefore, the nut (**40**) can be fixed at a position corresponding to the mounting hole (**31**) without coming loose during the removal of the temporal bolt (**45**) and without dropping down in the heat insulating layer (**4**) after the removal of the temporal bolt (**45**).

[0056] Then, a mounting bolt (**30**) is inserted into each bolt insertion hole (**16a**) in the component, such as the evaporator (**16**), and screwed and threadedly engaged in the nut (**40**) through the mounting hole (**31**) in the inner sub-plate (**2**) and the through hole (**42a**) in the seat (**42**) of the L-piece (**41**), thus being fixed to the inner sub-plate (**2**). Since, also during the screwing of the mounting bolt (**30**), the heat insulating material in the heat insulating layer (**4**) acts as a resisting force on the extension (**43**) and the seat (**42**) of the L-piece (**41**), this prevents the nut (**40**) from coming loose and stabilizes the fixing force of the mounting bolt (**30**).

[0057] Note that the opposed arrangement of the inner sub-plate (**2**) and the outer sub-plate (**3**) in the preparation step is carried out at latest just before the heat insulating step.

[0058] - Effects of Embodiment I -

In this embodiment, the component mounting plate (**s1**) of the casing (**11**) of the reefer container (**10**) includes nuts (**40**) disposed in the heat insulating layer (**4**) to correspond to mounting holes (**31**) in the inner sub-plate (**2**) and their respective L-pieces (**41**) disposed in the heat insulating layer (**4**) with the nuts (**40**) welded thereto, and the extensions (**43**) of the L-pieces (**41**) are extended towards the outer sub-plate (**3**). Therefore, the resistance from the heat insulating material in the heat insulating

layer (**4**) to the extensions (**43**) can be used to prevent the nuts (**40**) from being displaced.

[0059] Furthermore, since the seat (**42**) of each L-piece (**41**) is formed into a flat plate, the seat (**42**) can be surely brought into contact with the inner sub-plate (**2**), which surely increases the contact area with the inner sub-plate (**2**) as compared with the case where only the nut (**40**) is brought into contact with the inner sub-plate (**2**). Therefore, a small amount of heat insulating material in the gap (**2a**) between the inner sub-plate (**2**) and the seat (**42**) of the L-piece (**41**) can significantly exert its adhesion force to fix the nut (**40**). This prevents the nut (**40**) from dropping out of the position corresponding to the associated mounting hole (**31**) and prevents the nut (**40**) from coming loose during screwing of the mounting bolt (**30**) thereinto. Hence, the fixing force in mounting an in-container component, such as the evaporator (**16**), can be stabilized.

[0060] Furthermore, since each mounting bolt (**30**) passes through the through hole (**42a**) in the seat (**42**) of the associated L-piece (**41**) and is threadedly engaged in the threaded hole (**40a**) of the nut (**40**), the seat (**42**) of the L-piece (**41**) functions as a washer to stabilize the fastening force between the nut (**40**) and the mounting bolt (**30**).

[0061] Furthermore, since the component mounting plate (**s1**) is produced through the temporarily retaining step, the heat insulating step and the component mounting step, there is no need to attach the nut (**40**) with an adhesive unlike the known art. As a result, since there is no need to carry out some processing steps including treatment to the part of the inner sub-plate (**2**) surrounding the mounting hole (**31**) and adhesive mixing, this simplifies the casing production process. In addition, since there is no need to cure an adhesive, this reduces the casing production time.

[0062] Furthermore, since the charging holes (**43a**) for the heat insulating material are formed in the extension (**43**) of each L-piece (**41**), the heat insulating material can be closely and uniformly charged through the charging holes (**43a**) during the heat insulating step. Thus, the heat insulating material is closely charged also around the extension (**43**). Therefore, the resisting force of the heat insulating material surely acts on the extension (**43**), which prevents loosening and dropping of the nut (**40**). Furthermore, heat insulation can be surely provided between the interior and outside of the container (**10**).

[0063] <Embodiment 2>

In this embodiment, instead of formation of the through hole (**42a**) for a bolt in the seat (**42**) of each L-piece (**41**) in Embodiment 1, a fitting hole (**42b**) is formed for axial fitting of the nut (**40**) therein as shown in Figure **6**.

[0064] Specifically, the seat (**42**) of each L-piece (**41**) is formed with a fitting hole (**42b**) in which a nut (**40**) is axially fitted, and the nut (**40**) is fixed by being fitted into the fitting hole (**42b**). Furthermore, the mounting bolt (**30**) passes through the mounting hole (**31**) in the inner sub-plate (**2**) and is directly threadedly engaged in the nut (**40**).

[0065] According to this embodiment, since each nut (**40**) can be fixed to the seat (**42**) of the associated L-piece (**41**) by fitting the nut (**40**) into the fitting hole (**42b**) in the seat (**42**), there is no need to weld the nut (**40**) to the seat (**42**) of the L-piece (**41**). As a result, the step of securing the nut (**40**) to the L-piece (**41**) can be simplified.

[0066] The other configurations, behaviors and effects are the same as in Embodiment 1.

[0067] - Modification of Embodiment 2 -

In this embodiment, as shown in Figure **7**, the seat (**42**) of each L-piece (**41**) is formed with a through hole (**42a**) for a mounting bolt (**30**) like Embodiment 1 and concurrently formed with a fitting hole (**42b**) for a nut (**40**) like Embodiment 2.

[0068] Specifically, as shown in Figure **7**, the seat (**42**) of each L-piece (**41**) has a hole (**42c**) passing therethrough, in which a part of the hole (**42c**) towards the inner sub-plate (**2**) is a through hole (**42a**) and a part thereof towards the outer sub-plate (**3**) is a fitting hole (**42b**). The nut (**40**) is fixed to the seat (**42**) of the L-piece (**41**) by being fitted into the fitting hole (**42b**) in the seat (**42**). The mounting bolt (**30**) passes through the mounting hole (**31**) in the inner sub-plate (**2**) and is threadedly engaged in the nut (**40**) through the through hole (**42a**) in the seat (**42**) of the L-piece (**41**).

[0069] According to this embodiment, since the seat (**42**) of each L-piece (**41**) is formed with a through hole (**42a**) for a mounting bolt (**30**) and a fitting hole (**42b**) for a nut (**40**), the nut (**40**) can be fixed to the seat (**42**) of the L-piece (**41**) without welding the nut (**40**) to the seat (**42**). In addition, the seat (**42**) can function as a washer for the nut (**40**) to stabilize the fastening force between the nut (**40**) and the mounting bolt (**30**).

[0070] The other configurations, behaviors and effects are the same as in Embodiment 1.

[0071] <Other Embodiments>

The above embodiments may have the following configurations.

[0072] Although in Embodiment 1 the turning stop piece is an L-piece (**41**), it only has to include a seat (**42**) and an extension (**43**) and is not particularly limited in configuration.

[0073] Specifically, although the turning stop piece in Embodiment 1 has a single extension (**43**), the turning stop piece may include a plurality of extensions and, for example, may be a U-piece. Furthermore, although in Embodiment 1 the extension (**43**) has charging holes (**43a**) for a heat insulating material, it may have no charging hole (**43a**). When the turning stop piece has a plurality of extensions (**43**), the extensions (**43**) may comprise some having a charging hole (**43a**) and the others having no charging hole (**43a**). The extension (**43**) of the turning stop piece may be attached to the seat (**42**) such as by welding.

[0074] Furthermore, although in Embodiment 1 the heat insulating material in the heat insulating layer (**4**) is an expandable resin, such as urethane, it may also be

some other kind of heat insulating material. With the use of an expandable resin, such as urethane, for the heat insulating layer (**4**), as shown in Figure **5**, it reaches a very small gap between the seat (**42**) of the L-piece (**41**) and the inner sub-plate (**2**), thereby providing a secure fixing of the nut (**40**) and the L-piece (**41**). Also with the use of some other kind of heat insulating material, loosening and dropping of the nut (**40**) can be prevented by resisting forces of the seat (**42**) and the extension (**43**) of the L-piece (**41**).

[0075] The above embodiments are merely preferred embodiments in nature and are not intended to limit the scope, applications and use of the invention.

Industrial Applicability

[0076] As can be seen from the above description, the present invention is useful for casing structures for refrigeration systems and methods for producing such casings.

Claims

1. A casing structure for a refrigeration system including an outer sub-plate (**3**), an inner sub-plate (**2**) and a heat insulating layer (**4**) formed between the outer sub-plate (**3**) and the inner sub-plate (**2**) and made of a heat insulating material, the inner sub-plate (**2**) being formed with a mounting hole (**31**) through which a mounting bolt (**30**) for a component (**16**) passes, the casing structure further including:

a nut (**40**) disposed in the heat insulating layer (**4**) to correspond to the mounting hole (**31**) in the inner sub-plate (**2**) and threadedly engaged on the mounting bolt (**30**); and
a turning stop piece (**41**) having the nut (**40**) secured thereto, including a seat (**42**) in contact with the inner sub-plate (**2**) and an extension (**43**) extending from the seat (**42**) towards the outer sub-plate (**3**) and disposed in the heat insulating layer (**4**) to correspond to the mounting hole (**31**) in the inner sub-plate (**2**).

2. The casing structure for the refrigeration system of claim 1, wherein the seat (**42**) of the turning stop piece (**41**) is formed into a flat plate extending orthogonally to the mounting bolt (**30**).

3. The casing structure for the refrigeration system of claim 2, wherein the extension (**43**) of the turning stop piece (**41**) is formed by being bent from one side of the seat (**42**) in the axial direction of the mounting bolt (**30**).

4. The casing structure for the refrigeration system of claim 3, wherein the turning stop piece (**41**) is an L-piece (**41**) formed in an L-shaped cross section.

5. The casing structure for the refrigeration system of claim 1, wherein
the seat (**42**) of the turning stop piece (**41**) is formed with a through hole (**42a**) through which the mounting bolt (**30**) passes, and
the nut (**40**) is welded to the turning stop piece (**41**) so that the threaded hole (**40a**) of the nut (**40**) corresponds to the through hole (**42a**).

6. The casing structure for the refrigeration system of claim 1, wherein the seat (**42**) of the turning stop piece (**41**) is formed with a fitting hole (**42b**) for fixing the nut (**40**) to the seat (**42**) by fitting the nut (**40**) into the fitting hole (**42b**).

7. The casing structure for the refrigeration system of claim 1, wherein the extension (**43**) of the turning stop piece (**41**) is formed with a charging hole (**43a**) for the heat insulating material.

8. A method for producing a casing for a refrigeration system, the casing including an outer sub-plate (**3**), an inner sub-plate (**2**) and a heat insulating layer (**4**) formed between the outer sub-plate (**3**) and the inner sub-plate (**2**), the inner sub-plate (**2**) being formed with a mounting hole (**31**) through which a mounting bolt (**30**) for a component (**16**) passes, the method comprising:

a temporarily retaining step of putting, between the outer sub-plate (**3**) and the inner sub-plate (**2**), a nut (**40**) threadedly engageable on the mounting bolt (**30**) and a turning stop piece (**41**) including a seat (**42**) with the nut (**40**) secured thereto and an extension (**43**) extending from the seat (**42**) in the axial direction of the mounting bolt (**30**), while bringing the seat (**42**) of the turning stop piece (**41**) into contact with the inner sub-plate (**2**), and threadedly engaging a temporal bolt (**45**) through the mounting hole in the inner sub-plate (**2**) into the nut to retain the temporal bolt (**45**) to the inner sub-plate (**2**);
a heat insulating step of charging a heat insulating material between the outer sub-plate (**3**) and the inner sub-plate (**2**) to form a heat insulating layer (**4**); and
a component mounting step of removing the temporal bolt (**45**) and mounting a component (**16**) to the inner sub-plate (**2**) by threadedly engaging the mounting bolt (**30**) in the nut (**40**).

FIG. 1

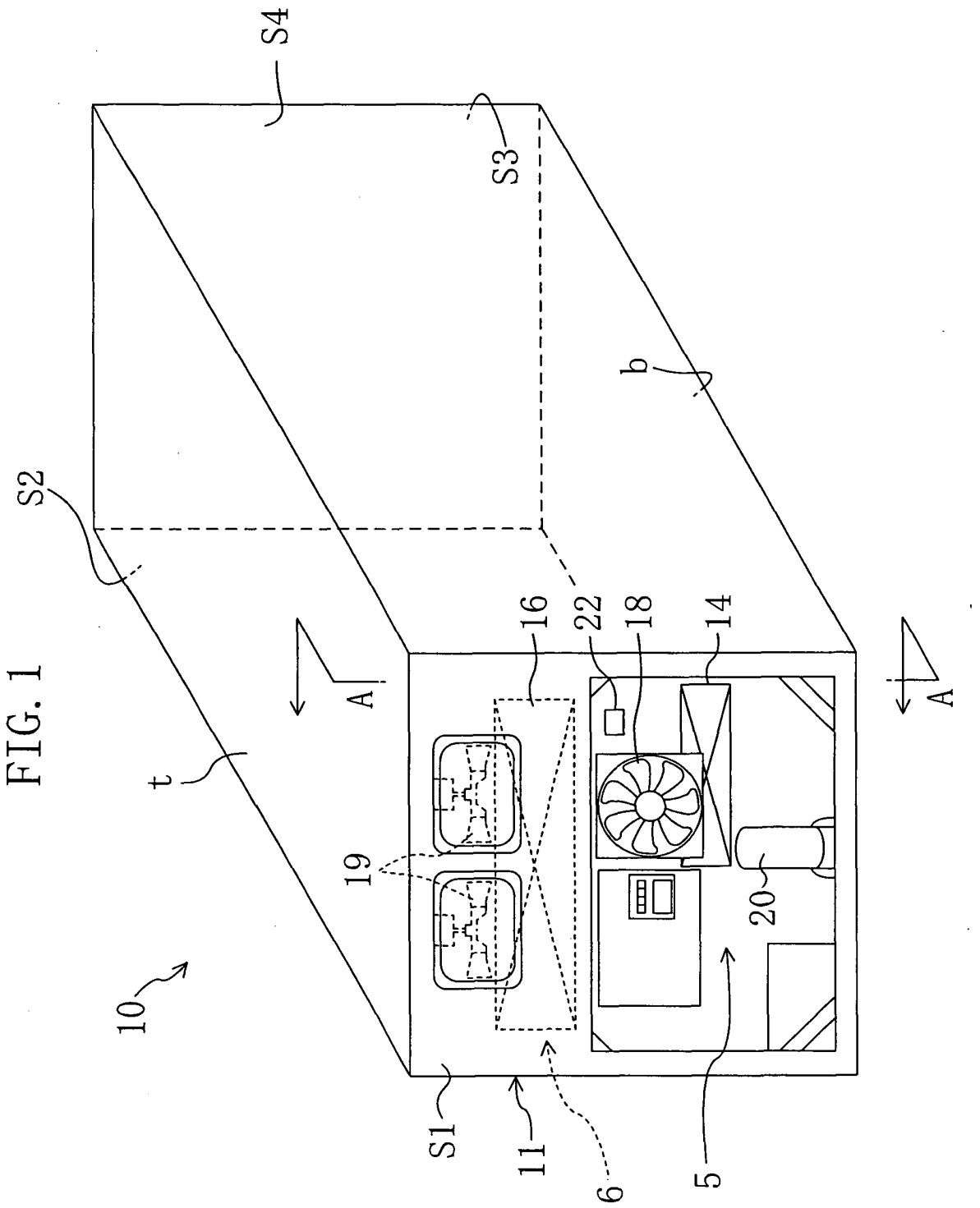


FIG. 2

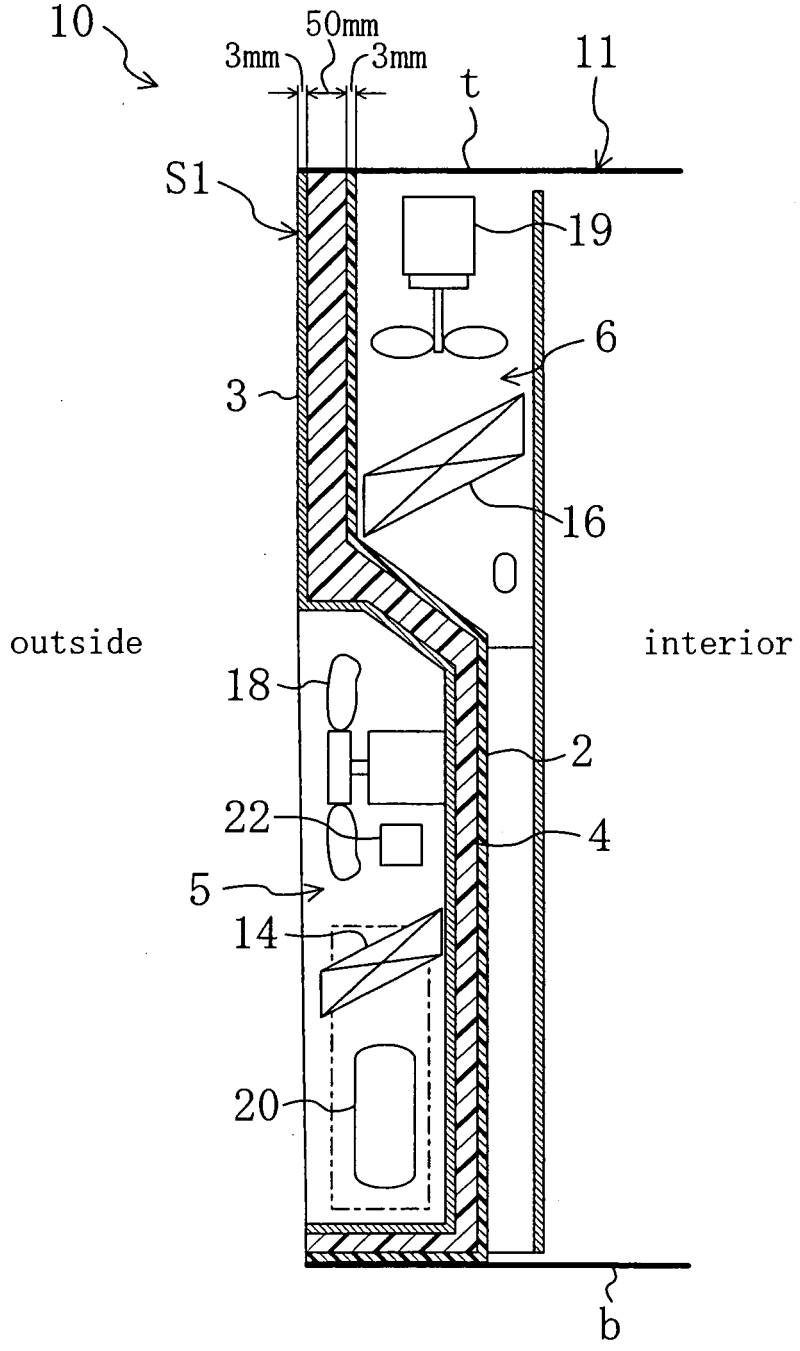
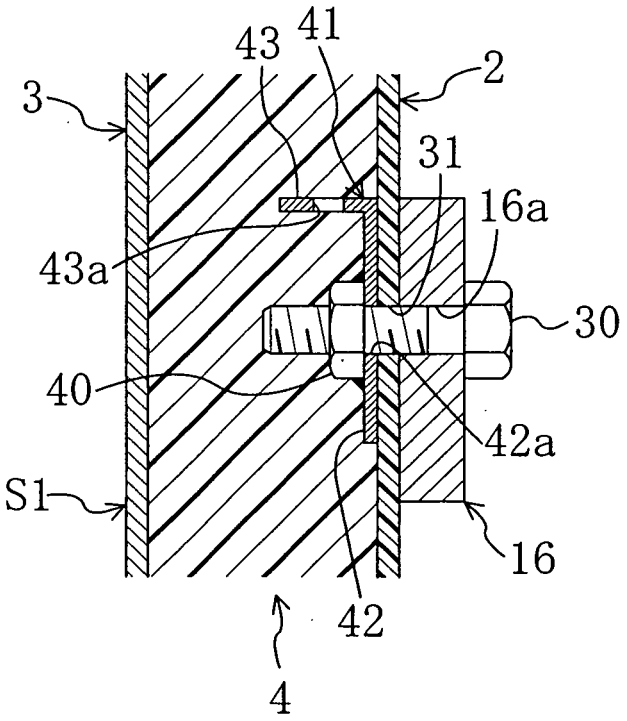

10
50mm
3mm
3mm
t
11
S1
19
6
3
16
O
outside
interior
18
2
22
4
5
14
20
b

FIG. 3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41
2
3
31
16a
43a
30
40
42a
S1
16
42
4

FIG. 4

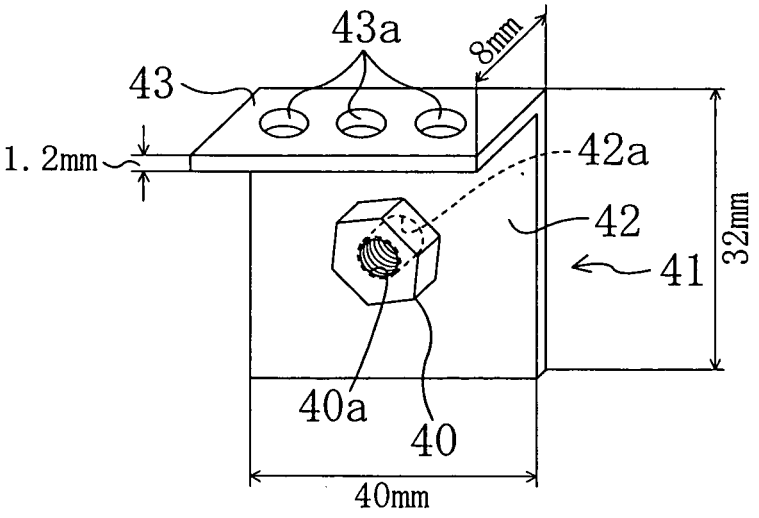

43a
8mm
43
1. 2mm
42a
42
41
32mm
40a
40
40mm

FIG. 5

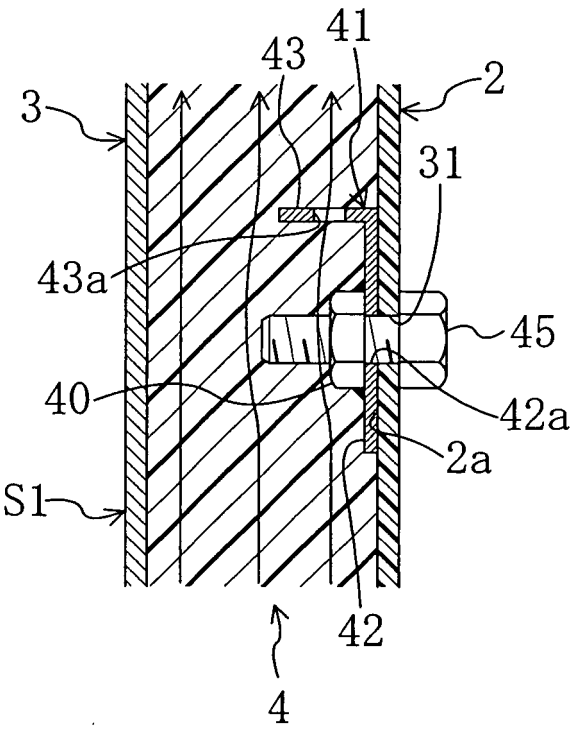


FIG. 6

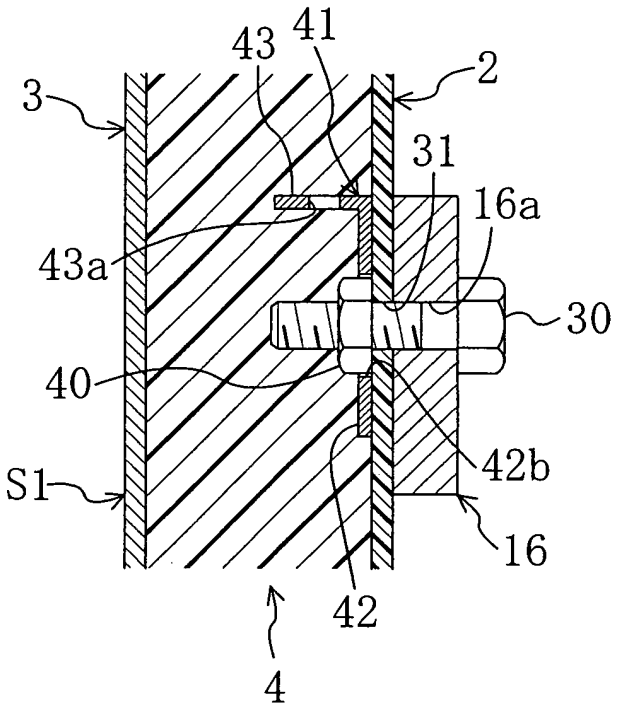
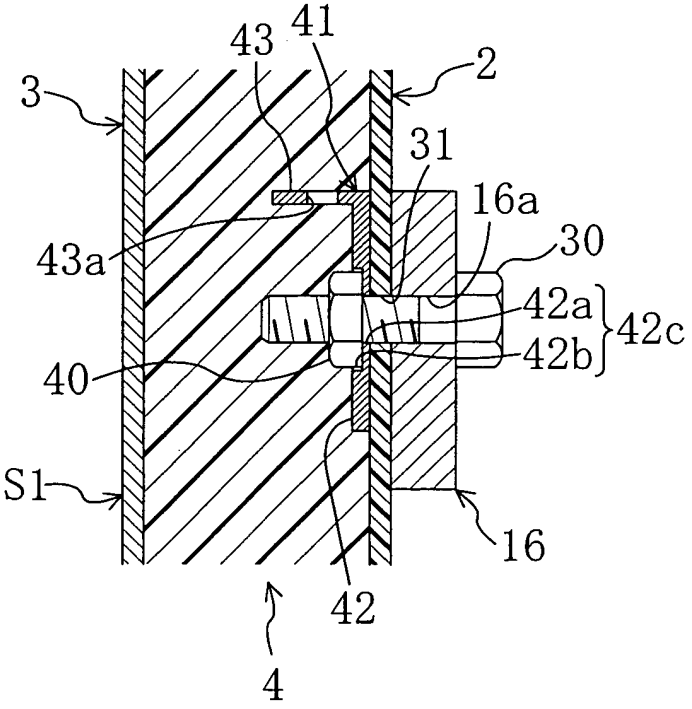

43
41
2
3
31
16a
43a
30
40
42b
S1
16
42
4

FIG. 7


43
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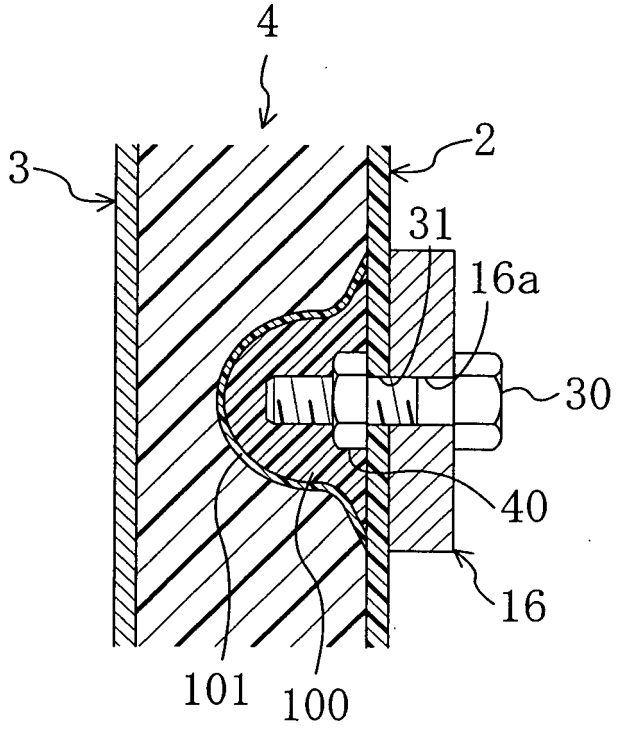
31
16a
30
43a
42a
42c
42b
40
S1
16
42
4

FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/319476

A. CLASSIFICATION OF SUBJECT MATTER
F25D23/06(2006.01)i, *B65D88/12*(2006.01)i, *B65D90/06*(2006.01)i, *B65D90/08*(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)
F25D23/06, B65D88/12, B65D90/06, B65D90/08

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 8-337287 A (Daikin Industries, Ltd.), 24 December, 1996 (24.12.96), Par. Nos. [0017] to [0019], [0023]; Figs. 2 to 4 (Family: none)	1-8
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 27513/1985(Laid-open No. 145295/1986) (Sanyo Electric Co., Ltd.), 08 September, 1986 (08.09.86), Page 4, line 19 to page 6, line 18; Figs. 3 to 6 (Family: none)	1-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 October, 2006 (11.10.06)	24 October, 2006 (24.10.06)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/319476

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 177724/1986(Laid-open No. 83580/1988) (Sanyo Electric Co., Ltd.), 01 June, 1988 (01.06.88), Page 7, line 18 to page 8, line 10; Fig. 1 (Family: none)	7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H08337285 B **[0003]**