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REFRIGERATORS

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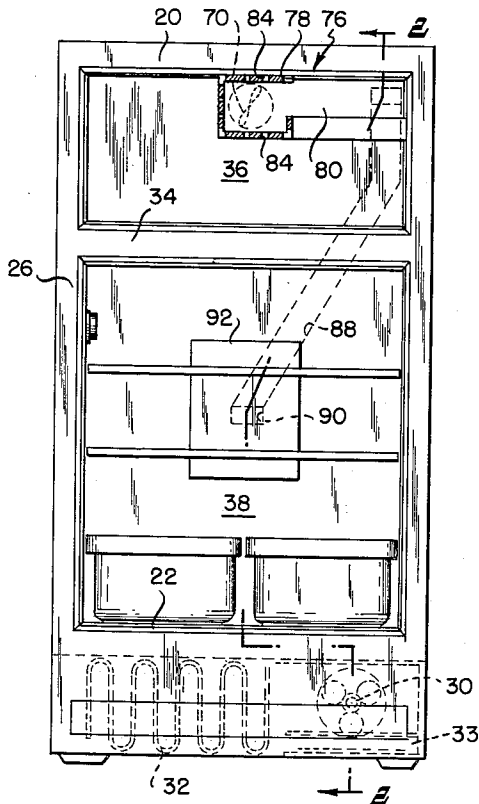


Fig. 1

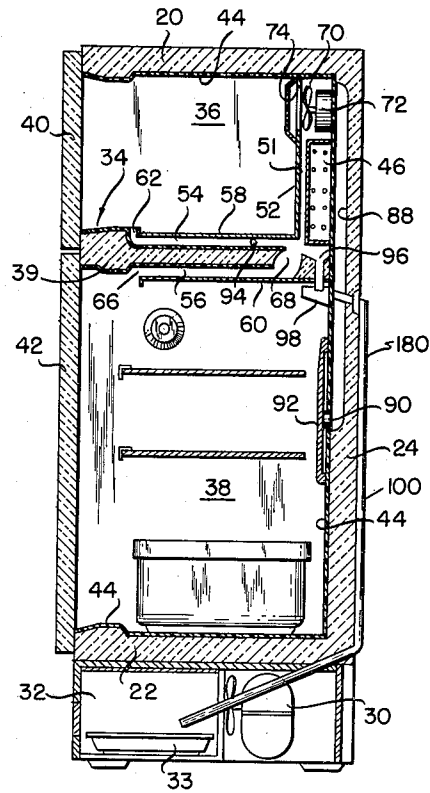


Fig. 2

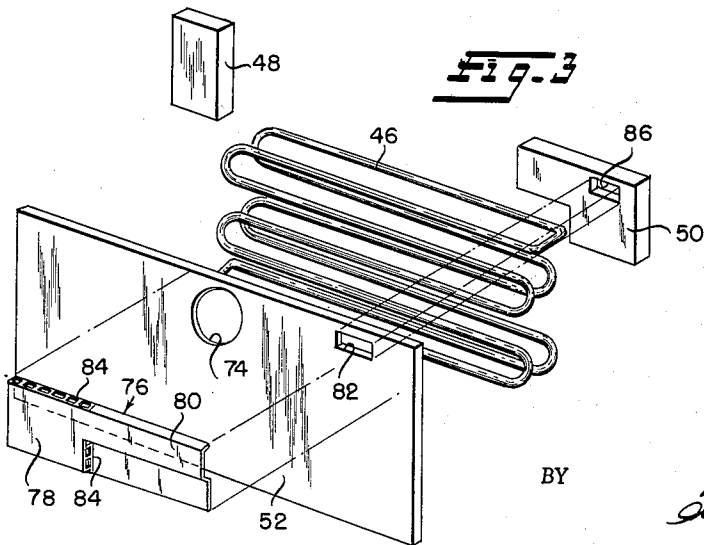


Fig. 3

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This invention relates to refrigeration apparatus, and more particularly to household refrigerators having separate compartments for the storage of frozen foods and the storage of foods at temperatures above freezing.

While multi-compartment household refrigerators have come into wide-spread use because of their convenience, their advantages are offset to some extent by their relatively high cost and relatively low efficiency. In general, such refrigerators either employ separate evaporator coils or coil sections and fans for the two compartments or operate with relatively low efficiency. Associated problems encountered in prior multi-compartment refrigerators employing a single coil are the maintenance of the proper temperature in the two compartments and the maintenance of the proper air-flow patterns.

With these considerations in mind, it is the principal purpose and object of the present invention to provide improved multi-compartment refrigerators employing a single evaporator coil and a single fan which operate with substantially improved efficiency and which are effective to maintain, within close limits, the desired temperature differential in the two compartments.

It is a further object of the present invention to provide improved multi-compartment refrigerators having a unique air flow system providing for the circulation of air in both compartments to assure the maintenance of proper conditions of temperature and humidity within the two compartments.

It is also an object of the present invention to provide a unique divider for a multi-compartment refrigerator which provides passages for channeling and directing the flow of air in both compartments and permits an important simplification in the refrigerator control system.

It is an additional object of the present invention to provide improved multi-compartment refrigerators in which the evaporator apparatus and air circulation system are such that the rate of frost formation on the evaporator apparatus is substantially reduced.

It is a further object of the present invention to provide improved multi-compartment refrigerators which are of relatively simplified construction and which thus may be manufactured and sold at a cost substantially below that of units offering comparable performance.

In attaining these and other objects, the present invention provides multi-compartment refrigerators having a horizontal wall dividing the interior of the refrigerator into an upper frozen food compartment and a lower compartment for the storage of food at temperatures above freezing. For convenience, this latter compartment will be termed a fresh food compartment. The single evaporator coil is positioned at the rear of the frozen food compartment out of the path of the warm air which tends to enter the refrigerator when the door or doors are open. The single fan, which is positioned in the upper compartment, draws air over the evaporator coil, the flow of air being divided by a proportioner, a portion of the air flowing in a closed circuit through the upper compartment and the remainder being delivered to the fresh food compartment. The air return circuits for both compartments are provided by passages formed in a unique manner in the divider.

Additional objects and advantages will become appar-

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ent as the description proceeds in connection with the accompanying drawings in which:

FIGURE 1 is a front elevation of the refrigerator of the present invention with the front door structure removed to show interior details;

FIGURE 2 is a vertical central section taken along line 2-2 of FIGURE 1; and

FIGURE 3 is an exploded view showing the components of the upper portion of the refrigerator.

Referring now more particularly to the drawings, the refrigerator of the present invention is housed in the usual insulated cabinet having top and bottom walls 20 and 22, a rear wall 24 and side walls 26 and 28, the latter extending the full height of the refrigerator compartment between the top and bottom walls 20 and 22. Below the bottom wall 22 the refrigerator is provided with an un-insulated space in which the compressor 30 and the condenser 32 are housed together with a drip pan 33. The condenser per se is no part of the present invention but preferably is the type disclosed in copending application Serial No. 99,541 filed March 30, 1961, for Refrigerators and Components.

The interior of the cabinet is divided by a horizontal wall assembly indicated generally at 34 into an upper frozen food compartment 36 and a lower fresh food compartment 38. The main body of the divider is a block 39 of Styrofoam or like insulating material. Access to the two compartments may be provided by separate upper and lower doors 40 and 42 or by a single door. In this latter case, an inner door will be provided extending across the front of the frozen food compartment 36. The interior surface of the refrigerator cabinet is formed by a liner 44 of plastic or porcelainized steel, preferably formed in one piece covering the full extent of the top, bottom side and rear walls. The horizontal divider wall 34 extends between the liner 44 at the rear and at the opposite sides of the compartment to the door 40 to prevent uncontrolled leakage of air around the margins of the wall.

The single copper tube, aluminum finned coil 46, is mounted at the rear of the freezer compartment 36 closely adjacent the liner 44 and extends vertically along a portion of the liner. As best shown in FIGURE 3, the ends of the coil 46 are spaced from the sides of the freezer compartment and the tops of the spaces formed at the opposite ends of the evaporator coil are closed by insulating blocks 48 and 50 preferably formed of Styrofoam or similar light-weight insulating material. A thin sheet-metal cover plate 52 extends along the front face of the coil 46 across the full height and width of the freezer compartment 36. The upper portion of the cover plate is in surface contact with the styrofoam blocks 48 and 50. Thus the cover plate forms, with the portion of the liner at the rear of the freezer compartment, an air passage 51 closely enclosing the coil 46. At its lower end this passage is in communication with outlet ends of passages 54 and 56 respectively. The passage 54 is formed by a thin metallic sheet 58 which extends over a recessed portion of the top of the divider block 39. The lower passage 56 is formed by a similar thin metal sheet 60 and a similarly recessed portion on the bottom face of the divider block 39. The inlet opening for the passage 54 is formed by a thin slot 62, preferably extending across the full width of the freezer compartment adjacent the forward edge thereof. The inlet 66 for the passage 56 also preferably extends across the full width of the fresh food compartment 38 adjacent the forward edge thereof. The passage 56 communicates with the passage 54 through an elongated slot or openings 68 formed in the divider block 39.

Air is caused to circulate through the freezer compartment and the fresh food compartment by a single fan 70

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driven by a fractional horse-power motor 72, the fan and the motor being positioned in the space behind the cover 52 and above the coil 46. Air is delivered by the fan 70 through an opening 74 in the cover plate 52 into the interior of a smaller cover 76 mounted on the front side of the cover plate 52. The cover 76 has a square box-like section 78 at one end in communication with a laterally extending channel 80 which extends over a second opening 82 in the cover plate 52.

The marginal edges of the box-like section 78 are provided with louvers 84 through which air delivered by the fan 70 flows in a diffused pattern into the upper portion of the freezer compartment 36. A portion of the air delivered by the fan 70 also passes through the channel 80 and through the opening 82 and through a corresponding opening 86 in the block 50 and into the upper end of an air duct 88 which extends along the outer surface of the liner 44 and the lower end of which is positioned opposite an opening 90 formed in the liner 44 adjacent the center of the rear wall of the fresh food compartment 38. A thin plate 92 is mounted over the opening 90 to provide a general diffused flow of air in the fresh food compartment 38. The size of the louver openings 84 in the fan cover 76 is carefully selected so the amount of air entering the fresh food compartment is carefully balanced with the amount of air entering the freezer compartment to maintain proper temperatures in both sections.

The air delivered by the fan to the freezer compartment 36 is returned to passage 51 through the passage 54 and the air delivered by the fan to the fresh food compartment 38 is returned to passage 51 through the passage 56 and opening 68.

The condenser and the fan are controlled by wholly conventional circuits which have been omitted since they are not necessary to an understanding of the invention. Controls will be so arranged that both the compressor 30 and the fan motor 72 are energized and de-energized by a temperature sensitive element located within the refrigerator. Provision is also made for de-energizing the fan motor 72 whenever the refrigerator doors are open.

The control capillary or other temperature sensitive element 94 is suspended between the metal sheet 58 and the main body 39 of the divider 34 out of contact with the surface of either of these elements so that it is responsive solely to the temperature of the air passing through the channel 54. When the fan and condenser are de-energized, the relatively warm air at the top of the fresh food compartment 38 will tend to circulate upwardly through the passage 56. A certain amount of this air will flow in a reverse direction through the passage 54 contacting the temperature sensitive element 94 which, when warmed sufficiently, will energize the compressor 30 and the fan motor 72. As soon as the fan 72 begins to operate, temperature sensitive element 94 is effectively placed in the path of the air drawn from left to right as viewed in FIGURE 2 through the passage 54. Thus, the cooling cycle is initiated in response to a rise in temperature in the fresh food cabinet and is discontinued when the temperature in the freezer compartment reaches a desired value. It has been found that this system of control effectively provides properly balanced temperatures in the two compartments.

Periodic defrosting is accomplished by conventional components which have been omitted for clarity. Preferably the defrost is accomplished by tubular heaters embedded in the cooling coil 46. The melted ice and frost drips into a collector 96 thence to a receptacle 98 and through a drain line 100 outside the cabinet. The water is delivered to the drip pan 33 where it is evaporated by compressor heat.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the

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appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A refrigerator comprising an insulated cabinet, an insulated horizontal wall dividing said cabinet into first and second compartments, a vertically extending evaporator coil in said first compartment at the rear thereof, means forming a vertically extending first air passage closely surrounding said evaporator coil, a fan for drawing air through said first passage over said coil, flow divider means for delivering a portion of said air to said first compartment and the remainder of said air to said second compartment, and means forming second and third passages extending horizontally between the front and rear portions of said divider wall, said second passage having an inlet adjacent the front of said first compartment and said third passage having an inlet adjacent the front of said second compartment, each of said passages having an outlet at the rear of said cabinet communicating with said first passage.

2. A refrigerator comprising an insulated cabinet, an insulated horizontally extending wall assembly dividing said cabinet into first and second compartments, a vertically extending evaporator coil in said first compartment at the rear thereof, means forming a vertically extending first air passage closely surrounding said evaporator coil, a fan for drawing air through said first air passage over said coil, means for delivering a portion of said air to said first compartment and the remainder of said air to said second compartment, and horizontally extending sheets mounted in the respective first and second compartments in spaced relation to said insulating wall to form therewith additional air passages for returning air from said first and second compartments to said first air passage, said additional air passages having inlet openings at the front of said cabinet and having outlet openings adjacent the rear of said cabinet.

3. A refrigerator comprising an insulated cabinet having top, bottom, rear and side walls and door structure forming the front wall of said cabinet, an insulated wall assembly dividing said cabinet into upper and lower compartments, an evaporator coil extending vertically in said upper compartment adjacent said rear wall, means forming a vertically extending first air passage closely surrounding said coil, a fan for drawing air through said first passage over said coil, a diffuser plate mounted in said upper cabinet in the path of air delivered by said fan to direct a portion of said air into said upper compartment, passage means in the rear wall of said cabinet connecting said upper compartment with said lower compartment, means for directing the remainder of the air delivered by said fan through said passage means to said lower compartment, and means forming separate passages extending horizontally adjacent the upper and lower surfaces of said wall for returning air from the respective compartments to said first air passage, each of said separate passages having an inlet adjacent the front of said cabinet.

4. A refrigerator comprising an insulated cabinet, a horizontally extending insulated wall dividing said cabinet into first and second compartments, a vertically extending evaporator coil in said first compartment at the rear thereof, a condenser-compressor assembly positioned externally of said cabinet and connected to said evaporator coil, means forming a vertically extending first air passage closely surrounding said coil, a fan for drawing air through said first air passage over said coil, means for delivering a portion of said air to said first compartment and the remainder of said air to said second compartment, means forming second and third horizontal passages in said wall, said horizontal passages having inlets respectively adjacent the front of said first and

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second compartments and having outlets communicating with said first air passage, said second and third passages thereby being effective to return air from the respective compartments to said first air passage, and a temperature sensitive element for controlling the operation of said compressor and said fan positioned in said second air passage to be subject to the air flowing therethrough when said fan is energized and subject to air flowing from said third passage into said second passage by convection when said fan is de-energized.

5. A refrigerator comprising an insulated cabinet having top, bottom, rear and side walls, door structure forming the front wall of said cabinet, a continuous liner extending along and covering the inner surface of said top, bottom, rear and side walls, an insulated shelf construction extending horizontally along the full width and depth of said cabinet within said liner and dividing said cabinet into an upper frozen food compartment and a lower fresh food compartment, an evaporator positioned along the rear wall of said frozen food compartment, a fan in said frozen food compartment for causing air to flow over said evaporator into each of said compartments, and means providing passages in said shelf for returning air from each of said compartments to said evaporator.

6. A refrigerator comprising an insulated cabinet having top, bottom, rear and side walls, door structure forming the front wall of said cabinet, a continuous liner extending along and covering the inner surface of said top, bottom, rear and side walls, an insulated horizontal wall dividing said cabinet into a frozen food compartment and a fresh food compartment, said horizontal wall extending across the full width and depth of said cabinet within said liner, a vertically extending evaporator coil in said frozen food compartment at the rear thereof inwardly of said liner, means forming a vertical first air passage closely surrounding said evaporator coil, a fan for drawing air through said first passage over said coil, flow divider means for delivering a portion of said air to said frozen food compartment, means forming second and third passages extending horizontally between the front and rear portions of said divider wall, said second passage having an inlet adjacent the front of said frozen food compartment and said third passage having an inlet adjacent the front of said fresh food compartment, each of said passages having an outlet at the rear of said cabinet communicating with said first passage.

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7. The combination according to claim 6 wherein said fan is positioned above said evaporator coil adjacent the upper edge of said frozen food compartment and said flow divider means comprises a cover plate extending over said fan and having openings communicating directly with said frozen food compartment, and a second passage leading to said fresh food compartment.

8. The combination according to claim 6 together with a drip trough positioned below said evaporator coil between said liner and the rearward end of said second and third passages and means connecting the drip trough to the exterior of said cabinet.

9. A refrigerator comprising an insulated cabinet, a horizontally extending insulated wall dividing said cabinet into first and second compartments, a vertically extending evaporator coil in said first compartment at the rear thereof, a condenser-compressor assembly positioned externally of said cabinet and connected to said evaporator coil, means forming a vertically extending first air passage closely surrounding said coil, a fan for drawing air through said first air passage over said coil, means for delivering a portion of said air to said first compartment and the remainder of said air to said second compartment, means forming second and third horizontal passages in said wall, said horizontal passages having inlets respectively adjacent the front of said first and second compartments and having outlets communicating with said first air passage, said second and third passages thereby being effective to return air from the respective compartments to said first air passage, and a temperature sensitive element for controlling the operation of said compressor and said fan positioned to be subject to air flowing from said first compartment to said evaporator coil when said fan is energized and subject to air flowing by convection from said second compartment when said fan is de-energized.

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