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R. H. TULL
REFRIGERATION APPARATUS
Filed Sept. 26, 1940

2,310,477

2 Sheets-Sheet 1

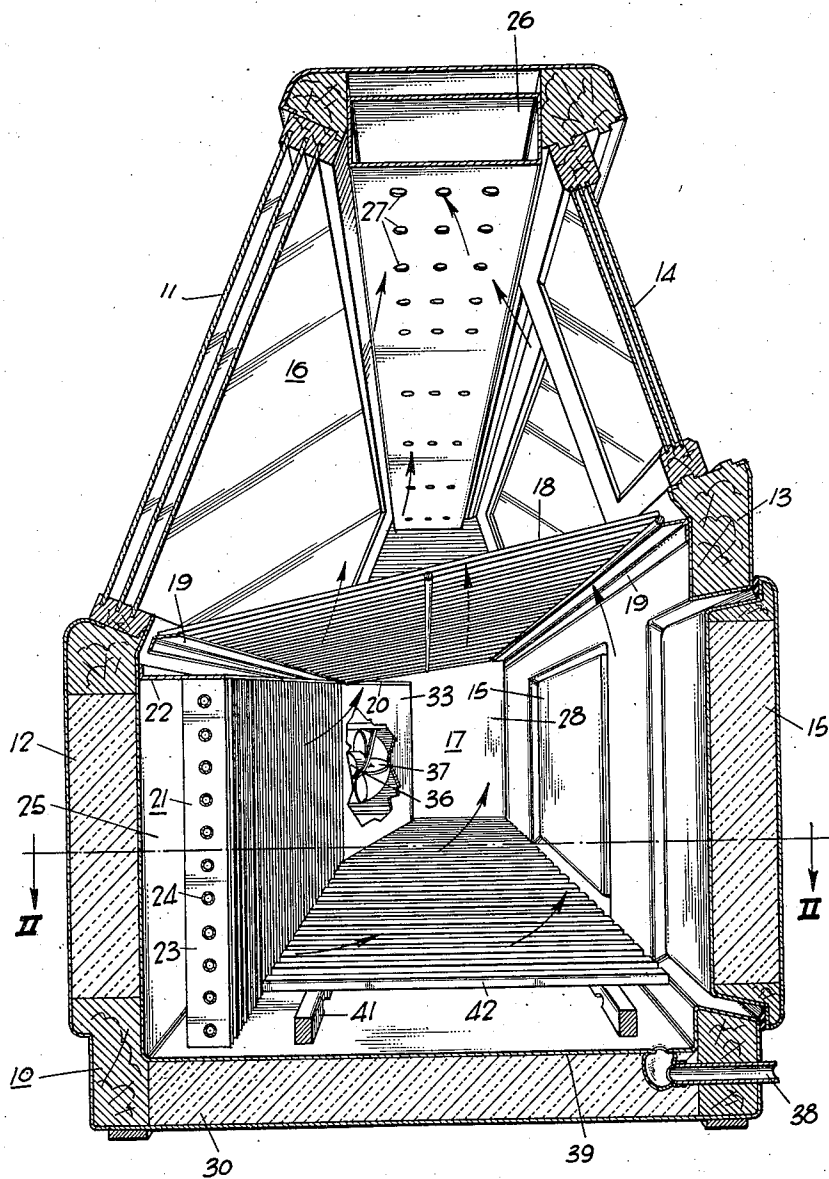


FIG. 1.

WITNESSES:

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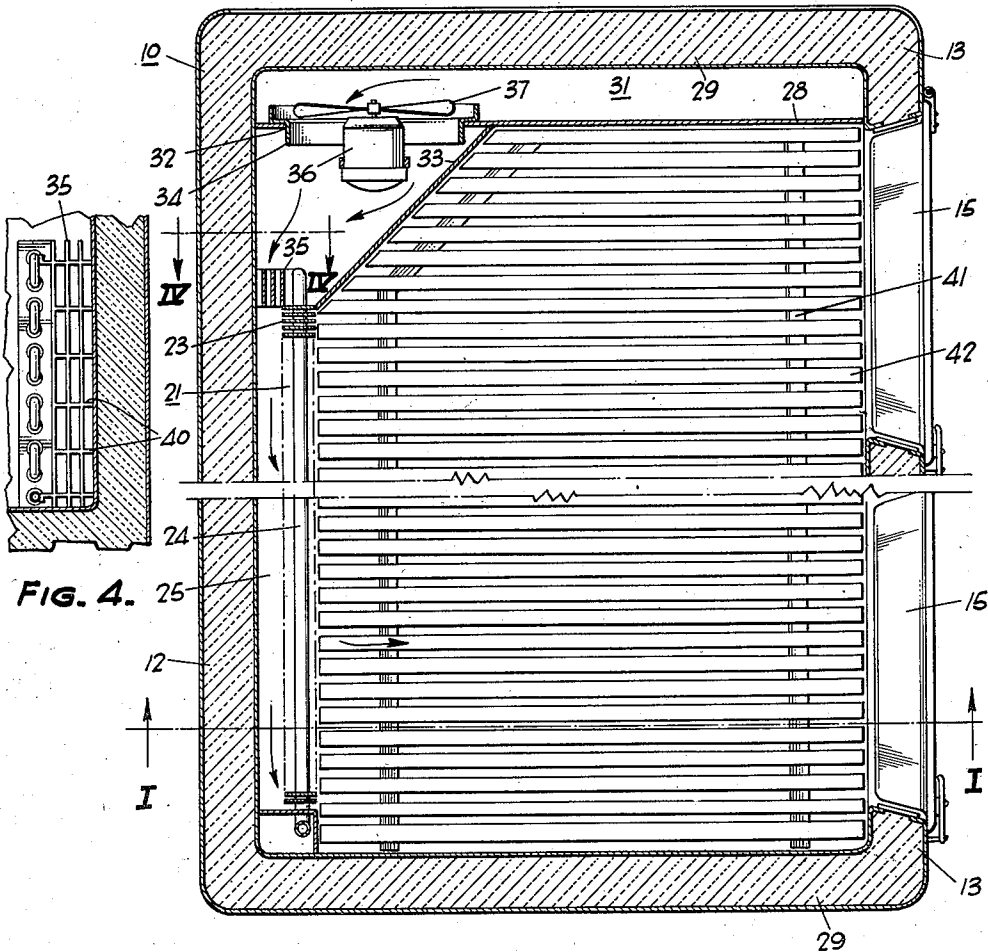


FIG. 4.

FIG. 2.

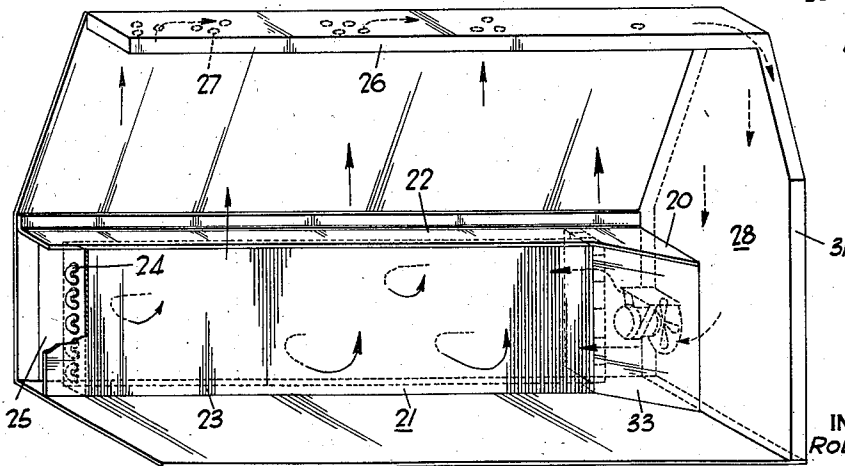


FIG. 3.

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REFRIGERATION APPARATUS

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Pennsylvania

Application September 26, 1940, Serial No. 358,433

9 Claims. (Cl. 62—89.5)

This invention relates to refrigeration apparatus and more especially to large refrigerator cabinets.

One object of the invention is to provide a simple construction for large refrigerators, such as display cases.

Another object is to provide a refrigerator of the type described which is cooled to a substantially uniform temperature throughout by a single cooling element which does not require a separate drip collector.

A further object is to provide refrigerators of the type described which are adapted for maintaining high humidities in the cabinets.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a sectional view in perspective of the refrigerator of this invention, taken on the line I—I of Fig. 2;

Fig. 2 is a partial section taken on the line II—II of Fig. 1;

Fig. 3 is a schematic view in perspective of the air passages in the refrigerator; and

Fig. 4 is a sectional view taken on the line IV—IV of Fig. 2.

Referring specifically to the drawings for a detail description of the invention, the reference numeral 10 designates an insulated cabinet such as used for displaying refrigerated merchandise and comprises a front wall 12, a rear wall 13, an end wall 29, and a bottom wall 30. A triple-glazed window 11 is provided in the upper portion of the front wall 12 of the cabinet and is slanted rearwardly to provide a view of the contents of the cabinet. The upper portion of the rear wall 13 is sloped similarly and provided with triple-glazed doors 14, which slide past one another to afford access to the interior of the upper portion of the cabinet. The lower portion of the rear wall 13 is provided with two doors 15 which provide access to the lower portion of the cabinet.

The cabinet is divided into an upper food storage chamber 16 and a lower food storage chamber 17 by a sloping grid 18 resting on supports 19 secured to the front wall 12 and the rear wall 13.

A flat cooling unit 21 is located in the lower food chamber 17 adjacent but spaced from the front wall 12 of the cabinet 10 and extends from the bottom of the chamber 17 to nearly the top thereof and from one end of the chamber 17 to nearly the opposite end thereof. The cooling unit 21 comprises a series of parallel and spaced-apart metal strips 23 standing on end and a refrigerant-carrying tube 24 passed back and forth through registering holes in the strips 23. The tube 24 may be supplied with refrigerant from a source such as a compressor-condenser unit (not

shown in the drawings). A horizontal baffle 22 is secured to the upper edge of the cooling unit and extends to wall 12 adjacent thereto to form a confined air passage 25 together with the cooling unit 21, the wall 12, and a portion of the bottom wall 30 of the lower food chamber 17.

An air duct 26 is located adjacent the upper wall on the interior of the cabinet and occupies the entire area of this wall. The air duct 26 is provided with openings 27 on its lower surface which communicate with the upper chamber 16.

A false end wall 28 is located adjacent the end wall 29 of the cabinet 10 to provide an air duct 31 with said end wall 29 which air duct 31 communicates with the upper air duct 26. A circular opening 32 is provided near the bottom of the false end wall 28 and adjacent the cooling unit 21, and a baffle 33 is located diagonally across the corner of the lower food storage chamber 17 which together with an extension 20 of the horizontal baffle 22, provides communication between the circular opening 32 and the air passage 25 adjacent the cooling unit 21. A housing 34 carrying a motor 36 is secured in the circular opening 32 and a fan 37 is secured to the shaft of the motor 36. The fan 37 is adapted to draw air through the air ducts 31 and 26 from the upper portion of the upper food storage chamber 16 and pass it to the air passage 25 adjacent the cooling unit 21, the air thereafter passing through the cooling unit 21.

The particular arrangement of the strips of metal 23 of the cooling unit 21 and the direction of air flow in the passage 25 is such as to force the air circulated by the fan 37 through the cooling unit 21 in a path which does not permit portions of the air to remain in prolonged contact with any of the cooling surfaces of the cooling unit 21. Prolonged contact of portions of the air with the cooling surfaces of the cooling unit would chill these portions of the air excessively thereby causing the moisture in these portions of air to condense and deposit on the cooling unit 21. Such action is not desired in a refrigerated cabinet of this nature because it is essential that all moisture is retained in the air as far as possible to preserve the humidity of the air. To minimize the length of time that the air is in contact with the cooling unit 21, the latter is relatively thin, a thickness of about one and one-half inches for a cooling unit about five feet in length having been found suitable. The openings 27 in the upper air duct 26 are proportioned to provide a substantially uniform air flow through the cabinet 10 and for this reason are more numerous at the portions of the duct 26 farthest removed from the fan 37.

The cooling unit 21 keeps the display case at a substantially uniform temperature. The chilled air from the central and lower portion of

the cooling unit 21 sweeps through the lower food storage chamber 17, absorbs heat therefrom and passes upwardly through the upper food storage chamber 16. The air from the upper portion of the cooling unit 21 flows more directly to the upper food storage chamber 16 without absorbing much heat from the lower food storage chamber 17 and is thus available for absorbing heat from the upper food storage chamber 16.

To aid the passage of the air through the cooling unit as above described, a cellular louver 35 comprising crossed louver boards 40 is provided at the entrance of the air passage 25. The louver 35 dampens the eddy currents ordinarily found in air flowing in irregular air ducts and the air swirls caused by the fan 37 so that the air passing through the cooling unit passes therethrough in quiescent layers.

The cooling unit 21 is maintained at a temperature sufficiently high to prevent the accumulation of frost thereon and is of large area in order to cool large quantities of the air passing through it substantially uniformly by a few degrees of temperature rather than by cooling a smaller quantity of air through a larger temperature range. This again avoids cooling portions of the air in the cabinet to a temperature low enough to cause precipitation of substantial quantities of the water vapor in the air.

The rate of air flow through the two food storage chambers 16 and 17 from the cooling unit 21 to the upper air duct 26 is about 15 feet per minute and is maintained at this low value to avoid the rapid sweeping of air over the foods displayed in the cabinet as this would tend to dehydrate the food. The current of air is furthermore directed upwardly through the food storage chambers so that the trays and platters on which moist foods are ordinarily displayed act as a wind break for the foods. It has been found that in actual practice a humidity of 85 per cent can be maintained in the cabinet.

The lower portion of the lower food storage chamber 17 is of leak-proof construction and the openings for the doors 15 are elevated above the bottom of the chamber 17 to prevent escape of the moisture condensed by the cooling unit 23. A drain 38 is also provided in the bottom of the lower food storage chamber 17 to carry off the moisture collected thereon. This construction makes the use of a drip collector unnecessary.

A platform for supporting the articles to be refrigerated is located in the lower food storage chamber, which platform comprises girders 41 resting on the bottom 39 of the lower food storage chamber 17 and cross pieces 42 placed across the girders 41.

It will be observed that this invention provides a large refrigerator of the display case type, which refrigerator is of simple construction and maintains a substantially uniform temperature and high humidity for the preservation of foods.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In a refrigerator, the combination of an insulated cabinet, the length of which exceeds its breadth; a foraminated partition in said cabinet

dividing the same into an upper and a lower food storage chamber; a flat cooling unit adjacent but spaced from one of the longitudinal walls of the lower food storage chamber, said cooling unit being substantially commensurate with said wall, said cooling unit having air passages therein substantially at right angles to the flat portion thereof; a substantially horizontal baffle at the upper edge of the cooling unit extending to the wall adjacent thereto to define an air duct together with said wall, said cooling unit, and a portion of the bottom of said cabinet; a second duct adjacent the upper interior wall of said cabinet and extending substantially the full length thereof, said duct having a plurality of openings distributed throughout its length and communicating with the upper food storage chamber; and means for forcibly conducting air from said second duct to said first-named duct, the air thereafter passing substantially horizontally through the air passages of the cooling unit and thereafter upwardly from the lower to the upper food storage compartment to cool said compartments substantially uniformly.

2. In a refrigerator, the combination of an insulated cabinet, the length of which exceeds its breadth; a foraminated partition in said cabinet dividing the same into an upper and a lower food storage chamber; a flat cooling unit adjacent but spaced from one of the longitudinal walls of the lower food storage chamber, said cooling unit being substantially commensurate with said wall, said cooling unit having air passages therein substantially at right angles to the flat portion thereof; a substantially horizontal baffle at the upper edge of the cooling unit extending to the wall adjacent thereto to define an air duct together with said wall, said cooling unit and a portion of the bottom of said cabinet; a louver comprising a series of parallel baffle plates in said air duct to suppress eddies of air in said duct; a second duct adjacent the upper interior wall of said cabinet and extending substantially the full length thereof, said duct having a plurality of openings distributed throughout its length and communicating with the upper food storage chamber; and means for forcibly conducting air from said second duct to said first-named duct, the air thereafter passing substantially horizontally through the air passages of the cooling unit, the air thereafter flowing upwardly from the lower to the upper food storage compartment.

3. In a refrigerator, the combination of an insulated cabinet, the length of which exceeds its breadth, said cabinet defining a food storage chamber, a flat cooling unit adjacent to but spaced from one of the longitudinal walls of the cabinet and extending along substantially the full length of said wall, said cooling unit having its lower edge adjacent the bottom of said cabinet and its upper edge extending upwardly in said food storage chamber to at least one-third the height thereof, said cooling unit having air passages therein at right angles to the flat portion thereof, a substantially horizontal baffle at the upper edge of the cooling unit extending to the wall of the cabinet adjacent thereto, a duct adjacent the upper interior wall of said cabinet and extending substantially along the full length thereof, said duct having a plurality of openings distributed throughout its length and communicating with the food storage chamber, a second duct communicating with said first-named duct and with the space between the cooling unit and the wall adjacent thereto, means for forcibly cir-

culating air through said second duct in a direction toward said space whereby said air passes through the air passages of the cooling unit substantially at right angles to the flat side thereof and flows through said food storage chamber to maintain the temperature of the top and bottom portions thereof substantially uniform.

4. In a refrigerator, the combination of an insulated cabinet, the length of which exceeds its breadth, a foraminated partition in said cabinet dividing the same into an upper and a lower food storage chamber, a flat cooling unit adjacent but spaced from one of the longitudinal walls of the lower food storage chamber, said cooling unit comprising a series of spaced-apart thin metal strips with the flat sides facing one another, said strips extending substantially from the bottom to adjacent the top of the lower food storage chamber, and the series of spaced-apart strips extending along at least three-quarters of the length of said lower food storage compartment, a substantially horizontal baffle at the upper edges of said spaced-apart strips and extending to the vertical wall adjacent the cooling unit, a duct adjacent the upper interior wall of said cabinet and extending substantially along the full length thereof, said duct having a plurality of openings distributed throughout its length and communicating with the food storage chamber, a second duct communicating with said first-named duct and with the space between the cooling unit and the wall adjacent thereto at one end of said space, and means for forcibly circulating air from said duct at the upper portion of the cabinet through said second duct, the air thereafter passing through at least a portion of the space between the cooling unit and the wall adjacent thereto and thereafter between the thin strips of metal, the thin strips of metal guiding said air at right angles to its direction of travel through said space through the cooling unit and into the lower food storage chamber, the air thereafter passing upwardly through the foraminated partition into the upper food storage chamber towards the openings in the duct adjacent the upper wall of said upper food storage chamber.

5. In a display case, the combination of an insulated cabinet, the length of which exceeds its breadth; a foraminated partition in said cabinet to divide the same into an upper and a lower food storage chamber; an inclined window in the upper food storage chamber; an access opening and a door for the same in the lower food storage chamber, said access opening being elevated above the bottom of said cabinet; a flat cooling unit adjacent but spaced from one of the longitudinal walls of the cabinet and extending along substantially the full length and height of said wall, said cooling unit having air passages therein substantially at right angles to the flat surface thereof; a substantially horizontal baffle at the upper edge of the cooling unit and extending to the wall adjacent thereto to define an air duct together with said wall, cooling unit, and a portion of the base of the cabinet; a second duct adjacent the upper interior wall of said cabinet and extending substantially along the full length thereof, said duct having a plurality of openings distributed through its length and communicating with the upper food storage chamber; a third duct communicating with the duct in the upper portion of the cabinet and the air duct adjacent the cooling unit; means for forcibly circulating

air through said second duct towards said first-named duct behind the cooling unit; and a drain in the bottom wall of the cabinet, the lower portion of said cabinet being of leak-proof construction to provide for conducting the moisture dripping from the cooling unit to said drain.

6. In a refrigerator, the combination of an insulated cabinet, said cabinet defining a food storage chamber, a flat cooling unit at the lower portion of the cabinet and positioned substantially parallel to, but spaced from one of the vertical walls of the cabinet to define an air duct between said vertical wall and said cooling unit, said cooling unit having horizontal air passages therethrough, and means for moving air from the upper portion of the food storage chamber to said air passage, said air, thereafter, flowing substantially horizontally through the air passages of the cooling unit and into the food storage chamber.

7. In a refrigerator, the combination of an insulated cabinet, said cabinet defining a food storage chamber, a flat cooling unit at the lower portion of the cabinet and positioned substantially parallel to, but spaced from one of the vertical walls of the cabinet to define an air duct between said vertical wall and said cooling unit, said cooling unit having horizontal air passages therethrough, and means for moving air from the upper portion of the food storage chamber to said air passage, said air, thereafter, flowing substantially horizontally through the air passages of the cooling unit and into the food storage chamber, said cooling unit being substantially the sole means for cooling said food storage chamber.

8. In a refrigerator, the combination of an insulated cabinet, said cabinet defining a food storage chamber, a flat cooling unit at the lower portion of the cabinet and positioned substantially parallel to, but spaced from one of the vertical walls of the cabinet to define an air duct between said vertical wall and said cooling unit, said cooling unit being of a height of at least $\frac{1}{4}$ the interior height of the cabinet and having horizontal air passages therethrough, and means for moving air from the upper portion of the food storage chamber to said air passage, said air, thereafter, flowing substantially horizontally through the air passages of the cooling unit and into the food storage chamber, said cooling unit being substantially the sole means for cooling said food storage chamber.

9. In a refrigerator, the combination of an insulated cabinet having at least one substantially vertical wall and an upper wall, said cabinet defining a food-storage chamber, a cooling unit in said cabinet adjacent to said substantially vertical wall of the cabinet and extending substantially the full length of said wall, said cooling unit having its lower edge adjacent the bottom of said cabinet and extending upwardly in said food-storage chamber to at least one-third the height thereof, said cooling unit having air passages therein at right angles to said substantially vertical wall, a duct in said cabinet adjacent said upper wall and extending substantially the full length thereof, said duct having a plurality of openings distributed throughout its length and communicating with the food-storage chamber, and means for forcibly conducting air from said duct substantially horizontally through the air passages of the cooling unit toward said food-storage chamber.

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