April 2, 1968 W. F. HELSEL 3,375,679

REFRIGERATOR-FREEZER CONSTRUCTION

Filed Feb. 9, 1967 4 Sheets-Sheet 1

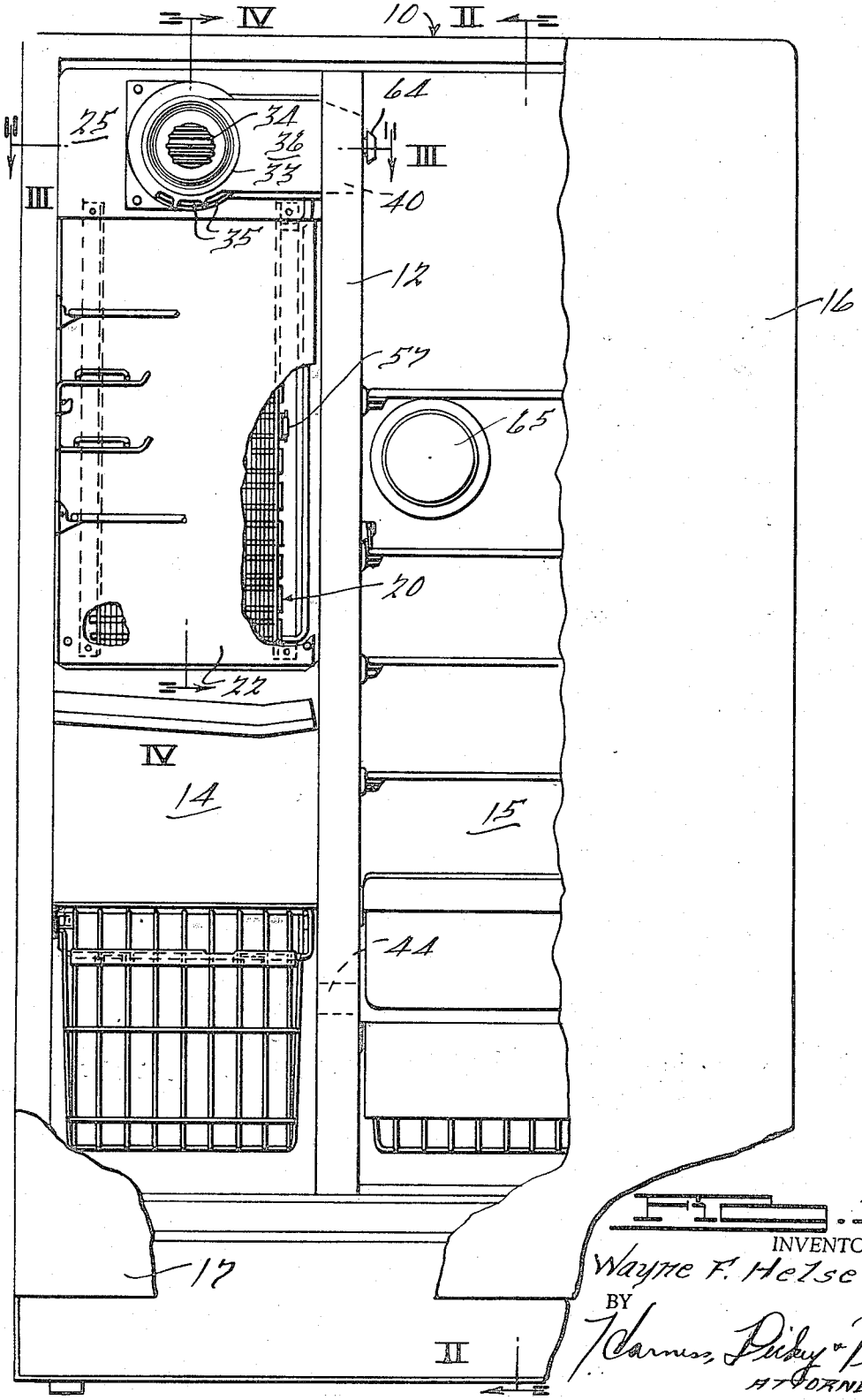

FIG. 1.

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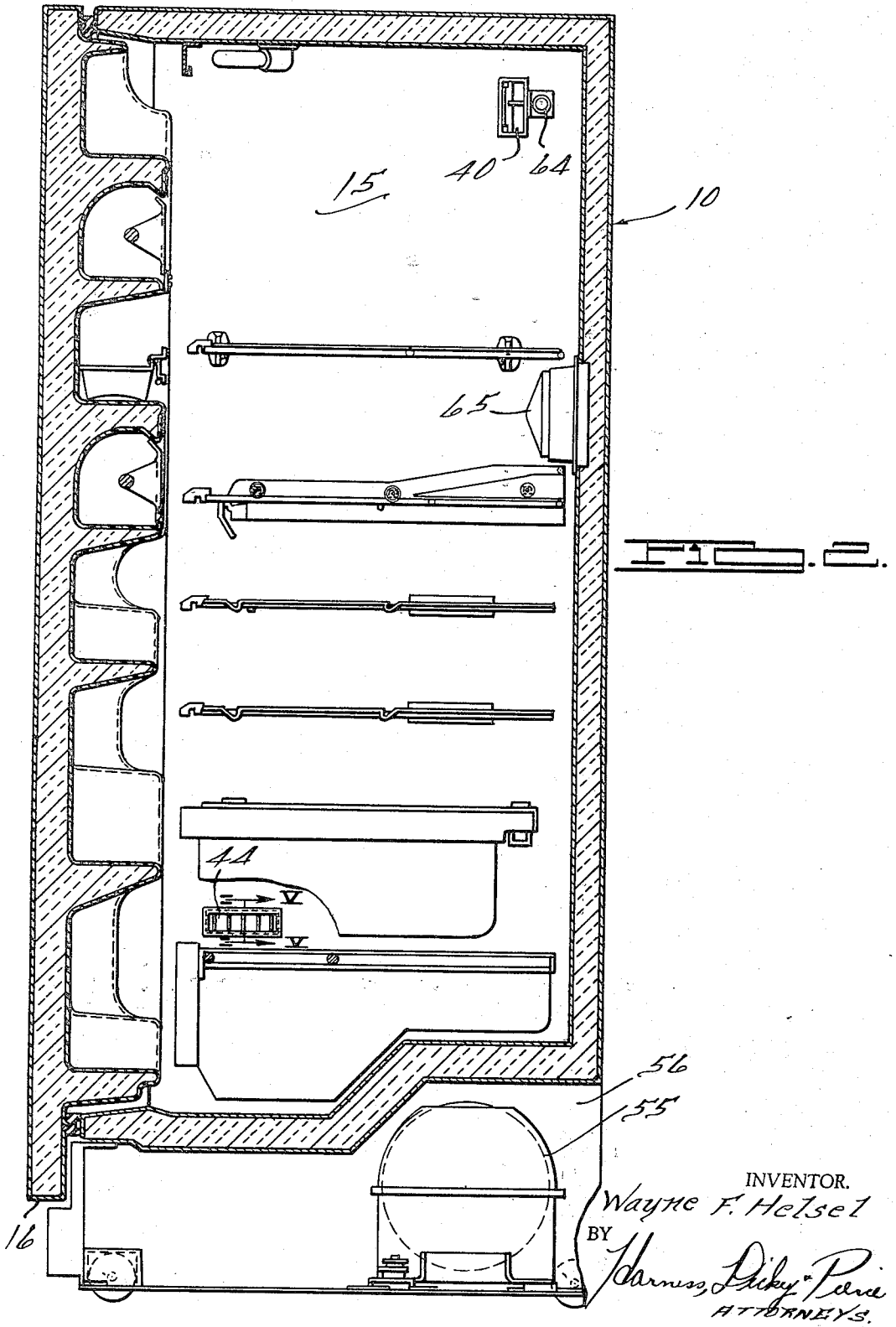

FIG. 2.

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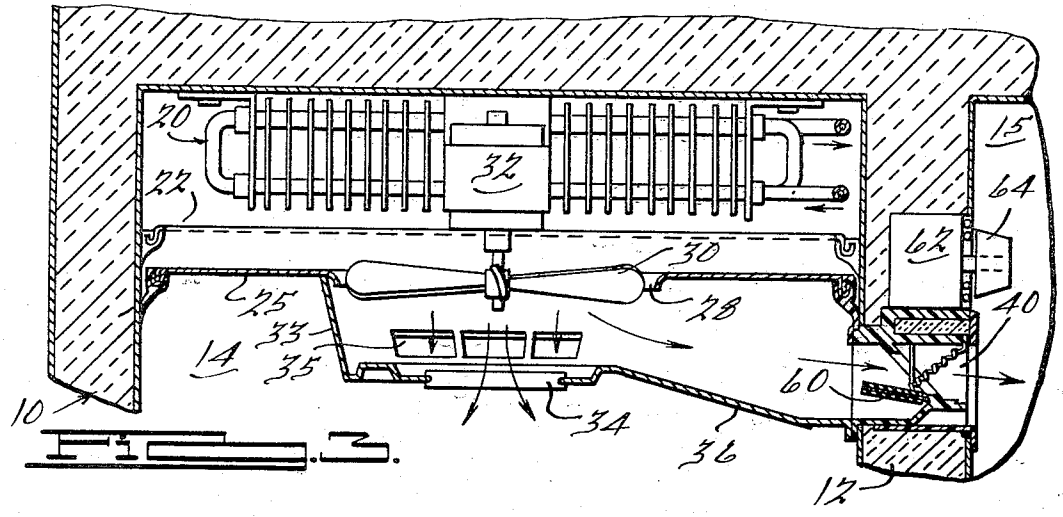


FIG. 3.

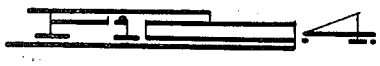
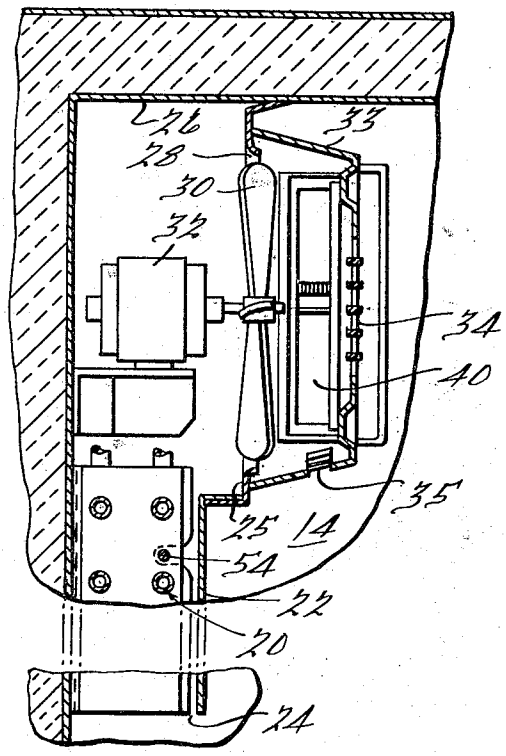


FIG. 4.



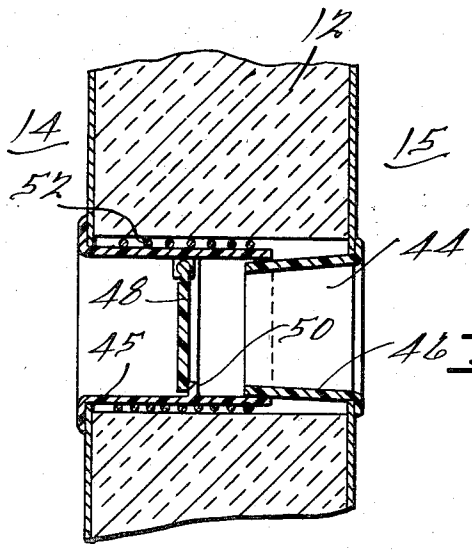


FIG. 5.

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Filed Feb. 9, 1967 4 Sheets-Sheet 4

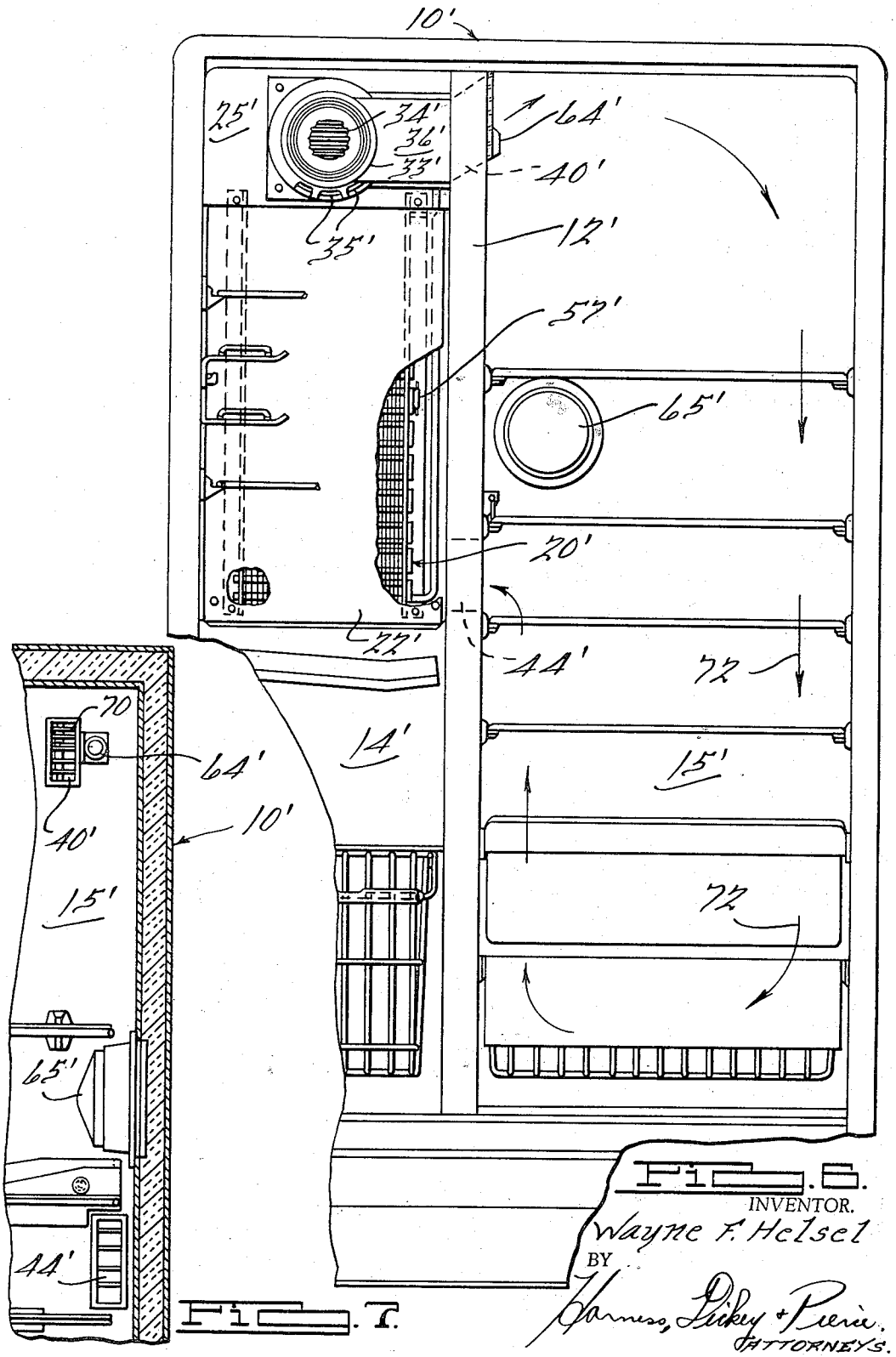

FIG. 6.

FIG. 7.

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United States Patent Office

3,375,679

Patented Apr. 2, 1968

3,375,679

REFRIGERATOR-FREEZER CONSTRUCTION

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Continuation-in-part of application Ser. No. 485,269, Sept. 7, 1965. This application Feb. 9, 1967, Ser. No. 622,872

6 Claims. (Cl. 62—441)

ABSTRACT OF THE DISCLOSURE

A refrigerator-freezer has two compartments arranged side-by-side and separated by a vertical partition extending from front to back of the cabinet. A freezer compartment for storage of foods at below freezing temperatures contains an evaporator on its back wall covered by a baffle, an upper portion of the baffle communicating with a combined fan housing, shroud assembly and duct structure containing a fan which draws air upwardly over the evaporator behind the baffle, and discharges the chilled air in two streams, one stream directed forwardly into the top of the freezer compartment and another laterally through the partition into the top of the warmer compartment. The air which enters the warmer compartment flows downwardly therein and returns to the freezer compartment through a return duct extending through the partition at a lower position. A damper in the return duct opens in the direction of return flow but closes in the opposite direction to prevent backflow of air into the warmer compartment during off cycles of the fan. An automatic damper responsive to the air temperature in the warmer compartment is also disclosed for controlling the volume of air delivered to the warmer compartment. In one embodiment the return duct is located near the bottoms of the two compartments. In another embodiment the return duct is located at a higher elevation but below the inlets and returns the air from the warmer compartment to the space behind the baffle in the freezer compartment.

This application is a continuation-in-part of my previously filed copending application, Ser. No. 485,269, filed Sept. 7, 1965, now abandoned.

Brief summary of the invention

The present invention relates to refrigeration equipment and particularly to an improved multi-compartment refrigerated cabinet construction adapted for the storage of perishable goods at different temperatures. The invention has important utility in connection with household refrigerators of the class having separate compartments for the storage of frozen and unfrozen food.

An important object of the invention is to provide an improved refrigerator-freezer having vertical compartments arranged side-by-side and separated by a vertical wall, and wherein the two compartments may be reliably and uniformly maintained at substantially different temperatures through the agency of a single refrigerating system employing a single evaporator located in the colder compartment, and a single fan, and wherein the entire system is of simple, inexpensive and reliable construction. A further object is to provide such a construction which occupies a minimum of space within the cabinet and which requires a minimum of internal or inaccessible duct-work. Another object is to provide such a construction wherein efficient air circulation is maintained throughout both compartments.

Other objects and advantages will be apparent upon consideration of the present disclosure in its entirety.

In the drawing:

FIGURE 1 is a somewhat diagrammatic front elevational view of a household refrigerator-freezer incorporating the present invention with certain portions omitted and some parts broken away;

FIGURE 2 is a vertical sectional elevational view taken substantially on the line II—II of FIGURE 1 and looking in the direction of the arrows;

FIGURES 3 and 4 are cross sectional views taken substantially on the lines III—III and IV—IV, respectively, of FIGURE 1 and looking in the direction of the arrows;

FIGURE 5 is a cross sectional view taken substantially on the line V—V of FIGURE 2, looking in the direction of the arrows;

FIGURE 6 is a front view similar to FIGURE 1 but partly broken away and showing a modified construction; and

FIGURE 7 is a fragmentary vertical sectional elevational view of the upper rear portion of the modified construction, corresponding in section plane and direction of view to FIGURE 2.

Referring now to the drawing:

Reference character **10** designates generally the insulated external cabinet of a household refrigerator-freezer of the front-opening type having an internal partition **12** which divides the interior into a freezing compartment **14** and a compartment **15** for non-frozen cool storage of foods. The partition **12** extends all the way to the front, and the cabinet may be provided with individual doors as **16**, **17** for each compartment. The doors are hinged at their outer edges to the vertical side walls of the outer cabinet and seal at their abutting inner edges against the front of partition **12**. It will be recognized that the door arrangement is a matter of choice on the part of the designer, and that a single external door may be employed if desired, in which event the single door may seal against the partition wall **12** as well as against the periphery of the cabinet structure. An internal door may also be used to protect the freezer compartment against unwanted escape of air when the main door is opened, as is also a frequent practice in the construction of refrigerator-freezers of this general class.

Within the freezer compartment and mounted flat against the upper portion of the back wall is a finned evaporator **20** which may be of conventional construction. The evaporator is designed for vertical circulation of air and its front is covered by a baffle plate **22** which extends the full width of the compartment. An upward continuation **25** of the baffle **22** extends to juncture with the top wall **26** of the freezer compartment liner. The partition portions **22** and **25** are effectively sealed to the liner of the freezing compartment at the sides and top, but the bottom is open as indicated at **24** so that the baffle portions **22–25** coact to define an open-bottomed stack containing the evaporator.

A circular opening **28** is formed in the front of the baffle portion **25** for the impeller **30** of an air circulating fan, the driving electric motor of which is designated **32**. The fan discharges forwardly into a housing **33** which covers the fan and extends laterally to partition **12** where it communicates with a port **40**. Housing **33** permits escape of air only through port **40** and through outlet openings **34**, **35** in the front central portion and lower portion respectively of housing **33**. Openings **34**, **35** discharge a predetermined proportion of the discharge from the fan into the freezer compartment **15**, and a smaller predetermined proportion is conducted through the laterally extending duct portion **36** of the housing and through port **40** into the upper rear area of compartment **15**.

Another port **44** extends through the partition **12** near

the lower front. As best shown in FIGURE 5, the port **44** is provided with a liner formed by telescoping sections **45**, **46**, the former of which is provided with an internal check-type damper **48** hinged at the top and urged by gravity toward a closed position against a shoulder **50** on its side toward compartment **15** so that it may be urged toward open position by a flow of air from the higher temperature compartment **15** into the freezer compartment **14**. Damper **48** is preferably made of a light weight plastic material and hinged in a low friction manner such that it will open under slight pressure differential, but will close to prevent back flow from the freezer into the higher temperature storage compartment.

The evaporator **20** is maintained at a suitable reduced temperature by refrigerating apparatus which may include the motor compressor unit **55** located in a compartment **56** beneath the cabinet. The details of construction of the refrigerating components per se do not form a part of the present invention.

The openings **34**, **35** from the fan chamber into the freezer compartment and the duct **40** are so proportioned to each other and to the air flow and designed operating temperature range of the evaporator that the heat absorbing capacities of the chilled air delivered to the two compartments bear a desired proportional relationship to each other.

The fan induces an upflow over the evaporator in a direction opposite to that which would be induced by natural convection, and the chilled air is discharged into the upper portion of main food storage compartment **15**, where it tends to fall due to its low temperature. Due to the induced pressure differential the damper **48** opens when the fan is operating permitting a return flow of air into the freezer compartment from the compartment **15**.

During off cycles of the compressor, air tends to fall in the freezer compartment due to the chilling effect of the evaporator and the frozen contents, and air tends to rise in the compartment **15**. These tendencies maintain the damper **48** closed preventing unwanted movement of very cold air into the non-frozen storage compartment **15**.

The fan motor **32** is preferably so connected electrically to the circuitry for the refrigeration compressor that the fan runs only when the compressor is also running, and a cutout switch is also preferably incorporated in the door of the freezer compartment, and so connected as to disconnect the fan whenever the freezer door is opened.

In a successful embodiment of this invention the evaporator refrigerant inlet is at the top, and the refrigerant outlet is at the bottom of the evaporator. The sensing bulb **57** for the compressor control thermostat is secured about midway of the height of the evaporator to one of the return bends and the operating temperature range may be adjustable by the dial **65** of a conventional temperature control unit mounted on the back wall of the liner of compartment **15**. The evaporator assembly may incorporate a heater-type defroster **54**.

A small electrical resistance-type heater **52** may be included in the duct **44** surrounding the liner **45**. This is of very small size, of the order of one or two watts. The invention has been successfully operated without this heater, but in my presently preferred embodiment I regard this heater as useful to prevent any unwanted gathering of frost in the area of the duct and damper, such as might occur during off cycles when operating at very low temperatures in the freezer compartment and very high humidity in the compartment **15**. The heater **52** may also be energized intermittently as for example during off cycles of the compressor (at which time the cold air tends to fall in the freezer) or during on cycles (at which time assurance of a freely-operating gravity damper **48** is desired).

In the upper duct **40** a thermostatically controlled damper **60** is preferably installed, arranged to close the duct when the temperature in the upper portion of the compartment **15** falls below a desired value and vice-versa. This also is a feature which is not necessary to the

operation of the system but introduces certain advantages. The damper **60** is operable by an actuating unit **62** mounted in the partition **12** adjacent the duct opening **40**. This may be one of the well-known commercially available varieties having a built-in thermostat sensitive to the temperature in its immediate environment and the temperature response range of which is adjustable by means of the knob **64**, and which is designed so that its mid-adjustment setting causes damper opening to occur at about 37° F., and closing at about 34° F.

When such a supplemental damper control is used, the designer may provide a greater relative cooling rate for the higher temperature compartment **15** without danger of freezing its contents at light loads.

It will be noted that the effective rate of delivery of chilled air into compartment **14** is much higher than that into compartment **15** and that in fact the grilled openings **34** directly in front of the fan and the openings **35** around the bottom of shroud portion **33** permit most of the forced air to pass therethrough into the freezer compartment. Circulation through compartment **15** is at a much lower velocity and to a substantial degree aided by the gravity-induced tendency of the chilled air to fall in compartment **15**.

Although the air outlet from the warmer compartment **15** is shown in FIGURES 1 and 2 as delivering the return air to a lower part of freezer compartment **14** near the front, I have also found that satisfactory operation can be attained with an air return duct at a higher location and positioned to deliver the returned air from the warmer compartment directly through the partition wall **12'**, near the back wall, to the evaporator space behind the baffle **22'**, as shown in FIGURES 6 and 7. Parts shown in FIGURES 6 and 7 which correspond to parts already disclosed are designated by similar reference numbers primed, and many will not require redescription.

In the modified construction shown in FIGURES 6 and 7 the inlet **40'** to warmer compartment **15'** is preferably provided with upwardly inclined top and bottom walls, and similarly inclined louvers **70**, and the entering air is guided along the top wall and tends to flow, as indicated by arrows **72**, downwardly along the outer wall, inwardly across the bottom, and up the side nearer the partition wall **12'** to the return duct **44'**.

Returning the air to the portion of the freezer compartment **14'** behind the baffle **22'** rather than to the food storage portion has the advantage that even if a very large warm load is placed in compartment **15'**, the air returning through duct **44'** does not impinge upon and so tend to unduly warm any part of the material stored in the freezer compartment.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. Two temperature refrigerating means including portions defining a low temperature compartment and a higher temperature compartment and means including an upright partitioning wall substantially isolating the compartments from one another, a cooler in the low temperature compartment, air circulating means including a baffle and a fan for forcing circulation of air over said cooler and into said compartments, said circulating means having an inlet communicating with said low temperature compartment and having two outlets from an upper portion thereof, one outlet opening into an upper portion of the low temperature compartment and the other outlet opening into an upper portion of the higher temperature compartment, and a return duct extending through said partitioning wall at a position below said outlets for returning air from the higher temperature compartment to the low temperature compartment.

2. Two temperature refrigerating means as defined in claim 1 wherein the fan is located in an upper portion of the low temperature compartment and causes air to flow laterally through said partitioning wall into the upper portion of the higher temperature compartment.

3. In combination with means as defined in claim 1, a check-type damper in the return duct and opening in a direction toward the low temperature compartment.

4. In combination with means as defined in claim 1, temperature-responsive means for varying the effective delivery of air through the outlet which opens into said higher temperature compartment only.

5. In combination with means as defined in claim 1, temperature-responsive means for controlling the delivery of air through the outlet which opens into said higher temperature compartment in response to changes of temperature in said higher temperature compartment.

6. Two temperature refrigerating means as defined in claim 1 wherein the cooler is at the rear of the low temperature compartment behind the baffle, and the return duct delivers return air to a position behind the baffle.

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Disclaimer

3,375,679.—*Wayne F. Helsel*, Greenville, Mich. REFRIGERATOR-FREEZER CONSTRUCTION. Patent dated Apr. 2, 1968. Disclaimer filed Apr. 5, 1973, by the assignee, *Fedders Corporation.*

Hereby enters this disclaimer to claims 1 and 2 of said patent.

[*Official Gazette September 2, 1975.*]