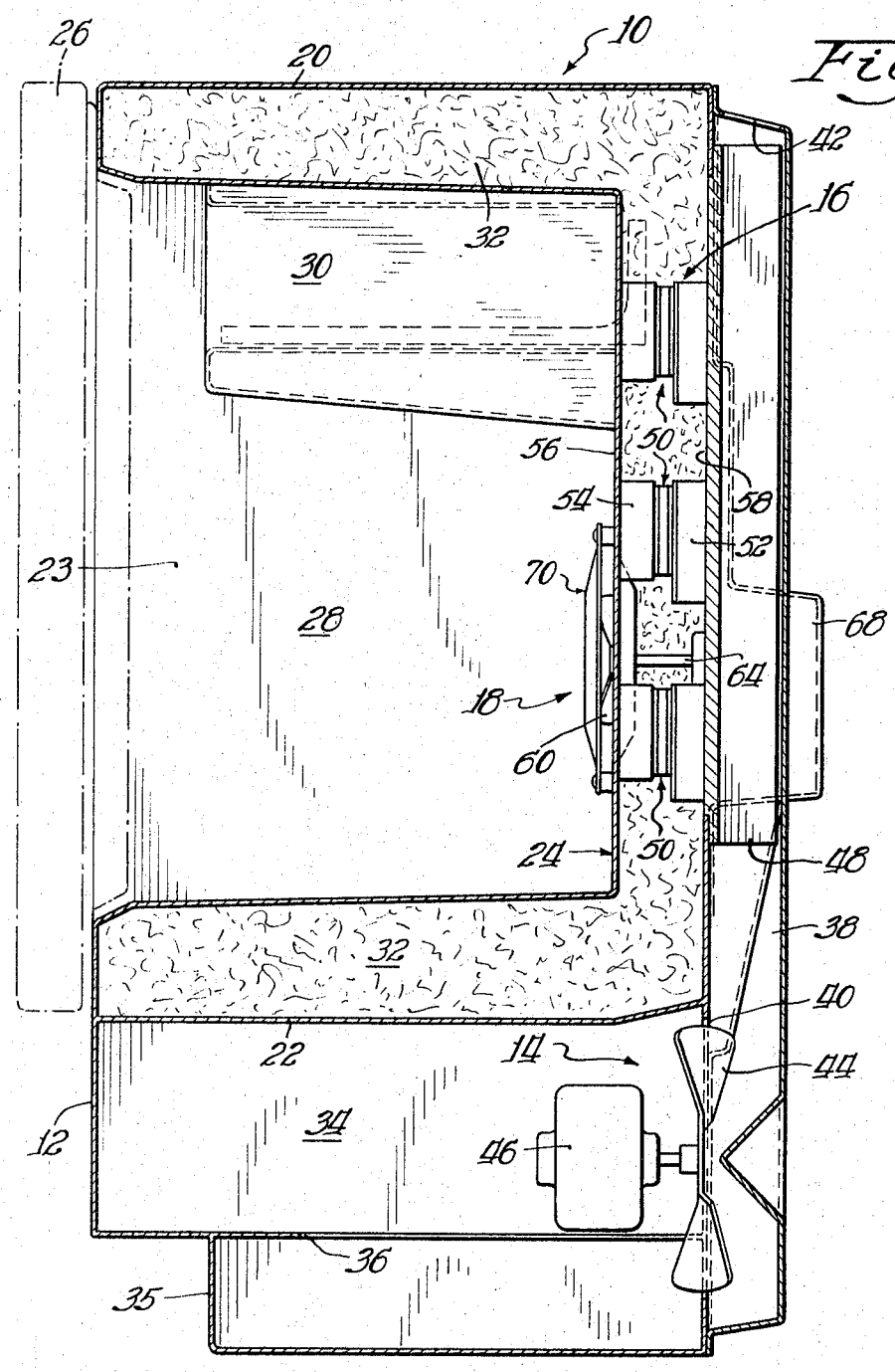
March 7, 1967 R. S. TOWNSEND 3,307,365

REFRIGERATOR HAVING AIR CIRCULATION GUIDE MEANS

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Fig. 1



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Fig. 2

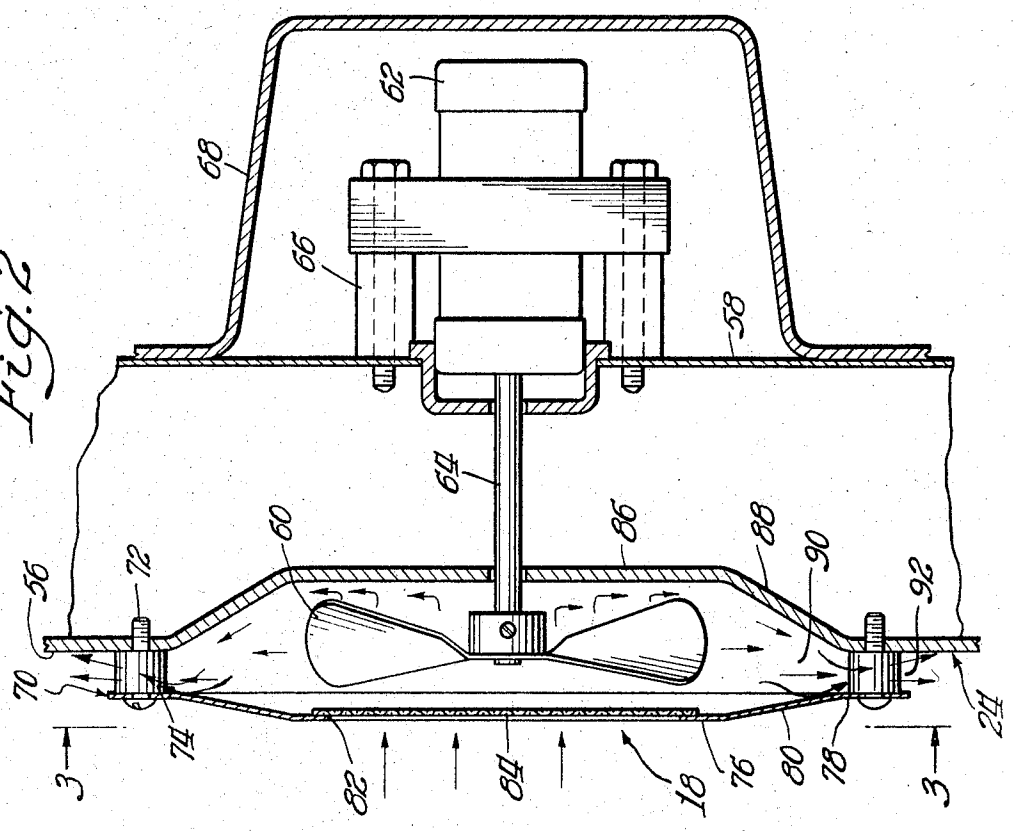
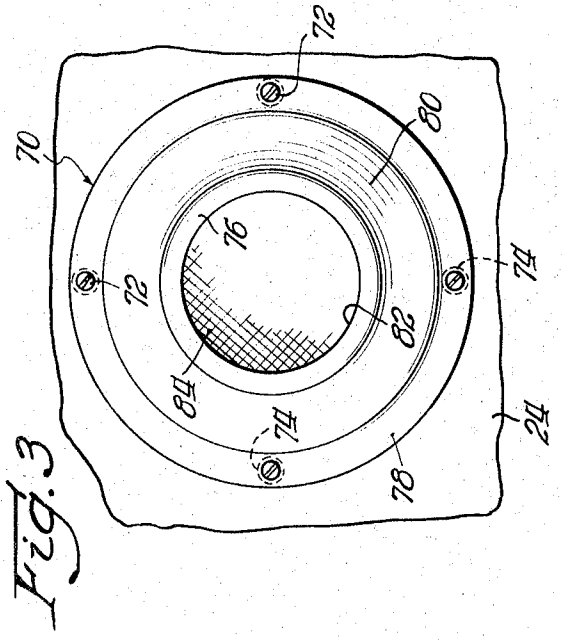


Fig. 3



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REFRIGERATOR HAVING AIR CIRCULATION GUIDE MEANS

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14 Claims. (Cl. 62—3)

This invention relates to means for providing uniform cooling of a compartment of a refrigerator unit of the forced air circulation type.

It is an object of this invention to provide for a more efficient cooling of a refrigerating compartment and also to provide means to achieve a more even and uniform cooling throughout a refrigeration compartment and thereby contribute to increased efficiency.

A further object is to provide means, in conjunction with air circulation means, for controlling the air flow in a refrigerating unit to achieve a more uniform distribution of cooling air.

The above and other objects and advantages of the invention will be more readily apparent when read in connection with the accompanying drawings in which:

FIGURE 1 is a view in elevation and partly in section of a refrigerator cabinet;

FIGURE 2 is an enlarged view of the air circulating means used in conjunction with the refrigerator cabinet; and

FIGURE 3 is a view along the line 3—3 of FIGURE 2.

Referring now to the drawings, 10 designates generally a refrigerator unit. The unit 10 comprises a refrigerator cabinet structure 12 having associated therewith a blower means 14, refrigeration means in the form of a heat absorption unit 16, and air circulating means 18.

The cabinet structure comprises upper wall structure 20, a lower wall structure 22, similar side wall structures one of which is identified 23, a back wall structure 24, and a door 26 for access to a cooling chamber and ice making compartment. The cabinet structure generally defines a cooling chamber 28 and an ice-making compartment 30 located within the confines of the wall structures and door described above.

The wall structures may be constructed of metal panels between which are disposed an insulation material 32, such as a foam insulating material.

The cabinet structure further comprises a lower compartment 34, between the cooling chamber and base 35 of the cabinet, adapted to house the blower means 14 operative to draw air from the atmosphere through an air-intake opening 36.

At the rear of the back wall 24, there is formed a duct 38 having its lower end in communication with the space 34. The duct 38 extends substantially the full height of the back wall 24. It has an opening 40 at the bottom and an air outlet opening 42 at the top so that air, drawn in at the bottom of the cabinet by the blower means 14, is moved upward through the duct 38 and out the top opening 42.

The blower means 14 may comprise a fan 44 driven by a motor 46, its purpose being to force atmospheric air through the duct 38 past vertically-disposed fins 48 to cool the fins which have absorbed heat from the refrigerating unit with which they are associated. The cooling fins are positioned in the duct 38 and are attached to the back wall structure.

In the embodiment illustrated and as best shown in FIGURE 1, the cooling unit 16 is of the thermoelectric type. The cooling unit 16 comprises a plurality of thermoelectric modules or couples 50 disposed in the back wall section 24 of the cabinet structure. Each thermoelectric couple comprises a hot junction 52 and a cold junction 54.

The cold junction 54 is attached to a module cooling plate 56 which constitutes an inner panel section of the back wall structure. The cooling plate 56, also referred to as a cold wall, is made of a sheet aluminum material having good heat conducting qualities. The hot junction 52 is attached to another metal plate 58 which forms an outer panel of back wall 24. The metal plate 58 may be made of material similar to that used in plate 56. The cooling fins 48 may be attached to or formed from the metal plate 58. Thus, heat from the cooling chamber 28 and ice-making chamber 30 is conducted away through cooling plate 56, cold and hot junctions 54 and 52 of the thermocouples 50 and plate 58 to the fins 48. Blower means 14 is effective to blow air through duct 38 over fins 48 to carry away the heat from the fins 48 through opening 42.

Also associated with cabinet structure 12 is the cold air circulating means 18 to assure that the cooling chamber is uniformly cooled and efficiently as possible.

The cold air circulating means 18 comprises a circulating fan 60 and a motor 62 connected thereto by shaft 64 for driving the fan. These are mounted so that the shaft 64 extends through the back wall 24 of the cabinet. The motor 62 is attached to the back wall 24 by suitable mounting means such as bracket means 66 bolted to the outer panel 58 of the back wall structure. A housing 68 may encase the motor and, as shown in FIGURE 1, extends through duct 38.

Associated with the air circulating means 18 is an air interrupting or air deflecting means including a deflector plate 70 directed to accomplishing the main object of my invention and will be hereinafter more fully described.

In a preferred form of the invention for controlling the air flow from the air circulating means, a deflector plate 70 and depressed portion 71 of plate 58 is provided in conjunction with the fan 60. In the embodiment disclosed, the plate 70, which may be made of sheet aluminum, is positioned adjacent the fan 60 and may be secured to the plate 56 by suitable means such as bolts 72. Spacer means 74, surrounding the bolts 72, are provided to space the deflector plate 70 from the plate 56 at the desired distance in a manner so that the space between plate 56 and deflector 70 is sufficient to accommodate the fan 60.

The deflector plate 70 as illustrated comprises an annular disc element having substantially a pie tin shape. It is formed with an inner or central peripheral portion 76, an outer peripheral portion 78 which lies in a vertical plane parallel to but spaced from the plane of the central portion and an intermediate frusto-conical portion 80 connecting the central and outer peripheral portions. The central portion 76 defines an opening 82 covered with a suitable screen 84 adapted to permit the passage of air therethrough. This screen may be constructed of expanded metal. The outer peripheral portion 78 of the deflector plate 70 could also be formed at substantially the same angle to the central portion 76 as portion 80 to form essentially an extension of the intermediate peripheral portion 80.

From FIGURE 2, it will be observed that the depressed portion 71 of cooling plate 56, adjacent the fan 60, is formed inwardly into the back wall 24 to form a recess for the fan 60. The depressed portion comprises the central vertical section 86 and angular frusto-conical portion 88, the latter portion extending between and connecting central section 86 and the main body section of cooling

plate 56. Thus, the intermediate portion 80 of deflector plate 70 and angular portion 88 of plate 56, in their assembled relation, form a narrowing or truncated discharge path 90 leading to peripheral orifice or outlet 92 for the air discharged from the fan 60. The air forced through the constricted discharge path to the peripheral opening 92 tends to be compressed and the velocity thereof increased.

When the fan 60 is operating, air from the chamber 28 is drawn through the opening 82 of plate 70 and screen 84 and is discharged through the peripheral opening 92 formed by the edge of the plate 70 and the cooling plate 56. More specifically, operation of the fan causes air to flow from the cooling chamber 28 through the opening 82 of plate 70 and the screen 84 in a direction axially of the fan, and the air is then discharged by the fan in directions axially and radially of the fan against the vertical and angular portions 86 and 88 of the cooling plate. The air is then discharged radially outwardly around the entire periphery of the plate 70 and is simultaneously directed along the entire surface area of the cooling plate. It will be apparent the depressed portion of plate 56 is formed in order to recess the fan to more effectively produce radial discharge of the air and to aid the baffle plate 70 to deflect the air along the entire length of the cooling plate 56. It should also be noted that the outer periphery of the baffle plate 70 is in such close proximity to the cooling plate 56 as to provide a narrow passage forming a restriction such that the velocity of the air, discharged by the fan, is increased for the purpose of insuring travel of the air along the entire length of the cooling plate 56 prior to diffusion within the cooling chamber 28.

It will be appreciated this preferred embodiment may be modified and still be within the scope of this invention. For example, the deflector means might be more nearly flat or the intermediate portion 80 might be formed at an even greater angle with the central portion of the plate 70.

The feature of basic importance is the provision of means for controlling the flow of air in a refrigeration compartment by a plurality of deflecting surfaces suitably arranged and disposed to achieve even and uniform cooling throughout the refrigeration compartment and thereby insure maximum cooling efficiency.

The invention described herein has been found to be particularly successful with a small thermoelectric refrigerator unit. On the other hand, it should be noted that it can be used in units of varying sizes and that it can be used in non-thermoelectric types of refrigerating units wherein improved air circulation in the cooling chamber is desirable.

Thus, while a preferred embodiment of the invention has been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its fullest possible interpretation within the terms of the following claims.

What is claimed is:

1. A refrigeration unit comprising:
a cooling chamber defined by surrounding wall structure;
a cold wall defined by a portion of said wall structure;
heat absorption means associated with said cold wall;
fan means mounted adjacent said cold wall for circulating air in said cooling chamber;
means, associated with said fan means, for controlling the discharge air flow from said fan means,
said controlling means comprising a circular deflector plate mounted adjacent said fan means, said deflector plate being formed with a peripheral portion extending beyond the tips of the blades of said fan means and disposed at an acute angle with respect to said cold wall to define, with said cold wall, a constricting outlet for the air discharged by said fan means.

2. The refrigeration unit of claim 1 wherein said deflector plate has formed therein a central opening through which said fan means draws air from the cooling chamber, and wherein said deflector plate is mounted on said cold wall.

3. In a refrigeration unit,
a cooling chamber having a cold wall provided with a recessed portion;
heat absorption means associated with said cold wall;
a fan associated with said cold wall and having blades disposed adjacent said recessed portion of said cold wall;
an annular plate adjacent to said recessed portion and having circumferentially spaced connections to said cold wall to provide air discharge outlets for air drawn through the opening in said plate by said fan blades,
said plate and recessed portion of said cold wall having angularly disposed surfaces for deflecting the air, discharged by said fan, through said outlets and along the surface area of said cold wall.

4. In a refrigeration unit as defined in claim 3 wherein said fan blades are the axial or propeller type, and said surface of said recessed portion of said cold wall is effective to provide for radial flow of the air, discharged axially by said blades.

5. In a refrigeration unit as defined in claim 3 wherein at least one of said angularly disposed surfaces is convergent toward said outlets to constrict the air flowing through said outlets and thereby increase the velocity of the air along the surface area of said cold wall.

6. In a refrigeration unit as defined in claim 3 wherein said blades provide for axial flow of air from the cooling chamber through the opening in said annular plate and toward said recessed portion, and said surface of said recessed portion is effective to cause radial flow of the air toward said plate surface for deflection of the air by said plate surfaces through said outlets and along the surface area of said cold wall.

7. In a refrigeration unit,
a cooling compartment including a cold wall;
an axial fan mounted on said cold wall, said cold wall having a depression providing a recess for the fan blades;
an annular baffle plate adjacent said depression and provided with a central opening for flow of air from said cooling compartment by said fan toward said depression, said plate being spaced from said wall and having circumferentially spaced portions of its outer periphery connected to said wall to provide air discharge outlets, said fan blades discharging air both radially and axially against said wall depression, and said depression being operative to induce radial flow of the discharged air toward said outlets, and also toward said plate for deflection of the air by said plate, through said outlets and along the surface area of said wall.

8. In a refrigeration unit as defined in claim 7 wherein the outer periphery of said plate is angularly disposed toward said wall to restrict the flow of the discharged air through said outlets to increase the velocity of the air flowing over the surface area of said wall.

9. In a refrigeration unit,
a cooling compartment including a cold wall having a recessed portion;
an annular plate adjacent to said recessed portion and having a central opening providing an air inlet, the outer periphery of said plate being spaced from said cold wall to define an air discharge outlet;
an axial fan associated with said cold wall and having blades disposed between said recessed portion and said plate, said plate recessed portion having frustoconical surfaces converging radially outwardly to construct, and thereby increase the velocity of, the air discharged by said fan blades through said outlet and along the cold wall.

10. In a refrigeration unit,

a cooling compartment including a cold wall having a depressed portion forming a recess in said wall, said portion comprising a central flat surface and a frusto-conical surface surrounding said flat surface;

an annular baffle plate adjacent to said recessed portion and having circumferentially spaced portion of its outer periphery connected to said wall to provide air discharge outlets, said plate having a frusto-conical surface defining a central opening providing an air inlet and being opposed to the frusto-conical surface of said depressed portion, said frusto-conical surfaces converging radially outwardly toward said air discharge outlets;

and an axial fan having blades positioned between said plate and depressed portion and operative to draw air through said opening in said plate and discharge the air axially against said flat surface of said depressed portion and also radially and axially against the frusto-conical surface of said depressed portion.

11. In a refrigeration unit as defined in claim 10 wherein said blades have their tips located radially inwardly of said frusto-conical surfaces.

12. A refrigerator unit comprising:

a cooling chamber defined by surrounding wall structure;

heat absorption means in heat transfer relation to said wall structure and providing a cold wall of said wall structure;

air circulating means in said cooling chamber and

mounted adjacent said cold wall for circulating air in said cooling chamber;

air circulation control means including guide means spaced from and connected to said cold wall and disposed in the air discharge path of said air circulating means, said guide means and said cold wall having adjacent angularly arranged surfaces for deflecting the air from one of said surfaces to the other of said surfaces to induce and direct the flow of the discharged air along the cold wall surface area exteriorly of said guide means.

13. The refrigeration unit of claim 12 wherein said adjacent surfaces of said guide means and said cold wall define a constricting outlet for the air discharged from said air circulating means to increase the velocity of the discharged air.

14. The refrigeration unit of claim 13 wherein said guide means is formed with a peripheral portion disposed at an acute angle to said cold wall for providing a deflecting surface and also a constricted peripheral outlet for the discharged air.

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