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"METHOD OF FABRICATING HEAT INSULATION HOUSING"

The present invention relates to a method of fabricating heat insulation housing used in a refrigerator.

When heat insulation housing for a refrigerator is fabricated, the following method has been heretofore employed. A body having a rectangular frame is composed by first forming side plates and connecting plates by respectively pressing the right and left sides of the steel plates at their upper ends so that the side plates are connected integrally with the connecting plates. Next, the side plates are secured to bottom plates similarly made of steel by respectively welding both the right and left edges of the bottom plates to the lower edges of the side plates. After the body is then coated with paint, an inner casing is inserted into the body, which is further fastened to the body by a suitable engaging means. Further, a rear plate made of steel which closes the back surface opening may be clamped, for example, by screws to the back surface of the body, and a ceiling plate which is called a table board may be fastened, for example, by a clamping and engaging means to the upper surface (the above-described connection plate) of the body. Subsequently, thermal insulators are foamed and filled in the space formed within the body (and the ceiling plate), the inner

casing and the rear plate.

Constructing the above-described heat insulation housing, the steps of welding and clamping are relatively complicated. Since a painted steel plate, such as a colored steel plate cannot, be used due to the necessity of welding a separate painting step is required, thus increasing cost, complicating the process, and resulting in an increase in the total number of steps. Consequently, more manhours and a wider fabricating facility are necessary, forcing the production cost of the heat insulation housing to increases.

It is an object of the present invention to provide a method of fabricating a heat insulation housing capable of eliminating the welding and clamping steps, and of obviating the painting step, thereby reducing manhours, simplifying production facility, and decreasing the fabricating cost.

According to the present invention, there is provided a method of fabricating a heat insulation housing comprising relatively moving an inner casing having a rectangular opening on the front surface thereof, a left-side plate opposite to the outer left of the casing at a predetermined interval, a right-side plate opposite to the outer right of the inner casing at a predetermined interval, a rear plate opposite to the rear outside of the inner casing at a predetermined

interval, a bottom plate opposite to the bottom outside of the inner casing at a predetermined interval, and a ceiling plate opposite to the upper outside of the inner casing at a predetermined interval to press-fit engaging portions formed at the edges of the inner casing and these plates to fasten them in the above-described relationship, and then foaming and filling thermal insulators in a space formed among the inner casing, the left-side plate, the right-side plate, the rear plate, the bottom plate and the ceiling plate, the engaging portion of said inner casing comprising left and right flanges respectively formed at the left and right ends of the front surface thereof, and lower and upper flanges formed at the lower and upper ends thereof, and said engaging portions of the left side plate, the right side plate, the rear plate, the bottom plate and the ceiling plate respectively comprise engaging recesses to be press-fitted with the corresponding flanges, said engaging recess being formed by bending said plates.

An embodiment of the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a 2-temperature type refrigerator fabricated by a method of fabricating a heat insulation housing according to an embodiment of the present invention;

Fig. 2 is an exploded perspective view of the refrigerator;

Fig. 3 is a perspective view partly showing the lower portion of the refrigerator;

Fig. 4 is a lateral sectional view of the front portion of the refrigerator;

Fig. 5 is a longitudinal sectional view of the upper portion of the refrigerator;

Fig. 6 is a perspective view showing the piping of

the refrigeration cycle of the refrigeration;

Fig. 7 is a perspective view of an assembling jig used for assembling the refrigerator; and

Fig. 8 is a sectional view showing part of the assembling jig.

The present invention will be described with respect to an embodiment applied to a 2-temperature type refrigerator with reference to the accompanying drawings.

In Fig. 1 showing the external appearance of a 2-temperature type refrigerator, reference numeral 1 designates a rectangular heat insulation housing having therein a freezing chamber and a cooling chamber (both of which are not shown) in the upper and lower portions, numeral 2 designates a door for the freezing chamber and numeral 3 designates a door for the cooling chamber.

Figs. 2 to show a concrete construction of the housing 1 and a refrigeration cycle associated with the housing 1 whose construction will be now described. Reference numeral 4 designates a plastic inner casing for forming the cooling chamber, and flanges 6a, 6b, 6c, 6d directed outwardly are integrally extended over the entire periphery of the edge defining a front surface opening 5 of a rectangular shape. In this case, the flanges 6a, 6b, 6c and 6d are formed in a waveform shape of a lateral section as shown in Fig. 3. Reference numeral 7 designates a freezer

unit as the inner casing for forming a cooling chamber which is constructed as below.

Reference numeral 8 depicts a cooler for the freezing chamber, which is constructed by attaching a zigzag refrigerant pipe 8b to the outer surface of a cooling plate 8a of a U-shaped section formed, for example, by bending the upper and lower parts of an aluminum plate forward and by mounting respectively as an engaging means, plastic freezer side plates 9 and 10 on both side ends of the cooler 8 so that the entirety is formed in a box shape. Numeral 11 designates a rectangular plastic insulating frame mounted on a front opening defined by the upper and lower ends of the cooler 8, as well as the side ends of the side plates 9 and 10. Flanges 12a, 12b, 12c and 12d directed outwardly are integrally extended from the four side ends of the insulating frame 11. In this case, the flanges 12a, 12b, 12c and 12d are formed in the same waveform shape as that of the flanges 6a to 6d of the inner casing 4 (Fig. 4). Also, the metal reinforcing frame 13 of the U-shaped section is fixedly engaged in the form of a flange with the upper flange 12a. Further, forward projections 14 and 15 are integrally protruded in the vicinity of the left and right ends respectively of the lower flange 12d of the frame 11. Tong pieces 16 and 17 which extend downward are integrally disposed at the lower positions of the

projections 14 and 15, respectively. An oblique surface 14a is formed at the top left of the projection 14 as shown in Fig. 4, and an oblique surface 15a is similarly formed at the top right of the projection 15. Numeral 18 denotes a dew-retardation pipe, which is composed of a rectangular frame portion 18a attached to the back surface of the flanges 12a to 12d of the frame 11, and to both ends of the connecting portions 18b and 18c which are disposed at substantially the center of the upper part of the frame portion 18a as viewed from the back. The freezer unit 7 is composed by assembling in advance the cooler 8 for the freezing chamber, the freezer side plated 9 and 10, the insulating frame 11, the reinforcing frame 13 and the dew-retardation pipe 18.

Reference numeral 19 designates a metal partition plate disposed between the inner casing 6 and the front ends of the freezer unit 7, and through holes 20 and 21 are respectively formed corresponding to the projections 14 and 15 of the frame 11 in the vicinity of the left and right ends of the partition plate 19. Numeral 22 depicts a rectangular left side plate made of a steel. Engaging recesses 23 and 24 (Fig. 3) are formed at an engaging means opened at the right and rear at the front and rear ends of the left side plate 22 by bending the front and rear ends of the plate 22; and flanges 25 and 26 (flange 26 is shown in Fig. 3) of a U-shape are

respectively formed as engaging means directed upward and towards the right at the upper and lower ends by bending the upper and lower ends thereof. Numeral 27 denotes a zigzag condenser pipe attached to the inner surface (right side surface) of the left side plate 22, both ends of which are respectively disposed at the top and bottom in the vicinity of the rear end of the left side plate 22. Numeral 28 designates a rectangular right side plate made of a steel plate. Engaging recesses 29 and 30 (Fig. 3) are respectively formed as engaging means opened at the left and rear of the front and rear ends of the right side plate 28 by bending the front and rear ends of the plate 28, and flanges 31 and 32 (flange 32 is shown in Fig. 3) of a U-shape are respectively formed as engaging means which are directed upward and towards the left at the upper and lower ends thereof by bending the upper and lower ends. Numeral 33 depicts a zigzag condenser pipe attached to the inner surface (left side surface) of the right side plate 28, and both ends of the pipe 33 are respectively disposed at the top and bottom of the right side plate 28 in the vicinity of the rear end. Engaging holes 23a and 29a respectively corresponding to the projections 14 and 15 of the frame 11 are perforated, as shown in Fig. 4, at the side wall in the vicinity of the front side in the engaging recesses 23 and 29 of the left and right side plates 22 and 28. Numeral 34 denotes a rear plate,

which is formed by raising and engaging a steel plate 35 and a plastic frame 36 operating also as engaging means. Flanges 37, 38 and 39 (Fig. 3) also having a U-shape are integrally formed as an engaging means directed towards the front at the lower, left and right ends of the plate 35 by bending the lower, left and right ends of the plate 35; and a flange 40 of a U-shape is directed towards the front to be integral at the upper end by bending the upper end. An engaging recess 41 which is open at the back is formed at the lower end of the frame 36 by bending the lower end of the frame 36; and the frames 35 and 36 are integrated by press-fitting the flange 40 of the plate 35 into the engaging recess 41. Flanges 42 and 43 are respectively extended to be integral as engaging means directed towards the front by bending the left and right ends of the frame 36. Numeral 44 designates a rectangular plastic bottom plate, which has a swelled part 44a for forming a machine chamber which projects upward from the rear of the bottom plate 44. An engaging recess 46 is formed as an engaging means defined by two parallel projecting strips 45a and 45b directed upward from the front end of the bottom plate 44 as shown in Fig. 3; and engaging recesses 49 and 50 are respectively formed between the two parallel projecting strips 47a, 47b and 48a, 48b, and are directed to be outward (towards the left and towards the right) at the left and right ends. Further,

an engaging recess 52 as an engaging means and a recess 53 for holding a machine chamber cover (not shown) are elevated and formed by three parallel projecting strips 51a, 51b and 51c towards the of the rear end. Detents 47c, 48c and 51d are respectively formed at the ends of the upper projecting strips 47a, 48a and 51a for defining the engaging recesses 49, 50 and 52.

Reference numeral 54 designates a rectangular ceiling plate integrally formed of plastic; and an engaging recess 56 is formed as engaging means defined by two rectangular projecting strips 55a and 55b which are directed downward at the four peripheral ends as shown in Fig. 5. Detent 55c is formed on the lower inner surface of the projection 55a. Numeral 57 depicts a cooling plate for the cooling chamber (Fig. 2) formed of zigzag pipe, which is suspended in the depth in the inner casing 4 in the state that both ends pass through the upper wall of the casing 4.

In Fig. 6 showing the piping structure of a refrigeration cycle, reference numeral 58 designates a compressor disposed in the machine chamber. An exhaust port 58a of the compressor is connected to the lower end of the condenser pipe 33 attached to the right side plate 28, and a suction port 58b is connected to a suction pipe 59. The condenser pipe 33 and the condenser pipe 27 attached to the the left side plate 22 are respectively connected to couplings 18b and 18c

of the pipe 18. The lower end of the pipe 27 is connected through a drier 60 and a capillary tube 61 to one end of the refrigerator pipe 8b of the cooler 8. The other end of the pipe 8b is connected to one end of the cooler 57, and the other end of the cooler 57 is connected through an accumulator 62 to the pipe 59.

A method of fabricating a heat insulation housing 1 will now be described with reference to Fig. 7 and Fig. 8 showing an assembling jig in case of fabrication. In Figs. 7 and 9, reference numeral 63 designates a conveying platen formed in a rectangular frame shape, in which the platen can be automatically or manually moved, for example, along a production line in the direction of arrow A. Numeral 64 depicts an inner casing guide supported by a pair of rails 63a extending horizontally on the platen 63, in which the guide is divided into an upper guide 65 having a U-shaped wall 65a and a flat placing surface 65b around the wall 65a, and a lower guide 66 slidable in the direction of arrow A and in the reverse direction to arrow A, and having a U-shaped wall 66a and a flat placing surface 66b around the wall 66a. Thus, the peripheral edge of the front surface opening 5 of the inner casing 4 is engaged with the outer periphery of the walls 65a and 66a, and the inner casing 4 is placed in contact with the peripheral end of the surfaces 65a and 66b. The distance between the guides 65 and 66 is adjusted in response to the size

of the inner casing 4. Numeral 67 depicts a freezer guide mounted to be movable along the rail 63a on the platen 63. The front surface opening end of the freezer unit 7 (particularly the inner peripheral edge of the insulating frame 11) is engaged with the outer periphery of the rectangular wall 56a, so that the freezer unit 7 is placed in contact with the peripheral end on the surface 67a. Numeral 68 denotes a bottom plate guide installed to be slidable in the direction of arrow A and in the reverse through a supporting means (not shown) on the platen 63. This bottom plate guide 68 has rising wall 58a and a placing surface 68b, the upper surface of which extends horizontally from the base towards the direction of arrow A of the rising wall 68a. When the front end of the bottom plate 44 is placed on the surface 68b, the wall 68a makes contact with the outer bottom surface. The placing surfaces 65b, 66b, 67b and 68b are constructed to be in the same plane. Numerals 69 and 70 designate rectangular rod-shaped rotary members supported at both ends rotatably to arms 69a, 69b and 70a, 70b which extend horizontally from both sides of the platen 63 and which are secured fixedly to the platen. These rotary members 69 and 70 are rotated to the operating position designated by the two-dot chain lines in Fig. 8 from the standby position shown by the solid lines in Fig. 8, with the vertical shaft thereof as a center which

responds to the operation of levers (designated by 70c at the right rotary member) integral with the rotary members 69 and 70. The upper surfaces of the rotary members 69 and 70 in the standby state are separated from the upper surface of the platen 63 to form placing surfaces 69d and 70d. In this case, the surface 69d and 70d are set to be slightly lower than the placing surfaces 65b, 66b, 67b and 68b.

In order to fabricate heat insulation housing 1, the steps are carried out in the following order. First, the partition plate 19 is placed between the placing surface 65b of the inner casing guide 64 of the platen 63 and the placing surface 67b of the freezer guide 67; the inner casing 4 is placed as described above on the placing surfaces 65b and 66b of the inner casing guide 64; and the freezer unit 7 is placed as described above on the placing surface 67b of the freezer guide 67. When the freezer unit 7 is placed, the projections 14 and 15 of the insulating frame 11 are respectively inserted into the through holes 20 and 21 of the partition plate 19. Subsequently, the bottom plate 33 is placed as described above on the placing surface 68b of the bottom plate guide 68, the bottom plate guide 68 is slid in the direction of arrow A manually or automatically, and the lower flange 6b of the inner casing 4 is press-fitted into the engaging recess 46 of the bottom

plate 44 in response to the movement of the plate guide (first step). Then, the left and right side plates 22 and 28 are respectively placed as designated by the solid lines in Fig. 8 through the front ends on the placing surfaces 69d and 70d of the rotary members 69 and 70. The rotary members 69 and 70 are respectively rotated to the operating position designated by the two-dot chain lines in Fig. 8 manually or automatically (second step). Then, the left side plate 22 is slid towards the right on the placing surface 69d in response to the rotation of the rotary member 69, and is then pressed towards the right by the placing surface 69d. The left flange 6c of the inner casing 4, the left flange 12c of the insulating frame 11 and the left end of the partition plate 19 are respectively press-fitted eventually into the engaging recess 23 of the left side plate 22; and the engaging recess 26 of the left side plate 22 is press-fitted into the recess 49 of the bottom plate 44. In this case, as shown in Fig. 4, the projection 14 of the frame 11 is engaged with the engaging hole 23a of the recess 23, and the left end of the plate 19 is supported in a latched state. Further, the right side plate 28 is slid towards the leftwardly on the placing surface 70d in response to the rotation of the rotary member 70, and is then pressed towards the left by the placing surface 70d. The right flange 6d of the inner casing 2, the

right flange 12d of the frame 11 and the right end of the partition plate 19 are eventually press-fitted into the recess 29 of the right side plate 28; and the flange 32 of the right side plate 28 is presa-fitted into the recess 50 of the bottom plate 44. Even in this case, as shown in Fig. 4, the projection 15 of the frame 11 is engated with the hole 29a in the recess 28, and the right end of the partition plate 19 is supported in a latched state.

Thereafter, the couplings 18b, 18c of the pipe 18 and the upper ends of the pipes 27 and 33 are, for example, connected by brasing, as is one end of the pipe 8b of the cooler 8 and one end of the cooler 57. The accumulator 62 and the pipe 59 are also connected, for example, by brazing to the other end of the cooler 57. Then, the rear plate 34 is moved down from above; and the flange 37 of the plate 34, the flanges 38, 42 and the flanges 39, 43 are respectively press-fitted into the recess 52 of the plate 44, the recess 24 of the left side plate 22 and the recess 30 of the right side plate 28 (third step). Further, the ceiling plate 54 is moved in the opposite direction of arrow A in Fig. 7; and the reinforcing frame 13 of the freezer unit 7, the flange 25 of the left side plate 22, the flange of the right side plate 2B and the top of the plate 35 of the rear plate 34 are respectively press-fitted into the recess 56 of the ceiling plate 54

(fourth step). Subsequently, as described above, the inner casing 4, the freezer unit 7, the partition plate 19, the left side plate 33, the right side plate 28, the rear plate 34, the bottom plate 44 and the ceiling plate 54 are integrated; and thermal insulation 71 (Fig. 3) is foamed and filled in the space formed by them (fifth step), thereby completing the heat insulation housing 1.

In the embodiment described above, the following various advantages can be carried out. The inner casing 4, the freezer unit 7, the partition plate 19, the left side plate 22, the right side plate 28, the rear plate 34, the bottom plate 44 and the ceiling plate 54 are all connected by a press-fitting engaging means, so that the foaming pressure of the insulator 71 is actuated as designated by arrow B in Figs. 3 to 5, and is rigidly maintained by the adhesiveness of the insulator 71. Therefore, complicated welding and clamping steps can be eliminated to fabricate the housing 1, thereby reducing the production cost of the housing 1. Since the welding step can be obviated as described above, the left and right side plates 22, 28 and the rear plate 34 (particularly the plate 35) can be composed of painted steel plates such as color steel plates, with the result that the painting step of the housing 1 can be eliminated, thereby further reducing the production cost. In addition, the range of materials used for the left and right side plates 22, 28 and for the surface

treatments thereof can be increased, thus enhancing the degree of freedom in the external appearance of the housing. Moreover, since the above-described engaging means is engaged entirely by press-fitting in surface contact, the insulator 71 is not leaked from the engaging portion when the insulator 71 is foamed and filled, and the amount of sealant for preventing the leakage can be remarkably reduced, thereby diminishing the production cost. When a method of altering only the height of the heat insulation housing is employed in the case where housings of different inner volumes are fabricated, the frame 36 of the rear plate 34, the bottom plate 44 and the ceiling plate 48 may be commonly fabricated, thereby reducing cost of mass producing these components. Further, since the condenser pipes 27, 33 are respectively attached to the left and right side plates 22, 28, the heat sink efficiency of the pipes 27, 33 can be improved. In this case, since the pipes 27, 33 may be attached in advance to the left and right side plates 22, 28 as independent components, the attaching work can be simplified, thereby automating the work.

The present invention is not limited to the particular embodiments described above and designated in the accompanying drawings. Various other changes and modifications may be made within the spirit and scope of the present invention. For example, the present

invention may also be applied to a one-temperature type refrigerator, a refrigeration display case or to a refrigeration stocker.

According to the present invention as described above, the welding and clamping steps may be eliminated to fabricate the heat insulation housing, the painting step can also be obviated to reduce the manhours and to simplify the fabrication facility, thereby decreasing the cost of fabrication and enhancing the degree of freedom in design of the external appearance of the heat insulation housing.

## CLAIMS

1. A method of fabricating a heat insulation housing comprising relatively moving an inner casing having a rectangular opening on the front surface thereof, a left-side plate opposite to the outer left of the casing at a predetermined interval, a right-side plate opposite to the outer right of the inner casing at a predetermined interval, a rear plate opposite to the rear outside of the inner casing at a predetermined interval, a bottom plate opposite to the bottom outside of the inner casing at a predetermined interval, and a ceiling plate opposite to the upper outside of the inner casing at a predetermined interval to press-fit engaging portions formed at the edges of the inner casing and these plates to fasten them in the above-described relationship, and then foaming and filling thermal insulators in a space formed among the inner casing, the left-side plate, the right-side plate, the rear plate, the bottom plate and the ceiling plate, the engaging portion of said inner casing comprising left and right flanges respectively formed at the left and right ends of the front surface thereof, and lower and upper flanges formed at the lower and upper ends thereof, and

said engaging portions of the left side plate, the right side plate, the rear plate, the bottom plate and the ceiling plate respectively comprise engaging recesses to be press-fitted with the corresponding flanges, said engaging recess being formed by bending said plates.

2. A method of fabricating a heat insulation housing according to claim 1, wherein said engaging portions of the rear plate comprise an upper flange at the upper end thereof, and said ceiling plate comprises at the rear end thereof an engaging recess to be press-fitted with the corresponding upper flange.

3. A method of fabricating a heat insulation housing according to claim 1, wherein said engaging portions of the rear plate comprises at the lower end thereof, a lower flange, said bottom plate comprising at the rear end thereof an engaging recess to be press-fitted with the corresponding lower flange.

4. A method of fabricating a heat insulation housing according to any of claims 1 to 3, wherein said inner casing comprises the first inner box portion forming a cooling chamber, and a second inner box portion forming a freezing chamber connected to said first inner box portion.

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5. A method of fabricating a heat insulation housing according to claim 4, wherein said fastening step comprises the first step of press-fitting the lower flange of said inner casing into the engaging recess of the bottom plate, the second step of press-fitting the left and right flanges of the inner casing into the engaging recesses of the left and right side plates and the lower flanges of the left and right side plates into the left and right engaging recesses of the bottom plate, the third step of press-fitting the left and right flanges of the rear plate as well as the lower flange into the engaging recess of the left side plate and the rear flange of the right side plate into the engaging recess of the bottom plate, and the fourth step of press-fitting the upper flange of the inner casing, the upper flange of the left side plate, the upper flange of the right side plate and the upper flange of the rear plate into the front engaging recess, the left engaging recess and the right engaging recess of the ceiling plate and the rear engaging recess.

6. A heat insulation housing fabricated by a method of fabricating a heat insulation housing according to any of claims 1 to 5.

7. A method of fabricating a heat insulation housing, substantially as hereinbefore described with reference to the accompanying drawings.

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