

"REFRIGERATOR"

The present invention relates to a refrigerator having a refrigeration cycle wherein a refrigerant delivered from a compressor is condensed by a condenser, supplied to a cooler and recovered to the compressor and, more particularly, to a refrigerator wherein a predetermined location of the refrigerator housing is heated by utilizing heat energy of a compressed evaporated refrigerant delivered from the compressor, thereby preventing formation of moisture condensate at such a location.

In a conventional refrigerator having a refrigeration cycle, a compressed evaporated refrigerant of a high temperature which is delivered from a compressor is supplied to a cooler after the refrigerant is supplied to a condenser, radiates heat therefrom and is liquefied. The liquefied refrigerant is evaporated by the cooler, and the vapor refrigerant is recovered to the compressor. In a refrigerator of this type, condensate is often formed by cool air from a freezer or refrigeration compartment at opening edges of the freezer compartment and the refrigeration compartment. For this reason, conventionally, the formation of condensate is prevented by utilizing heat of the compressed evaporated refrigerant delivered from the compressor. In this case, in the conventional refrigerator, part of a refrigerant pipe constituting the

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condenser is bent as a moisture condensation prevention pipe along the opening edges of the freezer and refrigeration compartments. Condensate formation is prevented by heating the opening edges with the relatively high-temperature refrigerant flowing through this pipe. In addition, in order to control a flow rate of the refrigerant to the condensation prevention pipe to an optimal value, another conventional refrigerator is proposed wherein the condensation prevention pipe is connected in parallel to the main condenser pipe.

However, since a refrigerant pipe portion (i.e., a condenser pipe portion) used as the condensation prevention pipe constitutes part of the refrigerant flow path of the refrigeration cycle, it must be able to supply a predetermined amount of refrigerant to the evaporator. Thus, the condensation prevent pipe is formed of a pipe which has a large diameter (generally, an inner diameter of 4.5 mm) and cannot be easily bent. For this reason, the bending and mounting operation of the condensation prevention pipe is cumbersome. In this sense, the shape and the mounting position of the condensation prevention pipe are limited. In a conventional construction shown in Fig. 1, the condensation prevention pipe can be easily provided at the edge portion of the front side of a refrigerator housing 100. When a condensation prevention pipe 108 is mounted in a relatively narrow partition wall 106

between a freezer compartment 102 and a vegetable storage compartment 104 as a refrigeration compartment, the pipe 108 must be bent in a U shape. However, as described above, the pipe has a relatively large diameter and cannot be easily bent into a U-shaped pipe, so that it is difficult to reduce a radius of curvature of the U-shaped portion. As a result, a distance X between straight pipe portions of the U-shaped pipe 108 in the partition wall 106 must be large. Accordingly, the mounting space required for the pipe 108 is increased, and the upper and lower straight portions of the pipe 108 come too close to the upper and lower edges of the partition wall 106, respectively. It is thus difficult to heat the central portion of the partition wall 106 at optimal heat energy although the central portion is subjected to condensate formation. In addition, heat is easily conducted from the condensation prevention pipe to the internal spaces of the freezer compartment 102 and the vegetable storage compartment 104, thereby degrading the cooling efficiency of the refrigeration compartments. In other words, the larger the mounting space of the condensation prevention pipe, the larger the heat radiation area and capacity thereof. The conventional condensation prevention pipe fails to effectively heat a small space. In order to solve this problem, a flexible electrical heating wire may be used in place of the condensation prevention pipe. In this

case, however, power consumption is increased.

The present invention has been made in consideration of the above situation, and has as its object to provide a refrigerator wherein condensate formation at a relatively small space of the refrigerator can be effectively prevented with low power consumption by utilizing heat energy of a compressed vapor refrigerant delivered from a compressor, and wherein a temperature of a refrigerant flowing through a condenser is effectively decreased to increase an amount of refrigerant circulated in the path of the refrigeration cycle such that operation efficiency of a refrigeration cycle is improved, and at the same time, manufacturing efficiency can be improved.

According to

the invention, there is provided a refrigerator comprising:

a housing;

a refrigeration cycle assembly disposed in the housing, said refrigeration cycle assembly having a compressor, a condenser for condensing a refrigerant delivered from the compressor, a cooler for evaporating the condensed refrigerant and a refrigerant pipe for sequentially connecting the compressor, condenser and cooler so as to constitute a closed circuit; and

a refrigerant communication tube which has one end connected to a discharge side of the compressor and the

other end connected to the condenser, and which causes part of the refrigerant delivered from the compressor to flow therethrough, said refrigerant communication tube being made of a flexible thin pipe having an inner
5 diameter smaller than that of the refrigerant pipe and being disposed to extend in a predetermined portion of the housing to heat the predetermined portion.

According to the refrigerator having the construction described above, the refrigerant
10 communication tube has a smaller diameter than that of the refrigerant pipe, so that the communication tube can be easily worked and installed in a narrow portion of the refrigerator housing in which a conventional condensation prevention pipe cannot be mounted. For
15 this reason, the narrow portion of the housing can be heated by utilizing heat energy of the refrigerant flowing through the communication tube, thereby effectively preventing condensate formation at the narrow portion. In addition, since the communication
20 tube is flexible, it can be easily worked, thus simplifying design and manufacture of the refrigeration cycle assembly.

This invention can be more fully understood from the following detailed description when taken in
25 conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view showing part of a conventional refrigerator housing; and

Figs. 2 to 9 show a refrigerator according to an embodiment of the present invention, in which

Fig. 2 is a perspective view of a refrigerator housing,

5 Fig. 3 is a plan view schematically showing a refrigeration cycle assembly of the refrigerator,

Fig. 4 is a perspective view of the lower portion of the housing when the refrigerator is viewed from the back,

10 Figs. 5 and 6 are perspective views showing assembly states of the refrigerator housing when viewed from different directions, respectively,

Fig. 7 is a partially broken perspective view showing the lower portion of the housing,

15 Fig. 8 is a sectional view of a partition wall of the housing, and

Fig. 9 is a perspective view of the housing when viewed from the back.

20 A refrigerator according to an embodiment of the present invention will be described with reference to the accompanying drawings. As shown in Fig. 2, the refrigerator comprises a housing 10. The housing 10 has an outer case 12 and upper and lower inner cases 13 and 14 which are disposed in the outer case. A heat-
25 insulating material (not shown) is disposed between the outer case 12 and the inner cases 13 and 14 and between the inner cases 13 and 14, thereby constituting

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a heat-insulating partition wall 15 between the inner cases 13 and 14. The upper inner case 13 defines a freezer compartment 16. The lower inner case 14 is further partitioned by a partition shelf 17 and a partition portion 18, which is disposed between the right and left walls of the lower inner case 14, into an upper refrigeration compartment 19 and a vegetable storage compartment 20. Three doors (not shown) are mounted to close the freezer compartment 16, the upper refrigeration compartment 19 and the vegetable storage compartment 20, respectively.

Fig. 3 shows the piping structure of the refrigeration cycle assembly 21 disposed in the housing 10. The refrigeration cycle assembly 21 comprises a rotary compressor 22, a freezer compartment cooler 23, a refrigeration compartment cooler 24, capillary tubes 25 and 26, a drier 27 and a refrigerant path switching electromagnetic valve 28. The electromagnetic valve 28 can be switched to a position wherein the refrigerant sequentially flows in the coolers 24 and 23 in the order named or to a position the refrigerant flows in only the cooler 23 through the capillary tube 26. The refrigeration cycle assembly 21 also comprises: a tray pipe 29 for supporting an evaporation tray (not shown) which stores water drained from the coolers 23 and 24; heat radiation pipes 30 and 31 embedded in the left and right walls of the housing 10, a moisture condensation

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prevention pipe 32 embedded along the opening edge of the front side of the housing 10, and a cooling pipe 33 part of which passes through a case 22a of the compressor 22. The tray pipe 29, the heat radiation pipes 30 and 31, the condensation prevention pipe 32 and the cooling pipe 33 constitute a condenser 34. An inner diameter of the respective pipes 29, 30, 31 and 32 as the refrigerant pipes in this invention is the same (i.e., about 4.5 to 6 mm) as that of the conventional refrigerant cycle assembly. A discharge port 22b of the compressor 22 is connected to the electromagnetic valve 28 through the tray pipe 29, cooling pipe 33, heat radiation pipes 30 and 31, condensation prevention pipe 32, drier 27 and capillary tube 25 in the order named. A suction port 22c of the compressor 22 is connected to a refrigerant outlet of the cooler 23 through a suction pipe 35. Sleeves 36, 37, 38 and 39 are connected between the tray pipe 29 and the cooling pipe 33, between the cooling pipe 33 and the heat radiation pipe 30, between the heat radiation pipes 30 and 31, and between the heat radiation pipe 31 and the condensation prevention pipe 32, respectively.

The refrigeration cycle assembly 21 has refrigerant communication tubes 40 and 41 which are formed of flexible copper tubes, respectively. Each tube has an inner diameter of about 1 to 2 mm, which is less than half of the inner diameter of each pipe constituting the

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condenser 34. One end of each of the refrigerant communication tubes 40 and 41 is coupled to the heat radiation pipe 30 through the sleeve 37, and the other end of each of the tubes 40 and 41 is coupled to a discharge port 22d of the compressor 22 through a sleeve 42 and a connecting tube 43 made of the same material as the refrigerant communication tube. The tubes 40 and 41 are connected in parallel to each other between the discharge port 22d of the compressor 22 and midway along the condenser 34. The discharge port 22d is constituted by an auxiliary refrigerant filling pipe disposed in the case 22a of the compressor 22. The respective connecting portions of the compressor 22, the capillary tube 25, the drier 27, the tray pipe 29, the heat radiation pipes 30 and 31, the condensation prevention pipe 32, the cooling pipe 33, the suction pipe 35, the refrigerant communication tubes 40 and 41, the connecting tube 43 and the sleeves 36, 37, 38, 39 and 42 are located in a mechanism chamber 44 which is formed at the lower portion of the rear side of the housing 10 and houses the compressor, the tray pipe and the like, as shown in Fig. 4. The coupling between the respective predetermined units is performed entirely in the mechanism chamber 44, thus simplifying the coupling of these units.

The refrigerant communication tubes 40 and 41 can be arranged in the housing 10, as shown in Figs. 5 to 9,

and will be described with reference thereto.

The refrigerant communication tube 40 extends up to the partition portion 18 (Fig. 2) of the housing 10 so as to heat the front surface of the partition portion 18 and will be described in detail hereinafter. As shown in Figs. 5 and 6, the tube 40 is temporarily fixed by an adhesive tape 45 on an inner surface 12a of the left wall of the outer case 12 before the inner case 14 is inserted in the outer case 12. In this case, the tube 40 is bent in half and has a small loop 40a at its distal end, so that a straight portion 40b comes close to and is parallel to a straight portion 40c. When the tube 40 is temporarily fixed, the distal end portion including the small loop 40a extends outside the outer case 12 through a notch 12c formed in a flange 12b of the outer case. An extended portion of the tube 40 is bent in the forward direction or the left direction of the housing 10 so as not to interfere with insertion of the inner case 14 into the outer case 12, as indicated by the alternate long and two short dashed line in Fig. 6. A notch 14b is formed in a flange 14a of the inner case 14, which engages with the flange 12b of the outer case 12, to allow the tube 40 to protrude through the notch 14b. The extended portion of the tube 40 is bent along the inner surface of the inner case 14 after the inner case 14 is inserted in the outer case 12, as shown in Fig. 6. The tube 40 is then temporarily held



in this state by adhesive tape 46. The communication tube 41 is disposed in the outer case 12 in a manner described later while the tube 40 is temporarily held as described above. In addition, after the heat radiation pipes 30 and 31 and the condensation prevention pipe 32 are arranged in predetermined positions, a foam material is filled between the outer case 12 and the inner cases 13 and 14. Thereafter, the extended portion of the tube 40 is straightened forward.

As shown in Fig. 2, the partition portion 18 of the housing 10 extends horizontally between the vertical right and left walls of the housing after the foam material is filled. As shown in Fig. 7, when the partition portion 18 is mounted in the housing 10, a frame 18a having an opened front is mounted between the right and left walls of the inner cases 14. A heat-insulating material 18b such as a foamed styrol of relatively high rigidity is deposited in the frame 18a. After the frame 18a is mounted, the extended portion of the tube 40 is bent again along the front surface of the frame 18a at the central portion thereof. The bent portion is then temporarily fixed by adhesive tape 47. Thereafter, an aluminum film 18c is fixed on the front surface of the heat-insulating material 18b so as to cover the tube 40. In addition, a metal partition plate 18e is fixed on the aluminum film 18c through an elastic spacer such as a synthetic resin spacer 18d. In this

way, the partition portion 18 having the frame 18a, the heat-insulating material 18b, the aluminum film 18c, the spacer 18d and the partition plate 18e is mounted in the housing 10. In this case, as shown in Fig. 8, the

5 aluminum film 18c and the spacer 18d are deformed in accordance with the shape of the tube 40, so that the tube 40 is clamped by the elastic force of the spacer 18d between the heat-insulating material 18b and the partition plate 18e. Heat from the tube 40 can be

10 properly conducted to the partition plate 18e through the aluminum film 18c and the spacer 18d. The right end portion of the partition plate 18e is screwed with a hinge support metal piece 48 of the housing 10 while a pawl 18f formed at the left end of the partition plate

15 18e is engaged with the flange 12b of the outer case 12.

The tube 41 is disposed in the housing 10, as shown in Fig. 9. Referring to Fig. 9, reference numeral 49 denotes a storage box formed in the rear surface of the housing 10 and holding the electromagnetic valve 28; and

20 numeral 50 denotes a storage box formed in the rear surface of the housing 10 and holding a fan motor 51 for circulating air in the freezer compartment 16. The tube 41 extends upward from the sleeve 42 along the inner surface of the rear wall of the outer case 12. The tube

25 41 further extends through the storage boxes 49 and 50 and then downward again along the inner surface of the rear wall of the outer case 12. The tube 41 is then

coupled to the sleeve 37.

The operation of the refrigerator having the arrangement described above will now be described.

When the rotary compressor 22 is driven, that is,
5 when the refrigeration cycle assembly 21 is operated, a compressed vapor refrigerant of a high temperature which is delivered from the discharge port 22b of the compressor is supplied to the condenser 34 and radiates heat therein, so that the refrigerant is liquefied and
10 is then supplied to the capillary tube 14 through the drier 27. The refrigerant is supplied to both the freezer compartment cooler 24 and the refrigeration compartment cooler 23 or only the cooler 23 in accordance with the selected position of the
15 electromagnetic valve 28. The refrigerant is then evaporated in the cooler or coolers to absorb ambient heat. Thereafter, the refrigerant is recovered to the rotary compressor 22 through the suction port 22c via the suction pipe 35. The above cycle is repeated to
20 cool the freezer compartment 16, the refrigeration compartment 19 and the vegetable storage compartment 20. In this case, when the refrigerant flows through the tray pipe 29 constituting part of the condenser 34, heat from the refrigerant is conducted to water in the
25 evaporation tray (not shown) supported on the tray pipe 29 so as to evaporate water. When the refrigerant flows through the cooling pipe 33 of the condenser 34, the

inner space of the rotary compressor 22 is cooled (an internal temperature of the rotary compressor is relatively higher than that of the cooling pipe 33). When the refrigerant flows through the condensation prevention pipe 32 of the condenser 34, the opening edge of the outer case 12 is heated by heat from the refrigerant, thereby preventing formation of condensate at the opening edge of the outer case 12. During the operation of the refrigeration cycle assembly 21, the compressed vapor refrigerant delivered from the discharge port 22d of the compressor 22 flows in the tubes 40 and 41 through the connecting pipe 43 and the sleeve 42 and returns to the heat radiation pipe 30 located midway in the condenser 34. As a result, the vapor refrigerant which has a relatively high temperature and which flows through the tube 40 heats the partition plate 18e of the partition portion 18, thereby preventing condensate formation at the partition portion 18. The storage box 49 and hence the electromagnetic valve 28 in the box are heated by the evaporated refrigerant which has a relatively high temperature and which flows through the tube 41. Thereafter, the fan motor 51 in the storage box 50 is cooled (a temperature of the fan motor is relatively higher than that of the refrigerant flowing through the tube 41) by the refrigerant flowing through the tube 41. Therefore, condensate formation at the electromagnetic

valve 28 and overheating of the fan motor 51 are prevented. The downstream end portions of the tubes 40 and 41 are connected to an intermediate portion of the condenser 34. In this intermediate portion, the refrigerant flowing through the condenser 34 is not entirely liquefied. For this reason, the flow of the evaporated refrigerant in the tubes 40 and 41 will not be prevented by the refrigerant flowing through the condenser 34. Furthermore, the evaporated refrigerant in the thin tubes 40 and 41 is liquefied in the vicinity of the outlet ports thereof, and the temperature of the refrigerant at the outlet ports is relatively low. Therefore, the refrigerant flowing through the tubes 40 and 41 cools the refrigerant in the condenser at a portion where these refrigerants merge. As a result, pressure in the condenser 34 is reduced to improve the compressor operation efficiency, and an amount of refrigerant circulated in the circuit increases, thereby improving cooling efficiency in the cooler.

According to this embodiment, various effects are obtained as described below. The communication tubes 40 and 41 arranged to prevent condensate formation on the partition plate 18e of the partition portion 18 and the electromagnetic valve 28 are formed of thin flexible tubes each having an inner diameter of about 1 to 2 mm. For this reason, the tubes 40 and 41 can be easily and also manually bent, so that equipment for bending the

tubes 40 and 41 can be made smaller and simplified. At the same time, machining and assembly can be simplified to improve the manufacturing efficiency, thereby decreasing the manufacturing cost of the refrigerator.

5 As is apparent from the above, since the tubes 40 and 41 can be easily bent, their shape is not limited, as in the conventional refrigerator. The tubes 40 and 41 have a small inner diameter and require a small installation space, so that effective heating can be achieved with a
10 small space. As shown in Figs. 7 and 8, the tube 40 can be located at the central portion (i.e., a portion mostly affected by condensate formation) of the partition plate 18e of the partition portion 18. Further, in this case, the tube 40 is arranged parallel
15 to the condenser 34, so that heat generated from the tube 40 can be adjusted in a wide range by changing a diameter and a length of the tube 40 without adversely affecting the refrigeration cycle assembly 21. Accordingly, it is easy to set the heating capacity of
20 the tube 40 in such a manner that the central portion of the partition plate 18a is heated with an optimal thermal capacity for preventing condensate formation on the partition plate 18e. As a result, heat will not be excessively conducted from the tube 40 and hence from
25 the partition portion 18 to the refrigeration compartment 9 and the vegetable storage compartment 10, thereby preventing the degradation of cooling

efficiency, unlike the conventional refrigerator. The tube 41 can also be easily and effectively disposed in a relatively narrow space such as the storage boxes 49 and 50. The inner diameter of each of the tubes 40 and 41 is less than half of the condenser pipe in the conventional refrigeration cycle assembly. Therefore, the amount of refrigerant flowing through the tubes 40 and 41 is very small, so that the condenser capacity can be designed without consideration of the capacity of the tubes 40 and 41. When the pipe having the inner diameter of 4.5 mm or more is used as a condensation prevention pipe as in the conventional manner and is connected in parallel to the condenser, the length of the refrigerant pipe constituting the condenser must be designed in consideration of the length of the condensation prevention pipe so as to balance the condenser as a whole. However, according to this embodiment wherein the tubes 40 and 41 are embedded in the partition wall or the like, the length of the refrigerant pipe constituting the condenser need not be changed. As a result, a common refrigeration cycle assembly can be designed for different types of refrigerators. The compressed vapor refrigerant delivered from the discharge port 22d of the rotary compressor 22 radiates heat to decrease its temperature while flowing through the tubes 40 and 41, and then returns to the intermediate portion of the condenser 34.

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Thus, the temperature of the refrigerant flowing through the condenser 34 is decreased to reduce a load of the rotary compressor 22, thereby improving the operation efficiency of the refrigeration cycle assembly 21 and thus lowering power consumption. In addition, since the electrical heater wire need not be used to prevent condensate formation, power consumption is further decreased. Furthermore, in this embodiment, as described previously, the rotary compressor 22, the capillary tube 25, the drier 27, the tray pipe 29, the heat radiation pipes 30 and 31, the condensation prevention pipe 32, the cooling pipe 33, and the refrigerant communication tubes 40 and 41 are coupled within the mechanism chamber 44, so that the coupling operation can be simplified and productivity in the manufacture of the refrigerators can be thus improved. In this case, since the tubes 40 and 41 are made of thin flexible tubes, respectively, the installation space in the mechanism chamber 44 can be reduced, and noise caused by vibration of the tubes 40 and 41 can be reduced.

When the heat-insulating material is filled between the outer case 12 and the inner cases 13 and 14, since a holding jig is inserted in the inner case 14 to prevent its deformation, the tube 40 interferes with the holding jig. Therefore, the tube 40 is temporarily held along the inner surface of the inner case 14, as shown in Fig. 6. In this case, the tube 40 has a small inner



diameter, so that it will not substantially interfere with the holding jig, and the holding jig need not be modified. Therefore, productivity in the manufacture of refrigerators can be improved. Even in the example
5 shown in Fig. 1, the condensation prevention pipe 108 is bent in the same manner as the tube 40 of this embodiment when the heat-insulating foam material is filled. However, the pipe 108, having a relatively large diameter, interferes with the holding jig of the
10 inner case, so that a recess for pipe 108 must be formed in the holding jig. In addition to the above circumstances, since the pipe 108 is difficult to bend, productivity in the manufacture of conventional refrigerators is degraded.

15 The present invention is not limited to the above embodiment. Various changes and modifications may be made within the spirit and scope of the invention.

For example, another refrigerant communication tube may be arranged in parallel to the refrigerant
20 communication tubes 40 and 41. In this case, the additional refrigerant communication tube is disposed to extend along the heat-insulating partition wall 15 between the freezer compartment 16 and the refrigeration compartment 19, thereby preventing the condensate from
25 being formed on the partition wall 15. In addition, part of the condensation prevention pipe 32 may extend along the partition wall 15.

Claims:

1. A refrigerator comprising:

a housing;

a refrigeration cycle assembly disposed in the
5 housing, said refrigeration cycle assembly having a
compressor, a condenser for condensing a refrigerant
delivered from the compressor, a cooler for evaporating
the condensed refrigerant and a refrigerant pipe for
sequentially connecting the compressor, the condenser
10 and the cooler to constitute a closed circuit; and

a refrigerant communication tube which has one end
connected to a delivery end of the compressor and the
other end connected to the condenser, and which causes
part of the refrigerant delivered from the compressor to
15 flow therethrough, said refrigerant communication tube
being made of a flexible pipe having an inner diameter
smaller than that of the refrigerant pipe and being
disposed to extend at a predetermined portion of the
housing to heat the predetermined portion.

20 2. A refrigerator according to claim 1, wherein
said condenser is constituted by bending part of the
refrigerant pipe, and said refrigerant communication
tube has an inner diameter of not more than about half
that of said refrigerant pipe.

25 3. A refrigerator according to claim 2, wherein
the inner diameter of said refrigerant communication
tube is not more than about 2 mm.



4. A refrigerator according to claim 1, wherein the other end of said refrigerant communication tube is connected to a condenser at a point intermediate its ends.

5. A refrigerator according to claim 1, wherein said housing includes an outer case, an inner case mounted in the outer case, a heat-insulating material filled between the outer and inner cases, a partition shelf disposed in the inner case and a partition portion stretched between front edges of the inner case, said partition shelf and said partition portion partitioning an inner space of the inner case into a first refrigeration compartment and a second refrigeration compartment, and said refrigerant communication tube extends along the partition portion.

6. A refrigerator according to claim 5, wherein said refrigerant communication tube extends along said partition portion with being bent in a substantially U-shape.

7. A refrigerator according to claim 6, wherein said partition portion includes a frame which extends to the front edge of the inner case and open at a front side thereof; a heat-insulating material disposed in the frame, said refrigerant communication tube being fixed on the front surface of heat-insulating material in the frame; an aluminum film fixed on a front



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surface of the heat-insulating material so as to cover the refrigerant communication tube; a spacer made of an elastic material and fixed on the aluminum film; and a partition plate mounted on said frame to cover the
5 spacer.

8. A refrigerator according to claim 1, wherein said housing has a storage chamber which is open outside the housing, said compressor being disposed in the storage chamber, and the connecting portions of elements
10 of said refrigeration cycle assembly and of said refrigerant communication tube are located in the storage chamber.

9. A refrigerator according to claim 1, which further comprises another refrigerant communication tube
15 which has one end connected to the delivery end of the compressor and the other end connected to the condenser, and through which part of the refrigerant delivered from the compressor flows, said another refrigerant communication tube being made of a flexible thin pipe
20 having a smaller inner diameter than that of the refrigerant pipe, and extending to a predetermined portion to heat the predetermined portion.

10. A refrigerator, substantially as hereinbefore described with reference to Figs. 2 to 9 of the
25 accompanying drawings.

