

[Name of Document] DESCRIPTION

[Title of Invention] REFRIGERATOR-FREEZER

[Technical Field]

[0001]

5 The present invention relates to a refrigerator-freezer including a condenser at a bottom portion of a refrigerator-freezer body.

[Background Art]

[0002]

10 Existing refrigerator-freezers generally have a structure in which a machine compartment, where a compressor and a fan are disposed, is disposed at a back bottom portion of a refrigerator-freezer body; a condenser is disposed at a back portion of the refrigerator-freezer body; and air is taken in from a front bottom portion of the refrigerator-freezer body, is sent to the condenser, and is discharged from the back of the machine compartment.

15 [0003]

 As a typical example of a refrigerator-freezer, the following refrigerator-freezer exists (refer to, for example, Patent Literature 1). The refrigerator-freezer includes a duct and a plate-type condenser. The duct guides air that has flowed in from an air inlet into a machine compartment via an air inflow port. The air inlet faces the front of
20 a refrigerator-freezer body. The plate-type condenser is provided horizontally in the duct so as to partition an upper portion and a lower portion of the interior of the duct.

 A plurality of vent holes are provided in a plate of the plate-type condenser. The air inlet is provided at the front of a lower space of the duct that is partitioned by the plate condenser. Further, the back of an upper space of the duct is connected to
25 the air inflow port of the machine compartment. This allows air from the air inflow port to be discharged from the back of the machine compartment, provided at the back bottom portion of the refrigerator-freezer body, leading to enhancement cooling effect of the plate-type condenser.

[Citation List]

30 [Patent Literature]

[0004]

[Patent Literature 1] Japanese Unexamined Patent Application Publication No. 7-270036 (page 3, Fig. 1)

[Summary of Invention]

5 [Technical Problem]

[0005]

In the above-described existing refrigerator-freezer, an air outlet is provided at the back of the machine compartment of the refrigerator-freezer body. Therefore, if air circulation is reduced when, depending upon setting conditions and setting periods of the refrigerator-freezer body, a gap between the air outlet and a wall is narrow or is closed by dust, it becomes difficult to secure a condensation amount in accordance with the operation of the refrigerator-freezer body, leading to deterioration of cooling capability of the refrigerator-freezer body.

[0006]

15 In addition, in the plate-type condenser disposed at the bottom portion of the refrigerator-freezer, the area that is capable of transferring heat is highly dependent upon the plate width. Therefore, when air circulation is reduced, it becomes difficult to increase the condensation amount.

[0007]

20 The present invention is carried out to solve problems such as those described above, and has as its object the provision of a refrigerator-freezer that is not restricted by setting of a refrigerator-freezer body and that can improve heat-transfer efficiency of a condenser.

[Solution to Problem]

25 [0008]

A refrigerator-freezer according to the present invention includes a machine compartment, a duct, and a condenser. The machine compartment is formed in a compartment at a back bottom portion of a refrigerator-freezer body, and includes at least a compressor and a fan provided in an interior thereof. The duct is disposed at a bottom portion of the refrigerator-freezer body and in an area in front of the machine

compartment. The condenser is provided in the duct. The duct includes an air inlet that is provided at a front side of the refrigerator-freezer body; an air inflow path that connects the air inlet and an air inflow port provided at the machine compartment, and is provided with the condenser; an air outlet that is provided at the front side of the refrigerator-freezer body so as to be adjacent to the air inlet; and an air outflow path that connects the air outlet and an air outflow port provided at the machine compartment.

[Advantageous Effects of Invention]

[0009]

According to the present invention, since the air inlet and the air outlet of the duct are positioned at the front side of the refrigerator-freezer body, it is possible to easily set the refrigerator-freezer body without being influenced by setting conditions of the refrigerator-freezer that differ depending upon the user. In addition, even if air circulation is considerably reduced due to adhesion of dust to the air inlet or the air outlet, the refrigerator-freezer body can be easily cleaned without moving thereof. Consequently, it is possible to maintain air circulation in an optimal state, maintain an initial heat transfer amount over a long period of time, and improve cooling capability of the refrigerator-freezer body.

[Brief Description of Drawings]

[0010]

[Fig. 1] Fig. 1 is a front view of a refrigerator-freezer according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a side sectional view of the refrigerator-freezer according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a front view of the interior of a machine compartment provided at a back bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a side sectional view of a duct that is disposed at a bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention, and

the machine compartment that is disposed at the back bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 is an exploded perspective view of the duct of the refrigerator-freezer according to Embodiment 1 of the present invention.

5 [Fig. 6] Fig. 6 is a top plan view of the interior of the duct and the interior of the machine compartment of the refrigerator-freezer according to Embodiment 1 of the present invention.

[Fig. 7] Fig. 7 is a perspective view of a lower cover of a duct of a refrigerator-freezer according to Embodiment 2 of the present invention.

10 [Fig. 8] Fig. 8 is a side sectional view of the duct that is disposed at a bottom portion of the refrigerator-freezer according to Embodiment 2 of the present invention, and a machine compartment that is disposed at a back bottom portion of the refrigerator-freezer according to Embodiment 2 of the present invention.

15 [Fig. 9] Fig. 9 illustrates temperature contours in the duct of the refrigerator-freezer according to Embodiment 2 of the present invention.

[Description of Embodiments]

[0011]

Embodiment 1

20 Fig. 1 is a front view of a refrigerator-freezer according to Embodiment 1 of the present invention. Fig. 2 is a side sectional view of the refrigerator-freezer according to Embodiment 1 of the present invention. Fig. 3 is a front view of the interior of a machine compartment provided at a back bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention.

25 As shown in Figs. 1 to 3, a refrigerator-freezer body 12 is formed so that a space between an outer box and an inner box is filled with a heat insulator, such as urethane foam. A plurality of storage compartments each having an open front are formed in the refrigerator-freezer body 12 by partition walls that are integrally formed with the refrigerator-freezer body 12. For example, a refrigerator compartment 1 is provided at a topmost portion of the refrigerator-freezer body 12, and an ice
30 compartment 2 and a switching compartment 3 that is capable of controlling

temperature at a temperature of 0 degrees Centigrade or less are provided below the refrigerator compartment 1 so as to be adjacent to each other. A vegetable compartment 5 is provided at a bottommost portion of the refrigerator-freezer body 12, and a freezer compartment 4 is provided above the vegetable compartment 5.

5 Although not shown, when a feed water tank containing water is set in the refrigerator compartment 1, the ice compartment 2 automatically makes ice, and causes ice to accumulate in an ice storage container that is removably provided therein.

[0012]

Each storage compartment is provided with a door for covering and uncovering
10 the front opening thereof. Refrigerator compartment doors 6 and 7 are a double-door type in which the refrigerator compartment doors 6 and 7 are rotatably supported by upper and lower hinges that are provided at corresponding sides of the refrigerator compartment 1. An ice compartment door 8 and a switching compartment door 9, and a freezer compartment door 10 and a vegetable compartment door 11 are
15 drawer-type doors. Along with a container having an open top, each door is provided so as to be capable of being drawn in and drawn out with respect to the storage compartment. Although the refrigerator compartment doors 6 and 7 are a double-door type, they may be a single-door type.

[0013]

20 A machine compartment 19 that is formed in a compartment at the back bottom portion of the refrigerator-freezer body 12. A cooling compartment 14, where, for example, a fan 13 and a cooling unit 14a are disposed, is provided behind the freezer compartment 4. The fan 13 forcefully blows cool air that has been cooled by the cooling unit 14a into each storage compartment. As shown in Figs. 2 and 3, for
25 example, a compressor 15, a machine-compartment condenser 16, a machine-compartment fan 17, and a capillary tube 18 are disposed in the machine compartment 19.

[0014]

For example, the aforementioned compressor 15, a wire-type condenser
30 (described below), a machine-compartment condenser 16, the capillary tube 18, and

the cooling unit 14a constitute a refrigerating cycle device of the refrigerator-freezer body 12. A high-temperature high-pressure gas refrigerant that has been compressed by the compressor 15 is condensed by the wire-type condenser and the machine-compartment condenser 16, and becomes an ordinary-temperature high-pressure liquid refrigerant. This liquid refrigerant becomes a low-temperature low-pressure liquid refrigerant by the capillary tube 18, and flows into the cooling unit 14a. The low-temperature low-pressure liquid refrigerant that has flown into the cooling unit 14a is evaporated at the cooling unit 14a. By removal of heat during the evaporation, the surrounding of the cooling unit 14a is cooled. The low-temperature low-pressure gas refrigerant that has passed through the cooling unit 14a returns to the compressor 15 and is compressed again. Meanwhile, the machine-compartment fan 17, though described below, cools the interior of the machine compartment 19, and the fan 13 in the cooling compartment 14 forcefully blows cool air that has been cooled by the cooling unit 14a into each storage compartment as mentioned above.

[0015]

Next, using Figs. 4, 5, and 6, the structure of a duct that is disposed at the bottom portion of the refrigerator-freezer so as to be situated in front of the machine compartment, and heat transfer of the wire-type condenser that is provided at the duct are described.

Fig. 4 is a side sectional view of the duct that is disposed at the bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention, and the machine compartment that is disposed at the back bottom portion of the refrigerator-freezer according to Embodiment 1 of the present invention. Fig. 5 is an exploded perspective view of the duct of the refrigerator-freezer according to Embodiment 1 of the present invention. Fig. 6 is a top plan view of the interior of the duct and the interior of the machine compartment of the refrigerator-freezer according to Embodiment 1 of the present invention.

[0016]

As shown in Fig. 4, the duct 25 is disposed at the bottom portion of the refrigerator-freezer so as to be situated in front of the machine compartment. More

specifically, the duct 25 is disposed in a space between the bottom portion of the refrigerator-freezer body 12 and the floor, is connected to the machine compartment 19, and is mounted to the bottom portion of the refrigerator-freezer body 12.

[0017]

5 As shown in Fig. 5, the duct 25 includes an upper cover 26 and a lower cover 27. As shown in Figs. 5 and 6, the lower cover 27 of the duct 25 is provided with a rib 27a extending from front to back so as to be situated on the right of the refrigerator-freezer body 12 as viewed from the front of the refrigerator-freezer body 12. The rib 27a allows the duct 25 to have an air inlet 21 on the left and an air outlet 22 on the
10 right. The width of the air outlet 22 is less than the width of the air inlet 21.

[0018]

 In addition, the rib 27a allows an air inflow path 23 and an air outflow path 24 to be formed in the duct 25. The air inflow path 23 also serves as a space where the wire-type condenser 20 is set, and connects the air inlet 21 and an air inflow port 19a
15 to each other. The air inflow port 19a is provided at the machine compartment 19. The air outflow path 24 connects the air outlet 22 and an air outflow port 19b to each other. The air outflow port 19b is provided at the machine compartment 19. The wire-type condenser 20 that is set in the air inflow path 23 is disposed so that each wire (wire fin) is orthogonal to a direction in which air flows through the air inflow path 23.
20 This arrangement causes a heat transfer coefficient to be improved. By mounting the upper cover 26 to the lower cover 27, the air inflow path 23 and the air outflow path 24 are separated from each other. Therefore, it is possible to suppress flowing around of air flowing through the air inflow path 23 and the air outflow path 24. Further, by mounting the upper cover 26 to the lower cover 27, transportability is
25 improved, so that it is possible to prevent the wire-type condenser 20 from being scratched.

[0019]

 Next, the flow of air that is taken in by the duct 25 is described with reference to Fig. 6.

When the machine-compartment fan 17 is operated, air is taken in from the air inlet 21 of the duct 25. The air that has been taken in by the air inlet 21 flows through the air inflow path 23, and flows into the air inflow port 19a of the machine compartment 19 while heat exchange is performed with the wire-type condenser 20.

5 A high-temperature high-pressure gas refrigerant that flows through the wire-type condenser 20 is condensed by the airflow in the air inflow path 23, and becomes an ordinary-temperature high-pressure liquid refrigerant.

[0020]

10 The air that has flowed into the air inflow port 19a of the machine compartment 19 is circulated in the machine compartment 19 by the machine-compartment fan 17, and cools the compressor 15 and the machine-compartment condenser 16, after which the air flows out from the air outflow port 19b to the air outflow path 24 of the duct 25. The air that has flowed through the air outflow path 24 is discharged to the outside from the air outlet 22.

15 [0021]

As described above, in Embodiment 1, the duct 25 is provided at the bottom portion of the refrigerator-freezer body 12 so as to be situated in front of the machine compartment and so that the air inlet 21 and the air outlet 22 face the front side of the refrigerator-freezer body 12. This causes air to be taken into the duct 25 from the air inlet 21 that is positioned at a front bottom portion of the refrigerator-freezer body 12. Then, after heat exchange with the wire-type condenser 20, the air that has been taken in flows into the duct 25 via the machine compartment 19, and is discharged to the outside from the air outlet 22 that is adjacent to the air inlet 21. Accordingly, since the air inlet 21 and the air outlet 22 are positioned at the front bottom portion of the refrigerator-freezer body 12, it is possible to easily set the refrigerator-freezer body 12 without being influenced by setting conditions of the refrigerator-freezer body 12 that differ depending upon the user.

[0022]

30 The air inlet 21 and the air outlet 22 face the front side of the refrigerator-freezer body 12. Therefore, even if air circulation is considerably reduced due to

adhesion of dust to the air inlet 21 and the air outlet 22, the refrigerator-freezer body 12 can be easily cleaned without moving thereof. Consequently, it is possible to maintain air circulation in an optimal state, maintain an initial heat transfer amount over a long period of time, and improve cooling capability of the refrigerator-freezer body 12. Further, since a reduction in air circulation capability in the duct 25 can be suppressed, it is possible to reduce power consumption of the refrigerator-freezer body 12.

[0023]

Since the condenser that is disposed at the bottom portion of the refrigerator-freezer body 12 is a wire-type condenser, it is possible to provide a larger heat transfer area than that of a plate-type without providing a vent hole and a cut-and-raised portion that are required in the plate-type. In addition, although, in a plate-type condenser, a vent hole and a cut-and-raised portion are provided for increasing heat exchange efficiency and the area allowing heat exchange by disturbing air flow, each wire of the wire-type condenser 20 can perform these functions. Therefore, it is possible to manufacture wire-type condensers with high productivity.

[0024]

In Embodiment 1, air circulation capability is improved by positioning the air inlet 21 and the air outlet 22 of the duct 25 at the front side of the refrigerator-freezer body 12. However, it is possible to further improve air circulation capability by providing, in addition to the air outlet 22, a side air outlet (not shown) at, of two machine-compartment-19-side side surfaces of the refrigerator-freezer body 12, the side surface at an air-sending side of the machine-compartment fan 17.

[0025]

Embodiment 2

In Embodiment 2, in addition to the air inlet 21 of the duct 25, lower air inlets are provided in the lower cover 27 of the duct 25.

Fig. 7 is a perspective view of the lower cover of the duct of a refrigerator-freezer according to Embodiment 2 of the present invention. Fig. 8 is a side sectional view of the duct that is disposed at a bottom portion of the refrigerator-freezer

according to Embodiment 2 of the present invention, and a machine compartment that is disposed at a back bottom portion of the refrigerator-freezer according to Embodiment 2 of the present invention. Fig. 9 illustrates temperature contours in the duct of the refrigerator-freezer according to Embodiment 2 of the present invention. Portions corresponding to those in Embodiment 1 are given the same reference numerals.

[0026]

As shown in Fig. 7, the lower air inlets 28 are provided in a bottom portion of the lower cover 27 so as to be situated in an air inflow path 23. The lower air inlets 28 are formed in the form of slits that extend in a direction that is orthogonal to the direction in which air flows through the air inflow path 23. As in Embodiment 1, a wire-type condenser 20 that is set in the air inflow path 23 is disposed so that each wire is orthogonal to the direction in which air flows through the air inflow path 23.

[0027]

As shown in Fig. 8, when a machine-compartment fan 17 operates, the duct 25 according to Embodiment 2 takes in air from an air inlet 21 of the duct 25 and takes in air in between the refrigerator-freezer body 12 and the floor from the lower air inlets 28. The air that has been taken in from the air inlet 21 merges with the air from the lower air inlets 28, and flows into an air inflow port 19a of the machine compartment 19. A front edge of the wire-type condenser 20 is subjected to heat exchange with the air that has been taken in from the air inlet 21, and a portion beyond the center of the wire-type condenser 20 is subjected to heat exchange with this air and the air from the lower air inlets 28.

[0028]

Next, temperature contours in the duct 25 are compared with those of Embodiment 1, and explained.

The wire-type condenser 20 that is set in the air inflow path 23 of the duct 25 has a shape extending towards the back. Therefore, in Embodiment 1, as shown in Fig. 9(a), the air that has flowed in has a higher temperature at a portion thereof that

is beyond the center of the wire-type condenser 20. This is highly dependent upon the heat transfer amount at the front edge.

[0029]

In contrast, in Embodiment 2, by providing the lower air inlets 28 (slits) in the lower cover 27, as shown in Fig. 9(b), the ambient temperature of the wire-type condenser 20 becomes substantially uniformly low, and the effective area of heat exchange of the wire-type condenser 20 is increased.

[0030]

As described above, by providing slits in the lower cover 27 of the duct 25, it is possible to also take in air from below the wire-type condenser 20. Therefore, as mentioned above, the ambient temperature of the wire-type condenser 20 becomes substantially uniformly low, and the effective area of heat exchange of the wire-type condenser 20 is increased. In addition, by providing slits in the lower cover 27, it is possible to easily set the refrigerator-freezer body 12 without being influenced by setting conditions of the refrigerator-freezer body 12, and to further increase durability with respect to dust. Further, since reduction in air circulation capability in the duct 25 can be suppressed, it is possible to reduce power consumption of the refrigerator-freezer body 12.

[0031]

In Embodiment 2, air circulation capability is improved by positioning the air inlet 21 and the air outlet 22 of the duct 25 at the front side of the refrigerator-freezer body 12, and by providing the lower air inlets 28 (slits) in the bottom portion of the lower cover 27 so as to be situated in the air inflow path 23. However, it is possible to further improve air circulation capability by providing, in addition to the air outlet 22, a side air outlet (not shown) at, of two machine-compartment-19-side side surfaces of the refrigerator-freezer body 12, the side surface at an air-sending side of the machine-compartment fan 17.

[0032]

Although, in Embodiments 1 and 2, the wire-type condenser 20 is set in the duct 25, a fin-and-tube type condenser may be set in the duct 25 instead. In this

case, the fin-and-tube type condenser is disposed in the air inflow path 23 so that each fin is orthogonal to the direction in which air flows through the air inflow path 23. Heat exchanger effectiveness of the fin-and-tube type condenser is greater than that of the wire-type condenser 20. Therefore, it is possible to reduce power consumption of the refrigerator-freezer.

[Reference Signs List]

[0033]

1: refrigerator compartment, 2: ice compartment, 3: switching compartment, 4: freezer compartment, 5: vegetable compartment, 6, 7: refrigerator compartment doors of a double-door type, 8: ice compartment door, 9: switching compartment door, 10: freezer compartment door, 11: vegetable compartment door, 12: refrigerator-freezer body, 13: fan, 14: cooling compartment, 14a: cooling unit, 15: compressor, 16: machine-compartment condenser, 17: machine-compartment fan, 18: capillary tube, 19: machine compartment, 19a: air inflow port, 19b: air outflow port, 20: wire-type condenser, 21: air inlet, 22: air outlet, 23: air inflow path, 24: air outflow path, 25: duct, 26: upper cover, 27: lower cover, 27a: rib, 28: lower air inlet (slit)

CLAIMS

[Claim 1]

A refrigerator-freezer comprising:

a machine compartment with an air inflow port and an air outflow port formed
5 on a front side, the machine compartment is formed in a compartment at a back
bottom portion of a refrigerator-freezer body, and the machine compartment
including at least a compressor and a fan provided in an interior thereof;

a duct that is disposed at an area formed between a bottom portion of the
refrigerator-freezer body and a floor and in an area in front of the machine
10 compartment; and

a condenser that is provided in the duct,
wherein the duct includes

an air inlet that is provided at a front side of the refrigerator-freezer body,
an air inflow path that connects the air inlet to the air inflow port

15 of the machine compartment, and is provided with the condenser,

an air outlet that is provided at the front side of the refrigerator-freezer
body so as to be adjacent to the air inlet, and

an air outflow path that connects the air outlet to the air outflow port
of the machine compartment.

20 [Claim 2]

The refrigerator-freezer of claim 1, wherein a plurality of lower air inlets for
taking in air from the floor are provided in a bottom portion of the duct so as to be
situated in the air inflow path.

[Claim 3]

25 The refrigerator-freezer of claim 2, wherein the lower air inlets are slits that
extend in a direction that is orthogonal to a direction in which air flows through the air
inflow path.

[Claim 4]

The refrigerator-freezer of any one of claims 1 to 3, wherein a side air outlet is
30 provided at a side surface being in an air-sending direction of the fan, of two side
surfaces of the refrigerator-freezer body corresponding to the machine compartment.

[Claim 5]

The refrigerator-freezer of any one of claims 1 to 4, wherein the air inflow path and the air outflow path are formed by a rib that is provided in the duct.

[Claim 6]

5 The refrigerator-freezer of any one of claims 1 to 5, wherein the condenser is a wire-type condenser, and is disposed so that each wire is orthogonal to a direction in which air flows through the air inflow path.

[Claim 7]

10 The refrigerator-freezer of any one of claims 1 to 5, wherein the condenser is a fin-and-tube type condenser and is disposed so that each fin is orthogonal to a direction in which air flows through the air inflow path.