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AIR DUCT OF A REFRIGERATOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an air duct of a refrigerator and more particularly, to an air duct of a refrigerator of which cooling efficiency is improved by increasing the amount of cooled air flowed into the refrigerator.

Description of the Related Art

Generally, a refrigerator has a refrigerating compartment and a freezer compartment for efficient storage of food. Doors for respectively closing the refrigerating and freezer compartments are provided to the front surfaces of thereof. In addition, an evaporator for cooling the air which circulates the refrigerator and a fan for supplying the air which is cooled by the evaporator are installed at a rear side of the freezer compartment. Moreover, an air duct for providing air passages through which the cooled air is introduced into the freezer and refrigerating compartments is installed at a rear side of the freezer compartment.

Figure 1 is an exploded perspective view showing a conventional air duct of a refrigerator, and Figure 2 is a section view taken along lines II-II of Figure 1.

An air duct is installed at a rear side of a freezer

compartment in order to prevent the heat generated when an evaporator operates for defrost, from being introduced into a refrigerator. An air duct includes a rear cover 1 having a predetermined thickness, for example, 35mm or more, and which is made of Styrofoam, and a front cover 6 having a plurality of freezer compartment air passages 7 and which is attached to an upper surface of the rear cover 1 and is made of resin.

A space portion 3 for providing, via the freezer compartment air passages 7 of the front cover 6, a freezer compartment with the air cooled by an evaporator, is formed by depth of approximately 20mm from a front surface 2 of the rear cover 1. A bell mouth 4 for introducing the cooled air into the space portion 3 is formed penetrating through the bottom surface of space portion 3 and a rear surface of the rear cover 1. A refrigerating compartment air passage 5 for providing the refrigerating compartment with the air introduced by the bell mouth 4 and passed the space portion 3 is formed in the lower center of the rear cover 1 by a depth same as that of the space portion 3.

As shown in Figures 1 and 2, the bell mouth 4 is formed as being tapered, that is, an area of aperture at the bottom surface of the space portion 3 is wider than that at the rear surface of the rear cover 1. A fan (not shown) for introducing the air which is cooled by the evaporator into the space portion 3 of the rear cover 1 is placed at the rear side of the bell mouth 4.

Thus, the air which is cooled by the evaporator passes through the bell mouth 4 forcedly by the fan which rotates in counter clockwise direction. Then, the air which has passed the space portion 3 is supplied respectively to the freezer and refrigerating compartments via freezer compartment air passages 7 and the refrigerating compartment air passage 5. Table 1 which will be

discussed later shows the amount of air introduced into the freezer and refrigerating compartments by a conventional air duct.

However, such conventional air duct has some problems.

The bell mouth is formed as being tapered in a way that the area of aperture at the bottom surface of the space portion is wider than that at the rear surface of the rear cover. Therefore, when the air cooled by the evaporator passes through the bell mouth and is introduced into the space portion by the fan, air flow resistance is increased by being affected by the tapered shape of the bell mouth. In addition, a means for efficiently leading into the refrigerating compartment air passage the air which is passed through the bell mouth and introduced into the space portion, is lacked.

As the fan rotates in counter clockwise direction, a vortex flow of the air occurs in the space portion. Thus, the amount of the air which flows into the freezer and refrigerating compartments is not sufficient.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an air duct of a refrigerator of which cooling efficiency is improved by increasing the amount of cooled air flowed into the refrigerator.

To achieve the above objects and other advantages, there is provided an air duct of a refrigerator consisting of a rear cover having a predetermined thickness and which is made of adiabatic substances, and a front cover having a plurality of freezer compartment air passages and which is attached to the front surface

of the rear cover, wherein the rear cover including: a space portion having a predetermined depth and which provides via the freezer compartment air passages a freezer compartment with the air cooled by an evaporator; a bell mouth which is formed penetrating through a bottom surface of the space portion and a rear surface of the rear cover so that the air can be flowed into the space portion; and a refrigerating compartment air passage for providing a refrigerating compartment with the air flowed into the space portion, wherein a guide member for adjusting the flow direction of the air so that the amount of air which flows through the refrigerating and freezer compartment air passages can be increased is formed at the bottom surface of the space portion between the bell mouth and the refrigerating compartment air passage.

Preferably, the guide member has a thickness same as the depth of the space portion and includes a guide plate having predetermined width and length.

It is also possible to have plural guide plates which are connected in lengthwise direction so as to achieve an overall curve. Preferably, space between the guide plate and the bell mouth or between the guide plate and the refrigerating compartment air passage can be adjustable.

In addition, a vortex flow preventive member for preventing vortex flow of the air is formed on the bottom surface of the space portion between the bell mouth and an end portion of the guide member facing toward the refrigerating compartment air passage.

Further, the bell mouth has an aperture area at the bottom surface of the space portion same as that at the rear surface of the rear cover, and is formed vertically with respect to the rear cover.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and other advantages of the present invention will become more apparent by describing in detail the preferred embodiments thereof with reference to the accompanying drawings, in which:

Figure 1 is an exploded perspective view showing a conventional air duct of a refrigerator;

Figure 2 is a section view taken along lines II-II of Figure 1;

Figure 3 is a front view showing a rear cover according to embodiment 1 of the present invention;

Figure 4 is a front view showing a rear cover according to embodiment 2 of the present invention;

Figure 5 is a front view showing a rear cover according to embodiment 3 of the present invention;

Figure 6 is a front view showing a rear cover according to embodiment 4 of the present invention;

Figure 7 is a perspective view showing a rear cover according to embodiment 5 of the present invention; and

Figure 8 is a section view taken along lines VIII-VIII of Figure 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather,

these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those having skill in the art.

Figures 3 to 5 show embodiments of rear covers employed for an air duct of the present invention. The rear covers are intended for increasing the amount of the air flowed into a refrigerator by efficiently leading to a refrigerating compartment air passage the air which has passed through a bell mouth and flowed into a space portion.

The front cover employed for the present invention is structured same as a conventional one. Therefore, only a rear cover will be explained hereinafter.

Referring to Figure 3, a rear cover 11 has a space portion 13 formed in a center portion thereof to a depth of approximately 20mm from a front surface 12 of the rear cover 11. A bell mouth 14 which penetrates through the rear surface of the rear cover 11 and the bottom surface of the space portion 13 and has a wider aperture area at the bottom surface of the space portion 13 than that at the rear surface of the rear cover 11, is formed in the space portion 13. A refrigerating compartment air passage 15 is formed in a lower center of the rear cover 11 so that the air flowed via the bell mouth 14 passes through the space portion 13 and flows into a refrigerating compartment. The refrigerating compartment air passage 15 is formed to a depth same as that of the space portion 13.

In addition, at the bottom surface of the space portion 13 between the bell mouth 14 and the refrigerating compartment air passage 15, a first guide plate 16 which is a rectangular

hexahedron in shape is formed. The first guide plate 16 has a width (W1) of 4 to 10mm, preferably 7mm, a length (L1) of 35 to 55mm, preferably 55mm, and a height corresponding to the depth of the space portion 13.

The first guide plate 16 is for increasing the amount of the air which passes through the refrigerating compartment air passage 15 and flows into the refrigerating compartment. The first guide plate 16 is formed in a fashion that one end portion thereof is placed at approximately two-thirds of the width (W2) of the refrigerating compartment air passage 15, as measured from the left end of the refrigerating compartment air passage 15. A gap (G1) between the end portion of the first guide plate 16 and the right wall of the refrigerating compartment air passage 15 is 20mm to 30mm, preferably 25mm, and an angle (α) with respect to a horizontal line (HL) is 20° to 40°, preferably 30°.

According to embodiment 1 so structured, the air flowed into the space portion 13 through the bell mouth 14 changes its flow direction in the space portion 13 by the first plate guide 16 provided at the bottom surface of the space portion 13. As a result, flow speed of the air being flowed via the refrigerating compartment air passage 15 becomes high.

Table 1 shows the amount of air introduced respectively into the freezer and refrigerating compartments by an air duct which employs conventional rear cover and by an air duct which employs the rear cover of embodiment 1 of the present invention. All the experiment conditions (for example, evaporator capacity, rotation speed of fan, structure of front cover, number of freezer and refrigerating compartments air passages) are the same, except that the first guide plate is provided for embodiment 1. Numerical values in the parenthesis are percentages of the amount of the air

in the freezer and refrigerating compartments to the total amount of the air.

< Table 1 >

	conventional air duct	air duct of embodiment 1
amount of air in freezer compartment (m^3/s)	0.01636 (86.86%)	0.01539 (80.37%)
amount of air in refrigerating compartment (m^3/s)	0.00248 (13.14%)	0.00376 (19.63%)
total amount of air (m^3/s)	0.01884	0.01915

As shown in Table 1, in the air duct that employs a rear cover having a first guide plate, the amount of air in the freezer compartment is increased by 6% than those in the air duct that employs conventional rear cover not having a first guide plate. However, the amount of air in the refrigerating compartment is increased by 51.61%. Thus, total amount of the air in the freezer and refrigerating compartments is increased approximately by 1.65% as compared with the air duct that employs conventional rear cover.

Figure 4 is a front view showing a rear cover according to embodiment 2 of the present invention. Here, a second guide plate 16' is connected to the first guide plate 16 of embodiment 1 so that both the amount of air flowed into the freezer and refrigerating compartments can be increased.

The second guide plate 16' is a rectangular hexahedron in shape having a width (W1) of 4mm to 10mm, preferably 7mm, a length

(L2) of 20mm to 32mm, preferably 32mm, a height corresponding to the depth of the space portion, and an angle (β) with respect to a horizontal line (HL) is 35° to 55°, preferably 40°.

The second guide plate 16' has a width same as that of the first guide plate 16 and a length shorter than that of the first guide plate 16, and tilts toward the bell mouth 14 by approximately 10° with respect to the lengthwise connection to the first guide plate 16.

In an air duct that employs a rear cover 11' having the first and second guide plates 16 and 16' formed at the bottom surface of the space portion, the air flowed into the space portion through the bell mouth 14 changes its flow direction in the space portion 13 by the first and second guide plates 16 and 16' formed at the bottom surface of the space portion 13. As a result, flow speed of the air being flowed into the freezer and refrigerating compartments via respective air passages becomes high.

Table 2 shows the amount of air introduced respectively into the freezer and refrigerating compartments by an air duct which employs the rear cover of embodiment 1 and by an air duct which employs the rear cover of embodiment 2 of the present invention. All the experiment conditions are the same as those in Table 1.

< Table 2 >

	air duct of embodiment 1	air duct of embodiment 2
amount of air in freezer compartment (m^3/s)	0.01539 (80.37%)	0.01650 (80.92%)

amount of air in refrigerating compartment (m^3/s)	0.00376 (19.63%)	0.00389 (19.08%)
total amount of air (m^3/s)	0.01915	0.02039

As shown in Table 2, in the air duct that employs a rear cover having the first and second guide plates, the amount of air in the freezer and refrigerating compartments are increased by 7.21% and 3.46% respectively than those in the air duct that employs a rear cover having only the first guide plate. In addition, total amount of the air flowed into the freezer and refrigerating compartments is increased by 6.48% as compared with the air duct of embodiment 1 and by 8.23% as compared with the conventional air duct.

Figure 4 is a front view showing a rear cover according to embodiment 2 of the present invention. Here, a second guide plate 16' is connected to the first guide plate 16 of embodiment 1 so that both the amount of air flowed into the freezer and refrigerating compartments can be increased.

Figure 5 is a front view showing a rear cover according to embodiment 3 of the present invention. Here, a third guide plate 16" is connected to an end portion of the second guide plate 16' of embodiment 2 so that the amount of air flowed into the freezer compartment can be further increased.

The third guide plate 16" is a rectangular hexahedron having a width, length, and height same as those of the first guide plate 16, and installed to have an angle (γ) 60° to 80° with respect to the horizontal line (HL), and preferably 60°. In addition, gap (G2) between the left end portion of the third guide plate 16" and the

bell mouth 14 is approximately 70mm or shorter.

In an air duct that employs a rear cover 11" having the first to third guide plates 16, 16', and 16", the air flowed into the space portion 13 through the bell mouth 14 changes its flow direction in the space portion 13 by the first to third guide plates 16, 16', and 16" formed at the bottom surface of the space portion 13. As a result, flow speed of the air being flowed into the freezer and refrigerating compartments via respective air passages becomes high.

Table 3 shows the amount of air introduced respectively into the freezer and refrigerating compartments by an air duct which employs the rear cover of embodiment 2 and by an air duct which employs the rear cover of embodiment 3 of the present invention. All the experiment conditions are the same as those in Table 2.

< Table 3 >

	air duct of embodiment 2	air duct of embodiment 3
amount of air in freezer compartment (m^3/s)	0.01650 (80.92%)	0.01686 (81.21%)
amount of air in refrigerating compartment (m^3/s)	0.00389 (19.08%)	0.00390 (18.79%)
total amount of air (m^3/s)	0.02039	0.02076

As shown in Table 3, in the air duct that employs the rear cover having the first to third guide plates, the amount of air in the freezer and refrigerating compartments are increased by 2.18%

and 0.26% respectively than those in the air duct that employs the rear cover of embodiment 2. In addition, total amount of the air flowed into the freezer and refrigerating compartments is increased by 1.81% as compared with the air duct of embodiment 2 and by 10.19% as compared with the conventional air duct.

Figure 6 is a front view showing a rear cover according to embodiment 4 of the present invention. Here, the rear cover includes the guide plate of embodiment 3.

According to embodiment 4 of the present invention, the amount of air in the freezer compartment is further increased by preventing a vortex flow which may occur in the space portion right below the bell mouth 14.

If the fan rotates in counter clockwise direction, a vortex flow occurs in the space portion 13 right below the bell mouth 14.

Embodiment 4 of the present invention is for preventing a vortex flow which may occur in the space portion right below the bell mouth 14. Here, gap (G3) between a vortex flow preventive member 17 and the bell mouth 14 is maintained at 15mm or shorter. The vortex flow preventive member 17 is installed in a fashion that its most left point is positioned on the same vertical line with respect to one end portion of the first guide plate 16.

The vortex flow preventive member 17 and the bell mouth 14 are positioned to have gap (G3) of 15mm or shorter because the amount of air flowed into the refrigerator is decreased and a cooling efficiency is decreased if the gap exceeds 15mm.

Table 4 shows the amount of air introduced respectively into the freezer and refrigerating compartments by an air duct which employs the rear cover of embodiment 3 not having a vortex flow preventive member and by an air duct which employs the rear cover

of embodiment 4 having a vortex flow preventive member. All the experiment conditions are the same as those in Table 3.

< Table 4 >

	air duct of embodiment 3	air duct of embodiment 4
amount of air in freezer compartment (m^3/s)	0.01686 (81.21%)	0.01853 (82.50%)
amount of air in refrigerating compartment (m^3/s)	0.00390 (18.79%)	0.00393 (17.50%)
total amount of air (m^3/s)	0.02076	0.02246

As shown in Table 4, in the air duct that employs the rear cover having a vortex flow preventive member, the amount of air in the freezer and refrigerating compartments are increased by 9.90% and 0.77% respectively than those in the air duct that employs the rear cover of embodiment 3. In addition, total amount of the air flowed into the freezer and refrigerating compartments is increased by 8.19% as compared with the air duct of embodiment 3.

Figures 7 and 8 show a rear cover according to embodiment 5 of the present invention. Here, the rear cover is the same as that of embodiment 4 except that the shape of the bell mouth is changed so as to minimize an air flow resistance when the air passes through the bell mouth.

If the bell mouth is shaped as being tapered, that is, if the area of aperture at the bottom surface of the space portion is wider than that at the rear surface of the rear cover, the air

passes through the bell mouth and is introduced into the space portion is affected by the tapered shape of the bell mouth, thereby increasing an air flow resistance.

To solve such problem, in embodiment 5 of the present invention, the aperture area at the bottom surface of the space portion is the same as that at the rear surface of the rear cover 11". In addition, the bell mouth 14' is formed vertically with respect to the rear cover 11" so as to reduce an air flow resistance.

Table 5 shows the amount of air introduced respectively into the freezer and refrigerating compartments by an air duct which employs the rear cover of embodiment 4 and by an air duct which employs the rear cover of embodiment 5. All the experiment conditions are the same as those in Table 4 except for the shape of the bell mouth.

< Table 5 >

	air duct of embodiment 4	air duct of embodiment 5
amount of air in freezer compartment (m^3/s)	0.01853 (82.50%)	0.02050 (87.87%)
amount of air in refrigerating compartment (m^3/s)	0.00393 (17.50%)	0.00283 (12.13%)
total amount of air (m^3/s)	0.02246	0.02333

As shown in Table 5, in the air duct that employs the rear cover of embodiment 5, the amount of air in the freezer

compartment is increased by 10.63% while the amount of air in the refrigerating compartment is decreased by 27.99% as compared with the air duct of embodiment 4. However, total amount of air is increased by 3.87% as compared with the air duct of embodiment 4.

Though embodiments 4 and 5 of the present invention are described being respectively applied to embodiments 3 and 4, they can be independently applied to the prior art shown in Figures 1 and 2.

As described above, an air duct of the present invention has a guide member between a bell mouth and a freezer compartment air passage so that the amount of the air flowed into the freezer and refrigerating compartments air passages is significantly increased. In addition, a vortex flow preventive member is installed and the shape of the bell mouth is changed so as to further increase the amount of the air. Thus, cooling efficiency of the refrigerator can be greatly enhanced.

This invention has been described above with reference to the aforementioned embodiments. It is evident, however, that many alternative modifications and variations will be apparent to those having skill in the art in light of the foregoing description. Accordingly, the present invention embraces all such alternative modifications and variations as fall within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. An air duct of a refrigerator consisting of a rear cover having a predetermined thickness and which is made of adiabatic substances, and a front cover having a plurality of freezer compartment air passages and which is attached to a front surface of said rear cover, said rear cover has a space portion having a predetermined depth and which provides via said freezer compartment air passages a freezer compartment with air cooled by an evaporator, a bell mouth which penetrates through a bottom surface of said space portion and a rear surface of said rear cover so that said air can be flowed into said space portion, and a refrigerating compartment air passage for providing a refrigerating compartment with said air flowed into said space portion,

wherein a guide member for adjusting flow direction of said air so that amount of said air which flows through said refrigerating and freezer compartment air passages can be increased substantially is formed at said bottom surface of said space portion between said bell mouth and said refrigerating compartment air passage.

2. The air duct according to Claim 1, wherein said guide member includes a first guide plate having a width of 4mm to 10mm, a length of 35mm to 55mm, and a height corresponding to the depth of said space portion.

3. The air duct according to Claim 2, wherein said first guide plate is formed in a fashion that an end portion thereof facing toward said refrigerating compartment air passage is positioned at two-thirds from left end of said refrigerating

compartment air passage.

4. The air duct according to Claim 3, wherein a gap between said end portion of said first guide plate and right end of said refrigerating compartment air passage is 20mm to 30mm.

5. The air duct according to Claim 4, wherein said first guide plate is installed to have an angle of 20° to 40° with respect to a horizontal line drawn between said right and left ends of said refrigerating compartment air passage.

6. The air duct according to Claim 4, wherein said guide member further comprises a second guide plate connected to an end portion of said first guide plate facing toward said bell mouth.

7. The air duct according to Claim 7, wherein said second guide plate is installed to have an angle of 35° to 55° with respect to said horizontal line drawn between said right and left ends of said refrigerating compartment air passage.

8. The air duct according to Claim 6, wherein said second guide plate is a rectangular hexahedron having a width of 4mm to 10mm, a length of 20mm to 32mm, and a height corresponding to the depth of said space portion.

9. The air duct according to Claim 6, wherein said guide member further comprises a third guide plate connected to an end portion of said second guide plate facing toward said bell mouth.

10. The air duct according to Claim 9, wherein said third guide plate is installed to have an angle of 60° to 80° with respect to said horizontal line drawn between said right and left ends of said refrigerating compartment air passage.

11. The air duct according to Claim 9, wherein said third guide plate is a rectangular hexahedron having a width of 4mm to 10mm, a length of 35mm to 55mm, and a height corresponding to the depth of said space portion.

12. The air duct according to Claim 9, wherein a gap between said bell mouth and an end portion of said third guide plate facing toward said bell mouth is 70mm or shorter.

13. The air duct according to Claim 1, wherein a member for preventing a vortex flow of said air is formed on said bottom surface of said space portion between said bell mouth and an end portion of said guide member facing toward said refrigerating compartment air passage.

14. The air duct according to Claim 13, wherein a gap between said vortex flow preventive member and said bell mouth is 15mm or shorter.

15. The air duct according to Claim 1, wherein said bell mouth is formed vertically with respect to said rear cover and such that an aperture area at said bottom surface of said space portion is the same as that at said rear surface of said rear cover.