

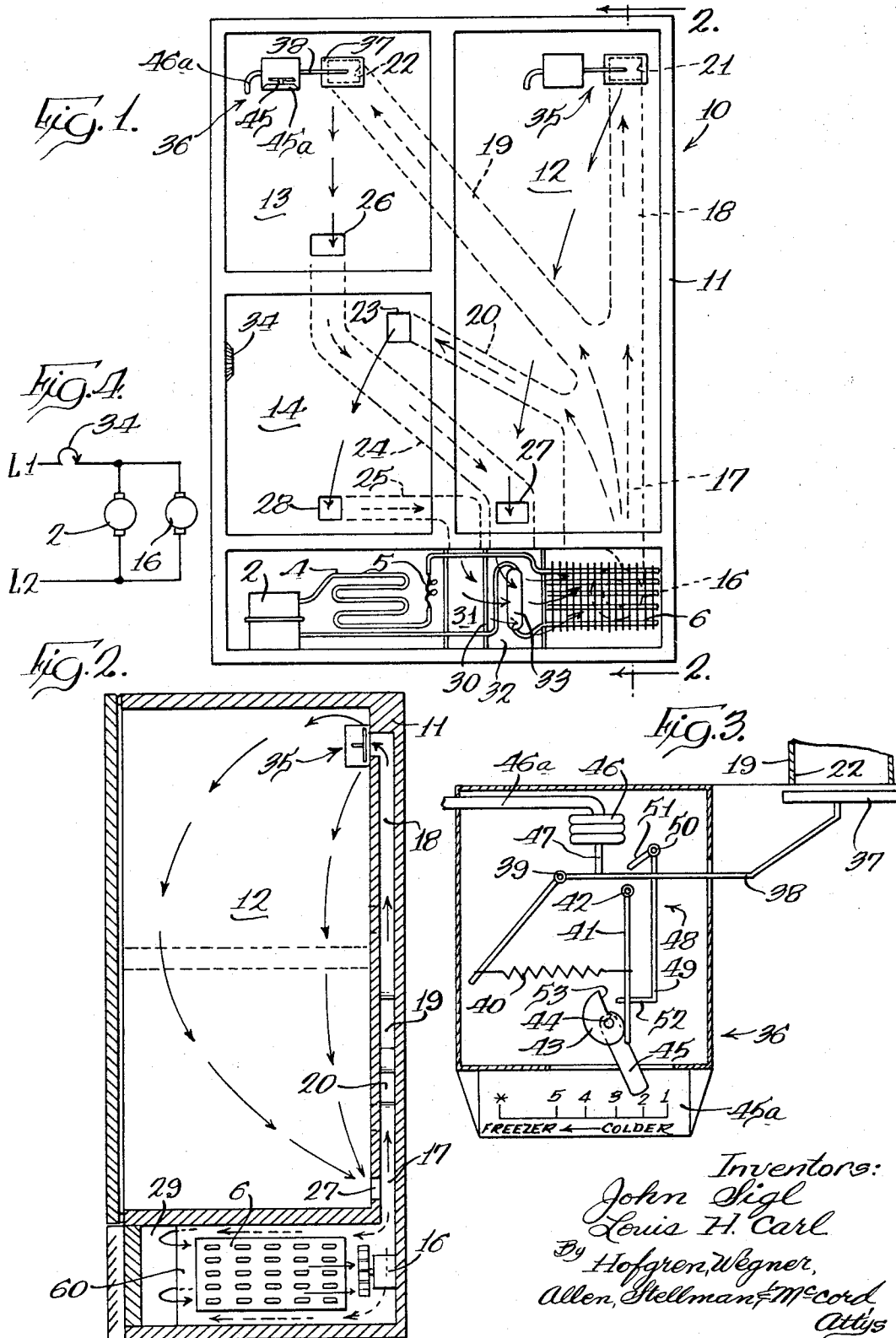
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REFRIGERATOR WITH CONVERTIBLE COMPARTMENT

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REFRIGERATOR WITH CONVERTIBLE COMPARTMENT

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ABSTRACT OF THE DISCLOSURE

A combination refrigerator-freezer having three compartments, one of which has a cold air controller permitting operation selectively as a refrigerator or freezer section. The air controller is locked open when the convertible compartment is operated as freezer and is thermally responsive to modulate the cold air flow when the compartment is operated as a refrigerator.

This invention relates to refrigeration apparatus and in particular to means for controlling the temperature of a plurality of refrigerated compartments.

In the conventional refrigerator-freezer apparatus means are provided for maintaining a refrigerator compartment at an above-freezing temperature, and for maintaining the freezer compartment at a below-freezing temperature. The needs of the user, however, may vary from time to time and thus it has been found desirable to provide a portion of the apparatus which may be maintained selectively as a refrigerator compartment or a freezer compartment as desired by the user. The present invention comprehends a refrigerator-freezer apparatus having new and improved means for providing such selective, convertible compartment use.

Thus, a principle feature of the present invention is the provision of a refrigeration apparatus having new and improved means for providing convertibility of a compartment thereof selectively to different temperature conditions.

Another feature of the invention is the provision of such a refrigeration apparatus including selectable means for adjustably regulating the temperature of the convertible compartment and for permitting maximum heat transfer conditions therein.

A further feature of the invention is the provision of such a refrigeration apparatus including a first refrigerator compartment, a second convertible compartment, and a third freezer compartment and means for selectively controlling the cooling of the convertible compartment to have either an adjustable above freezing temperature or a below freezing temperature as desired by the user.

Still another feature of the invention is the provision of such an apparatus including means for forced circulation of refrigerated air to effect the desired cooling of the several compartments and means for regulating the flow of the air separately to said compartments.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIGURE 1 is a diagrammatic front elevation of a refrigerator-freezer apparatus embodying the invention;

FIGURE 2 is a vertical section thereof taken substantially along the line 2—2 of FIGURE 1;

FIGURE 3 is a schematic representation partially in cross section of the air flow control means thereof; and

FIGURE 4 is a circuit diagram illustrating a portion of the control for the refrigerator-freezer apparatus.

In the exemplary embodiment of the invention as disclosed in drawing, a refrigeration apparatus generally designated 10 herein comprises a combination refrigerator-

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freezer having a cabinet 11 defining a first, refrigerator compartment 12, a second, convertible compartment 13, and a third, freezer compartment 14.

The respective compartments are cooled by a suitable fluid in heat transfer association therewith, and in the illustrated embodiment, the fluid comprises refrigerated air which is cooled by suitable means such as a conventional refrigeration system comprising a compressor 2, a condenser 4, a restrictor 5, and an evaporator 6. The air is force-circulated to the respective compartments by a suitable air moving apparatus, herein a blower 16, through a manifold duct 17 and individual compartment feed ducts 18, 19, and 20. Thus, a refrigerated air enters compartment 12 from duct 18 through an opening 21, refrigerated air enters compartment 13 from duct 19 through an opening 22 and refrigerated air enters compartment 14 from duct 20 through an opening 23.

Air is returned from the compartments for recooling by evaporator 6 by means of a first return duct 24 and a second return duct 25. Air from compartment 13 enters duct 24 through an outlet opening 26, and air from compartment 12 enters duct 24 adjacent the lower end thereof through an outlet opening 27. Air enters duct 25 from compartment 14 through an outlet opening 28. The return air enters a plenum chamber 29 which is divided by a wall 30 into a first space 31 receiving air from duct 25, and a second space 32 receiving air from return duct 24. An evaporator header or accumulator 33 is disposed in space 32 whereby the relatively moist refrigerator air is firstly cooled to remove a substantial amount of moisture therefrom by contact with the low temperature header before the air is passed to the evaporator. A wall 60 divides space 32 from the portion of plenum chamber 29 housing evaporator 15 and precludes short circuiting of return air directly to the evaporator.

The air delivered from evaporator 6 to manifold duct 17 comprises a commingling of the returned air effectively cooled to a desired low temperature by heat transfer association with the evaporator. A first portion of this low temperature air passes into chamber 12 through inlet opening 21, a second portion of this air passes into compartment 13 through inlet opening 22, and a third portion of this air passes into compartment 14 through inlet opening 23. As shown in FIGURE 1, the inlet 23 is unobstructed and, thus, compartment 14 receives continuous cooling to define a below-freezing chamber.

The temperature of compartment 14 may be controlled by a thermally responsive device 34 which responds to the temperature in freezer compartment 14 to control the operation of the refrigeration apparatus. Referring to FIGURE 4 it will be seen that thermally responsive device 34 comprises a switch in electrical circuit with compressor 2 and blower 16. When the switch closes in response to a predetermined high temperature the compressor and blower are energized and when the switch opens in response to a predetermined low temperature the compressor and blower are deenergized.

The inlet openings 21 and 22 are provided with mechanical temperature control means 35 and 36, respectively, for adjustably regulating the rate of flow of the refrigerated air through these chambers. More specifically, the controls 35 and 36 herein are similar, except that control 36 is further provided with means for locking out the adjustable control and maintaining the inlet opening 22 unobstructed when desired by the user. Thus, control 36 permits the user to utilize compartment 13 convertibly as a regulated temperature compartment in the manner of compartment 12 or an unregulated air flow freezer compartment in the manner of compartment 14. The thermally responsive device 34 is effective to control the on and off operation of the refrigeration apparatus

and the controls 35 and 36 are effective to control air flow to their respective compartments when the apparatus is on.

Because the control point for the apparatus compressor 2 and blower 16 is in the freezer, the forced air system of the present invention is arranged to provide sufficient cold air flow to compartments 12 and 13 to satisfy the cooling requirements of these compartments before the cooling requirement of freezer compartment 14 is satisfied. The illustrated forced air system, by proper selection of duct cross-sectional areas, duct directions, and cooperation of the respective ducts with the outlet of blower 16 is thus arranged to favor distribution of air to compartments 12 and 13 over freezer compartment 14. Air leaving blower 16 moves up the right-hand side of manifold duct 17 as viewed in FIGURE 1 and enters feed duct 18, provided control 35 has not closed inlet 21. In the division of the air flow, convertible compartment 13 is next favored, and freezer compartment 14 last favored. The stream of cold air discharged from blower 16 is thus divided on a preferential basis between ducts 18, 19 and 20, and compartment 13 is favored next after compartment 12 because compartment 13 may be operated as either a refrigerator or a freezer. If convertible compartment 13 was first favored, it could rob compartment 12 of cooling when operated as a freezer. While compartment 13 is favored over compartment 14 as described above, the system is arranged so that compartment 13 is not overly favored because when operated as a freezer, compartment 13 always receives cold air and thus reduces the amount of cold air available to compartment 14.

Referring now to FIGURE 3, the control 36 includes a damper 37 in overlying relationship to the opening 22. The damper is carried on an arm 38 which is pivotally mounted on a suitable pivot 39 to swing the damper 37 toward and away from the opening 22. The arm 38 is biased by a spring 40 in a counterclockwise direction as seen in FIGURE 3 to urge the damper to a closed air flow restricting position relative to the duct opening 22. The spring is connected between arm 38 and a cam follower 41 which is pivotally mounted on a pivot 42 and which rides against a cam 43 under the biasing action of spring 40. The cam is pivotally mounted on a pivot 44 to which is connected a handle 45 for manually adjusting the position of the cam. Suitable indicia of the temperature condition selected are displayed to the user on a panel 45a beneath handle 45.

Control 36 includes a thermally responsive fluid-filled bellows 46 with a connected sensing element 46a exposed to compartment 13. Bellows 46 is provided with an actuating arm 47 which engages the damper arm 38 to pivot the arm 38 in a clockwise direction about the pivot 39 and, thus, control the relationship of damper 37 to the inlet opening 22 as a function of the temperature in compartment 13. An increasing temperature in compartment 13 will cause bellows 46 to expand and move damper 37 away from opening 22. Tension on spring 40 as controlled by cam 43 changes the effect of bellows 46 on damper 37 to alter the amount of cooling air supplied to compartment 13 at any given compartment temperature. Increasing the tension on spring 40 raises the control point temperature of control means 36. Control means 35 is similar to this structure of control means 36.

In operation, the above described structure of control means 36 provides a variable closure of opening 22 by the adjustable positioning of the damper 37 under the control of the cam 43 and the bellows 46 to provide a preselected temperature range in compartment 13. In the illustrated embodiment, cam 43 is arranged so that rotation thereof in a clockwise direction (as seen in FIGURE 3) decreases the tension on spring 40 thus permitting the bellows 46 to overcome the spring and move the damper 37 away from the opening 22 at a relatively lower temperature. Alternatively, rotation of the cam 43 in counterclockwise direction causes the spring tension to be increased, thereby requiring

a higher temperature to move the damper 37 by the bellows 46. To provide a desired operating temperature, the user need merely adjust the position of cam 43 by manipulation of handle 45.

As indicated briefly above, control 36 further includes means for locking the damper in the fully opened position when desired. As shown in FIGURE 3, the locking means, generally designated 48, includes a lever 49 pivotally mounted on a pivot 50 and having connected thereto an arm 51 adapted to engage the damper arm 38. A second arm 52 is provided at the other end of lever 49 and is arranged to be engaged by a shoulder 53 on the cam 43 by extreme clockwise movement of the cam. The lever 49 is pivoted in a counterclockwise direction as seen in FIGURE 3 when shoulder 53 contacts arm 52, whereby arm 51 urges arm 38 to the fully opened position. Thus, the arm 38 is locked against pivotal movement toward inlet opening 22, which permits continuous air flow into compartment 13 notwithstanding a retraction of the bellows actuating arm 47 due to lower temperatures in compartment 13. To reinstate the regulated damper control, the user merely rotates cam 43 by means of handle 45 to disengage shoulder 53 from arm 52 and permit control of damper 37 by bellows 46.

Thus, apparatus 10 provides a refrigerator compartment, a freezer compartment, and a convertible compartment which may be utilized either as a regulated temperature refrigerator compartment or as a full air flow freezer compartment. When the compartment 13 is utilized as a refrigerator compartment wherein the air is relatively moist, the moisture is effectively dehumidified by the flow of the return air over the header 33 together with the return air from compartment 12. The individual regulated control of compartment 13 provided by control means 36 permits the compartment 13 to be regulated at a different temperature from that of compartment 12 hereby providing further improved utility of apparatus 10.

While we have shown and described one embodiment of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A forced air refrigerator-freezer apparatus comprising:

- an insulated cabinet defining an above freezing refrigerator compartment, a below freezing freezer compartment, and a convertible compartment selectively operable in above and below freezing temperature ranges;
- air cooling means;
- duct means interconnecting said air cooling means and said compartments;
- air moving means associated with said duct means for circulating air from said air cooling means through said duct means and said compartments; and means for controlling the cooling of said convertible compartment by said air selectively in above and below freezing temperature ranges, including selectively adjustable temperature responsive control means in said convertible compartment.

2. The refrigerator-freezer apparatus of claim 1 wherein said control means includes means for locking said control means in a position permitting continuous air flow to said convertible compartment.

3. The refrigerator-freezer apparatus of claim 1 wherein said duct means includes a common portion for commingling air returned from said convertible and refrigerator compartments before recirculating it thereto.

4. The refrigerator-freezer apparatus of claim 1 including a second temperature responsive control means

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for controlling the temperature of said refrigerator compartment.

5. The refrigerator-freeze apparatus of claim 1 including thermally responsive means in said freezer compartment for controlling operation of said air cooling means to maintain said freezer compartment in a pre-selected temperature range.

6. The refrigerator-freezer apparatus of claim 1 wherein said temperature responsive control means comprises:

- a bellows controlled damper for regulating air flow to said convertible compartment;
- a spring for biasing said damper toward an air flow restricting position;
- cam means for altering the biasing effect of said spring;
- manually adjustable means associated with said cam means for moving said cam means to any of a plurality of positions wherein the biasing effect of said spring is changed; and
- means for locking said damper in a fully open, non-air flow restricting position, said means including a portion of said cam means, whereby said control means is adjustable to provide a plurality of above freezing temperature selections by changing the biasing effect of said spring and to provide a single below freezing temperature selection by locking said damper in a fully open position.

7. The refrigerator-freezer apparatus of claim 1 wherein said air moving means and said duct means are

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cooperatively arranged to supply air to said refrigerator and convertible compartments in preference to said freezer compartment.

8. The refrigerator-freezer apparatus of claim 7 including a thermally responsive device in said freezer compartment for controlling operation of said air cooling means.

9. The refrigerator-freezer apparatus of claim 8 wherein said thermally responsive device further controls operation of said air moving means.

10. The refrigerator-freezer apparatus of claim 9 wherein said temperature responsive control means in said convertible compartment is a bellows controlled damper for regulating air flow to said convertible compartment.

11. The refrigerator-freezer apparatus of claim 10 including a bellows controlled damper in said refrigerator compartment for regulating air flow thereto.

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