

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

5 [0001]

The present invention relates to a refrigerator.

Background Art

[0002]

10 A conventional refrigerator has been known, which includes a refrigeration cycle and is configured to supply the air cooled in the refrigeration cycle to a storage chamber. The conventional refrigerator includes a machine chamber on the lower back side in a casing thereof, for example. In this machine chamber, a condenser as a component of the refrigeration cycle and a blower configured to blow air to the condenser are arranged. The machine chamber further houses a component(s)
15 other than the condenser and the blower. For example, a compressor as a component of the refrigeration cycle may be disposed in the machine chamber, and is cooled by the air blown by the blower. As another example, in the case of providing the machine chamber at the lower portion of the casing, a drain pan configured to store drain water discharged from the storage chamber may be disposed in the
20 machine chamber.

[0003]

For the conventional refrigerator configured as described above, a condenser (e.g., a fin-tube heat exchanger) formed in an I-shape as viewed in the horizontal cross-section thereof (when a horizontal cross section thereof is viewed from the
25 above) is used, for example. Such a condenser is, in the vicinity of a side surface portion of the machine chamber formed with a suction port, disposed parallel to the side surface portion.

Moreover, a refrigerator having the following configuration has been proposed as the conventional refrigerator configured as described above: a condenser formed
30 in an L-shape as viewed in the horizontal cross-section thereof is used, the

condenser is disposed parallel to a side surface portion and a planar portion of a machine chamber, and a suction port is formed to face the condenser at the side and planar portions of the machine chamber (see Patent Literature 1).

Citation List

5 Patent Literature

[0004]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2002-333259

Summary of Invention

10 Technical Problem

[0005]

In the above-described refrigerator configured such that the condenser is placed in the machine chamber condensing the refrigeration in the condenser affects improvement of energy saving performance. That is, for improvement of the energy saving performance in the refrigerator, the condensation performance (the heat exchange capacity) of the condenser needs to be improved. Thus, it is required that a certain volume of air flowing in the machine chamber is ensured and that much air contacts the condenser. However, since the compressor, the drain pan, etc. are arranged in the machine chamber as described above, it is difficult to secure a large area for an air path in the machine chamber. For this reason, to improve the condensation performance of the condenser, the heat dissipation area of the condenser needs to be increased. That is, to improve the condensation performance of the condenser in the conventional refrigerator using the condenser formed in the I-shape as viewed in the horizontal cross-section thereof, e.g., the following change should be made: the fin pitch of the fins is decreased such that the total number of fins is increased; or the length of each fin in an air flow direction (i.e., the length along the right-left direction of the machine chamber) is increased.

[0006]

However, when an attempt is made to improve the condensation performance of the condenser in the above-described manner, a pressure loss of the air in the

condenser increases, and accordingly, the volume of air flowing in the machine chamber decreases. For this reason, it is difficult for the conventional refrigerator to improve the condensation performance of the condenser, and it is also difficult to improve energy saving performance in the refrigerator.

5 [0007]

Moreover, since the compressor, the drain pan, etc. are arranged in the machine chamber of the conventional refrigerator as described above, it is difficult to ensure a working space for, e.g., connecting refrigerant pipes. For improvement of the condensation performance of the condenser, the region occupied by the condenser in the machine chamber increases with an increase in the size of the condenser, and for this reason, the working space in the machine chamber is further narrowed. Thus, when an attempt is made to improve the condensation performance of the condenser in the conventional refrigerator, workability in, e.g., connecting refrigerant pipe in the machine chamber is lowered.

15 [0008]

Since the refrigerator described in Patent Literature 1 uses the condenser formed in the L-shape as viewed in the horizontal cross-section thereof, the condensation performance of the condenser and energy saving performance in the refrigerator might be able to be more improved as compared to the conventional refrigerator using the condenser formed in the I-shape as viewed in the horizontal cross-section thereof. However, the refrigerator of Patent Literature 1 using the condenser formed in the L-shape as viewed in the horizontal cross-section thereof has an increased size of the region occupied by the condenser in the machine chamber as compared to the conventional refrigerator using the condenser formed in the I-shape as viewed in the horizontal cross-section thereof. For this reason, the region from the side surface portion to a back portion of the machine chamber is covered by the condenser, and as a result, workability in, e.g., connecting refrigerant pipe in the machine chamber is further lowered.

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[0009]

The present invention has been made in view of the above-described problems, and is intended to provide a refrigerator having an improved energy saving performance and workability in a machine chamber.

Solution to Problem

[0010]

The refrigerator of the present invention includes a casing including casing including a storage chamber, and a machine chamber having a suction port formed at least through a side surface portion of the machine chamber; and a condenser and a blower arranged in the machine chamber, wherein as viewed in a horizontal cross-section of the machine chamber, the condenser has an I-shape, the blower is disposed parallel to the condenser to face a longitudinal side of the condenser, and the condenser is disposed such that the longitudinal side thereof inclines with respect to the side surface portion having the suction port formed therethrough of the machine chamber.

Advantageous Effects of Invention

[0011]

In the refrigerator of the present invention, the condenser is, as viewed in the horizontal cross-section of the machine chamber, disposed to incline with respect to the side surface portion of the machine chamber having the suction port formed therethrough. Thus, in the refrigerator of the present invention, the width of the condenser in the longitudinal side thereof is increased, and therefore, a heat dissipation area can be increased. Consequently, the condensation performance (specifically, the dissipation area) of the condenser can be increased without an increase in a pressure loss of air in the condenser. As a result, energy saving performance in the refrigerator of the present invention can be more improved as compared to the conventional refrigerator using the condenser formed in the I-shape as viewed in the horizontal cross-section thereof. In addition, since the condenser and the blower are arranged parallel to each other in the refrigerator of the present

invention, the condensation performance of the condenser and energy saving performance in the refrigerator can be further improved.

[0012]

Unlike the refrigerator of Patent Literature 1 using the condenser formed in the L-shape as viewed in the horizontal cross-section thereof, the region from the side surface portion to the back portion of the machine chamber is not covered in the refrigerator of the present invention, and therefore, a large space can be ensured on the back side in the machine chamber. Thus, workability in the machine chamber can be also improved.

Brief Description of Drawings

[0013]

[Fig. 1] Fig. 1 is a perspective view of a refrigerator of Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a horizontal sectional view of a machine chamber of a conventional refrigerator.

[Fig. 3] Fig. 3 is a horizontal sectional view of a machine chamber of the refrigerator of Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a horizontal sectional view of an example of the arrangement angle between a condenser and a blower.

[Fig. 5] Fig. 5 is a graph of wind velocity distribution in the condenser in association with the arrangement angle between the condenser and the blower as illustrated in Fig. 4.

[Fig. 6] Fig. 6 is a graph of the condensation performance of the condenser in association with the arrangement angle between the condenser and the blower as illustrated in Fig. 4.

[Fig. 7] Fig. 7 is a horizontal sectional view of a machine chamber of a refrigerator of Embodiment 2 of the present invention.

[Fig. 8] Fig. 8 is a horizontal sectional view of a machine chamber of a refrigerator of Embodiment 3 of the present invention.

Description of Embodiments

[0014]

Embodiment 1.

Fig. 1 is a perspective view of a refrigerator of Embodiment 1 of the present invention. In Fig. 1, the back side of the refrigerator 1 is illustrated as the near side in the plane of paper.

The refrigerator 1 of Embodiment 1 includes a casing 1a having at least one storage chamber. An opening port is formed on the front side (depicted as being in the depth direction in the plane of drawing sheet of Fig. 1) in the storage chamber formed in the casing 1a. The opening port is openably closed by doors 1b, the doors 1b functioning as drawers or double doors. The refrigerator 1 includes a refrigeration cycle configured such that a compressor 4, a condenser 2, an expansion mechanism such as a capillary tube, and an evaporator are connected together through refrigerant pipes. The air cooled by the refrigeration cycle (more specifically, the evaporator) is supplied to the storage chamber, and therefore, the temperature in the storage chamber is maintained at a desired temperature.

[0015]

The storage chamber described herein is a freezing room, a refrigeration room, an ice making room, or a switching room, for example. Note that in Embodiment 1, the term "refrigerator" is used even in the case where the storage chamber is the freezing room.

[0016]

A machine chamber 10 is formed on the lower back side in the casing 1a, for example. As will be described later with reference to Fig. 3, the condenser 2 as a component of the refrigeration cycle and a blower 3 configured to blow air to the condenser 2 are arranged in the machine chamber 10. Moreover, in the refrigerator 1 of Embodiment 1, the compressor 4 as a component of the refrigeration cycle is disposed in the machine chamber 10, and is cooled by the air blown by the blower 3. Further, in the refrigerator 1 of Embodiment 1, a drain pan 5 configured to store drain water discharged from the storage chamber is also disposed in the machine chamber 10. In addition, the arrangement of the condenser 2 and the blower 3 in the machine

chamber 10 of the refrigerator 1 of Embodiment 1 is changed as compared to a conventional refrigerator so that energy saving performance in the refrigerator 1 and workability in, e.g., refrigerant pipe connection in the machine chamber 10 can be improved.

5 [0017]

For the sake of easy understanding of the arrangement of the condenser 2 and the blower 3 according to Embodiment 1, a machine chamber of the conventional refrigerator will be first described, and then, the machine chamber 10 of the refrigerator 1 of Embodiment 1 will be described.

10 [0018]

Fig. 2 is a horizontal sectional view of the machine chamber of the conventional refrigerator. Fig. 2 is the view of the cross section of the machine chamber 110 of the conventional refrigerator taken along a chain double-dashed line of Fig. 1, and is the view when the machine chamber 110 is viewed from the above. Note that the lower side as viewed in Fig. 2 is the back side of the conventional refrigerator.

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The machine chamber 110 of the conventional refrigerator includes a side surface portion 111 formed with a suction port 111a, and another side surface portion 111 formed with a discharge port 111b. A condenser 102, a blower 103, a compressor 104, a drain pan 105, etc. are housed in the machine chamber 110.

20 [0019]

Specifically, the condenser 102 is a fin-tube heat exchanger formed in an I-shape as viewed in the horizontal cross-section thereof (e.g., when the cross section indicated by the chain double-dashed line of Fig. 1 is viewed from the above). The condenser 102 is disposed near the side surface portion 111 having the suction port formed therethrough 111a such that the longitudinal side of the condenser 102 is parallel to the side surface portion 111. The blower 103 is, e.g., a propeller fan, and is disposed parallel to the condenser 102 to face the longitudinal side of the condenser 102 as viewed in the horizontal cross-section thereof. When the blower 103 is driven, the air in the vicinity of the machine chamber 110 is sucked into the machine chamber 110 through the suction port 111a, as indicated by a sucked air flow

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121. Then, the air is discharged from the machine chamber 110 to the outside, as indicated by a discharged air flow 122. That is, the blower 103 is disposed downstream of the condenser 102.

[0020]

5 In the refrigerator configured such that the condenser is placed in the machine chamber, energy saving performance is improved by refrigerant condensation in the chamber, energy saving performance is improved by refrigerant condensation in the condenser. That is, for improvement of energy saving performance in the refrigerator, the condensation performance (the heat exchange capacity) of the condenser needs to be improved. Thus, it is required that a certain volume of air
10 flowing in the machine chamber is ensured and that much air contacts the condenser. However, since the compressor 104, the drain pan 105, etc. are arranged in the machine chamber 110 as illustrated in Fig. 2, it is difficult to expand the area of an air path in the machine chamber 110. For this reason, for improvement of the condensation performance of the condenser 102 in the conventional refrigerator
15 illustrated in Fig. 2, the heat dissipation area of the condenser 102 needs to be increased. That is, for improvement of the condensation performance of the condenser 102, e.g., the following change should be made: a fin pitch is decreased such that the total number of fins is increased; or the length of each fin in an air flow direction (i.e., the length along the right-left direction of the machine chamber 110) is
20 increased.

[0021]

However, when an attempt is made to improve the condensation performance of the condenser 102 in the above-described manner, a pressure loss of the air in the condenser 102 increases, and therefore, the volume of air flowing in the machine
25 chamber 110 decreases. For this reason, it is difficult for the conventional refrigerator illustrated in Fig. 2 to improve the condensation performance of the condenser 102, and it is also difficult to improve energy saving performance in the refrigerator.

[0022]

Moreover, since the compressor 104, the drain pan 105, etc. are, as described above, arranged in the machine chamber 110 of the conventional refrigerator illustrated in Fig. 2, it is difficult to ensure a working space for, e.g., connection of refrigerant pipes. For improvement of the condensation performance of the condenser 102, the region occupied by the condenser 102 in the machine chamber 110 increases with an increase in the size of the condenser 102, and for this reason, the working space in the machine chamber 110 is further narrowed. Thus, when an attempt is made to improve the condensation performance of the condenser 102 in the conventional refrigerator illustrated in Fig. 2, workability in, e.g., refrigerant pipe connection in the machine chamber 110 is lowered.

[0023]

For this reason, in the refrigerator 1 of Embodiment 1, the arrangement of the condenser 2 and the blower 3 in the machine chamber 10 is changed so that both of energy saving performance in the refrigerator 1 and workability in the machine chamber 10 can be improved, as will be described later with reference to Fig. 3.

[0024]

Fig. 3 is a horizontal sectional view of the machine chamber of the refrigerator of Embodiment 1 of the present invention. Fig. 3 is the view of the cross section of the machine chamber 10 of the refrigerator 1 taken along the chain double-dashed line of Fig. 1, and is the view when the machine chamber 10 is viewed from the above. Note that the lower side as viewed in Fig. 3 is the back side of the refrigerator 1.

As in the machine chamber 110 of the conventional refrigerator illustrated in Fig. 2, the machine chamber 10 of the refrigerator 1 of Embodiment 1 includes a side surface portion 11 having a suction port 11a formed therethrough, and another side surface portion 11 having a discharge port 11b formed therethrough. As in the machine chamber 110 of the conventional refrigerator illustrated in Fig. 2, the condenser 2, the blower 3, the compressor 4, the drain pan 5, etc. are housed in the machine chamber 10. Thus, when the blower 3 is driven in the machine chamber 10 of the refrigerator 1 of Embodiment 1, the air in the vicinity of the machine chamber

10 is sucked into the machine chamber 10 through the suction port 11a, as indicated by a sucked air flow 21. Then, the air is discharged from the machine chamber 10 to the outside, as indicated by a discharged air flow 22. Moreover, as in the conventional refrigerator illustrated in Fig. 2, the refrigerator 1 of Embodiment 1 uses, as the condenser 2, a fin-tube heat exchanger formed in an I-shape as viewed in the horizontal cross-section thereof, and uses, as the blower 3, a propeller fan, for example.

[0025]

However, the refrigerator 1 of the Embodiment 1 is different from the conventional refrigerator illustrated in Fig. 2 in the arrangement of the condenser 2 and the blower 3 in the machine chamber 10.

Specifically, the condenser 2 is, as viewed in the horizontal cross-section thereof, disposed such that the longitudinal side thereof inclines with respect to the side surface portion 11 having the suction port 11a formed therethrough. Moreover, the blower 3 is, as viewed in the horizontal cross-section thereof, disposed to incline with respect to the side surface portion 11 having the suction port 11a formed therethrough. More specifically, the blower 3 is disposed parallel to the condenser 2 to face the longitudinal side of the condenser 2 as viewed in the horizontal cross-section thereof. In addition, the blower 3 is disposed on a downstream side of air of the condenser 2, as illustrated in Fig. 3.

[0026]

Since the condenser 2 is, as described above, disposed to incline with respect to the side surface portion 11 having the suction port 11a formed therethrough, the dimension of the condenser 2 in the longitudinal side thereof is increased, and therefore, the heat dissipation area of the condenser 2 can be increased. As a result, the condensation performance (specifically, the heat dissipation area) of the condenser 2 can be increased without an increase in the pressure loss of air in the condenser 2. Thus, energy saving performance in the refrigerator 1 of Embodiment 1 can be more improved as compared to the conventional refrigerator illustrated in Fig. 2.

[0027]

Moreover, since the condenser 2 is disposed to incline with respect to the side surface portion 11 having the suction port 11a formed therethrough, a large space on the back side in the machine chamber 10 can be ensured even when the condensation performance of the condenser 2 is enhanced. Thus, workability in the machine chamber 10 of the refrigerator of Embodiment 1 can be also improved.

[0028]

Further, since the condenser and the blower are arranged parallel to each other in the refrigerator of Embodiment 1, the condensation performance of the condenser 2 can be further improved, and energy saving performance in the refrigerator 1 can be further improved.

[0029]

Fig. 4 is a horizontal sectional view of an example of the arrangement angle between the condenser and the blower. Fig. 5 is a graph of wind velocity distribution in the condenser in association with the arrangement angle between the condenser and the blower as illustrated in Fig. 4. In addition, Fig. 6 is a graph of the condensation performance of the condenser in association with the arrangement angle between the condenser and the blower as illustrated in Fig. 4. Note that " θ " shown in Fig. 4 is the angle between the condenser 2 and the blower 3. Moreover, the horizontal axis L in Fig. 5 is the distance between one end portion and the other end portion of the condenser 2 as illustrated in Fig. 4. Further, the vertical axis V in Fig. 5 is the velocity of air flowing in the condenser 2. In addition, the vertical axis W in Fig. 6 is the amount of heat exchanged by the condenser 2 as the condensation performance of the condenser 2.

[0030]

In the case of arranging the condenser 2 and the blower 3 in parallel to each other, i.e., the case of $\theta = 0$, as shown in Figs. 4 to 6, uniform velocity distribution in the condenser 2, and therefore, a high condensation performance yield. On the other hand, a greater angle θ between the condenser 2 and the blower 3 leads to a

greater variation in the velocity distribution in the condenser 2. Thus, the condensation performance is lowered.

Thus, with the configuration in which the condenser 2 and the blower 3 are arranged parallel to each other as in the refrigerator 1 of Embodiment 1, the condensation performance of the condenser 2 can be further improved, and energy saving performance in the refrigerator 1 can be further improved.

[0031]

Note that in Embodiment 1, the blower 3 is disposed downstream of the condenser 2. The present invention is not limited to such a configuration.

Needless to say, the blower 3 may be disposed upstream of air of the condenser 2. However, the flow of air on the upstream side of the blower 3 is more uniform as compared to the flow of air on the downstream side of the blower 3. For this reason, in the case where the blower 3 is disposed downstream of the condenser 2, the condensation performance of the condenser 2 is more improved, and energy saving performance in the refrigerator 1 is more improved.

[0032]

Embodiment 2.

The suction port formed at the machine chamber 10 is not limited to the suction port 11a formed at the side surface portion 11. For example, a suction port may be formed at a machine chamber 10 of a refrigerator 1 as described below.

Note that the configuration not described in Embodiment 2 is similar to that of Embodiment 1, and the same reference numerals as those of Embodiment 1 are used to represent equivalent elements in Embodiment 2.

[0033]

Fig. 7 is a horizontal sectional view of the machine chamber of the refrigerator of Embodiment 2 of the present invention. Fig. 7 is the view of the cross section of the machine chamber 10 of the refrigerator 1 taken along the chain double-dashed line of Fig. 1, and is the view when the machine chamber 10 is viewed from the above. Note that the lower side as viewed in Fig. 7 is the back side of the refrigerator 1.

As illustrated in Fig. 7, in the machine chamber 10 of the refrigerator 1 of Embodiment 2, a suction port 12a is formed at a back portion 12 in addition to a suction port 11a formed at a side surface portion 11. The suction port 12a is formed at the position upstream of the condenser 2 and the blower 3.

[0034]

Since the suction port 12a is also formed at the back portion 12 in Embodiment 2, more air can contact the condenser 2 (the volume of flowing air can be increased). Moreover, in the refrigerator 1 of Embodiment 2 configured such that the condenser 2 is disposed to incline with respect to the side surface portion 11, the suction port 12a can more extend toward the center of the refrigerator 1 of Embodiment 2 as compared to the conventional refrigerator illustrated in Fig. 2. Thus, the volume of air flowing in the condenser 2 can be further increased.

With the configuration of the refrigerator 1 as in Embodiment 2, the condensation performance of the condenser 2 and energy saving performance in the refrigerator 1 can be more improved as compared to the refrigerator 1 of Embodiment 1.

[0035]

Embodiment 3.

The following configuration (a later-described cover 6) is added to the refrigerator 1 of Embodiment 1 or 2 so that the condensation performance of the condenser 2 and energy saving performance in the refrigerator 1 can be more improved as compared to the refrigerator 1 of Embodiment 1 or 2.

Note that the configuration not described in Embodiment 3 is similar to that of Embodiment 1 or 2, and the same reference numerals as those of the above-described embodiments are used to represent equivalent elements in Embodiment 3. Moreover, in Embodiment 3, the example where the cover 6 is added to the refrigerator 1 of Embodiment 1 will be described.

[0036]

Fig. 8 is a horizontal sectional view of a machine chamber of a refrigerator of Embodiment 3 of the present invention. Fig. 8 is the view of the cross section of the

machine chamber 10 of the refrigerator 1 taken along the chain double-dashed line of Fig. 1, and is the view when the machine chamber 10 is viewed from the above.

Note that the lower side as viewed in Fig. 8 is the back side of the refrigerator 1.

As illustrated in Fig. 8, the refrigerator 1 of Embodiment 3 includes the cover 6 covering the clearance between a condenser 2 and a blower 3.

[0037]

In the case of disposing the blower 3 downstream of the condenser 2, the cover 6 can prevent the air having passed through the outside of the condenser 2 from being sucked into the blower 3 through the clearance between the condenser 2 and the blower 3. Moreover, in the case of disposing the blower 3 upstream of the condenser 2, the cover 6 can prevent the air having discharged from the blower 3 from leaking through the clearance between the condenser 2 and the blower 3, and can prevent part of the air having discharged from the blower 3 from being discharged to the outside of the machine chamber 10 without passing through the condenser 2.

[0038]

With the configuration in which the cover 6 of Embodiment 3 is provided at the refrigerator 1 of Embodiment 1 or 2, the volume of air flowing in the condenser 2 can be further increased. Thus, the condensation performance of the condenser 2 can be further improved, and energy saving performance in the refrigerator 1 can be further improved.

Reference Signs List

[0039]

1	refrigerator	1a	casing	1b	door	2	condenser	3	fan
4	compressor	5	drain pan	6	cover	10	machine chamber		
11	side surface portion	11a	suction port	11b	discharge port	12			
back portion	12a	suction port	21	sucked air flow	22	discharged air flow			
102	condenser	103	blower	104	compressor	105	drain pan		
110	machine chamber	111	side surface portion	111a	suction port	111b			
discharge port	121	sucked air flow	122	discharged air flow					

CLAIMS

[Claim 1]

A refrigerator comprising:

a casing including

5 a storage chamber, and

a machine chamber having a suction port formed at least through a side surface portion of the machine chamber; and

a condenser and a blower arranged in the machine chamber,

wherein as viewed in a horizontal cross-section of the machine chamber,

10 the condenser has an I-shape,

the blower is disposed parallel to the condenser to face a longitudinal side of the condenser, and

the condenser is disposed such that the longitudinal side thereof inclines with respect to the side surface portion having the suction port formed therethrough of the machine chamber.

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[Claim 2]

The refrigerator of claim 1, wherein

the blower is disposed on a downstream side of air of the condenser.

[Claim 3]

20 The refrigerator of claim 1 or 2, wherein

a suction port is formed at a position of a back portion of the machine chamber on an upstream side of air of the condenser and the blower.

[Claim 4]

The refrigerator of any one of claims 1 to 3, further comprising

25 a cover covering a clearance between the condenser and the blower.