This invention relates to the art of refrigeration and more particularly to the control of condensation on openings in refrigerators where multi-pane units are employed.

In refrigeration where foods are displayed through windows or panels and where such panels are part of operative doors which are repeatedly opened for removing such foods, difficulty has been experienced in preventing the accumulation of moisture upon the window on both the inside and outside surfaces, and particularly on the inter-pane surfaces of glass forming the windows, and around the edges of the door. Where such units are employed in food dispensing operations, the accumulation of such moisture prevents a clear view of the contents therein and thus renders them less attractive to potential customers. Generally, a plurality of panes of glass are glazed in the windows and doors of such refrigerator units to minimize the heat loss.

In accordance with the prior art, it has been found that the zones between such multi-pane glazed units become sites for the accumulation of moisture which after a period of use causes the panes to become clouded through the deposition of minute dust particles carried in to the inter-pane zones by such moisture. It is difficult if not impossible to effect cleansing of the glass surfaces in the inter-pane areas, so that it is necessary to rebuild or replace the inter-pane door or window. It has been found that the undesirable effects may, to a degree, be controlled by providing a vent which leads from the interior of the refrigerator to each of the inter-pane spaces so that flow of air from the interior of the refrigerator will maintain the surfaces of the glass free of moisture, except for the periods immediately following the opening of a door and the flow of outside air into the inter-pane zones.

Furthermore, in prior art techniques, there has been employed the use of a fan to blow a blanket of air over the outside of such windows to maintain the outer surface free from moisture. Applicant has found it desirable to use an air blanket which serves to maintain the door gaskets and edges free from the accumulation of ice which would otherwise prevent opening thereof. However, such use tends to increase the circulation through the inter-pane zones when the door is opened.

Applicant has provided a combination of elements whereby the desirable effects of maintaining circulation from the inside of the refrigerator through the inter-pane spaces to maintain the inter-pane surfaces free from condensation may be utilized. At the same time, undesirable effects that may be encountered through the use of an air blanket with such a system are eliminated.

More particularly, in accordance with the present invention, applicant provides a refrigerator in which there is employed the combination of means for directing a blanket of air upwardly over the outside of the refrigerator to maintain the outside surfaces free from condensation. The refrigerator includes a multi-pane door which is adapted to be opened to permit access to the refrigerator. Flow channels communicating from the inside of the refrigerator through said door frame to the inter-pane spaces permit maintenance of the same atmospheric conditions in the inter-pane spaces as in the refrigerator. Applicant further provides valve means operable upon the closure of the refrigerator door to open said flow channels and to maintain them open until the door is open, said means being operable then to close said flow channels and prevent any flow of air through said inter-pane spaces when said door is open.

In accordance with a further aspect of the invention, applicant has found that the provision of a normally closed valve for control of air flow into the inter-pane spaces is desirable; applicant provides such a valve normally closed and adapted to be opened upon the closure of the door. In a more specific aspect, a spring biased closure member is mounted on each flow channel leading from the inner face of the door frame to the inter-pane spaces, with means adapted operably to engage the refrigerator body to open said flow channels when said door is closed.

For a more complete understanding of the present invention and for further objectives and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a sectional view of the multi-door refrigerator unit of a commercial type; FIG. 2 is a sectional view of the refrigerator of FIG. 1, taken along the lines 2—2 of FIG. 1; and FIG. 3 is an enlarged view of the valve element.

Referring now to FIG. 1, there is illustrated a multi-door refrigerator unit 10 having three doors 11, 12, and 13, which are located at the front of the unit. The doors are glazed to permit visual inspection of the contents. The unit is a commercial type refrigerator conveniently adapted to be used in marketing of groceries and edible foodstuffs which require maintenance at lowered temperatures in order to preserve them in a good condition. The doors 11, 12, and 13 are positioned at a sufficient height that all contents of the refrigerator can be readily viewed. The bottom of the door preferably is at a level to permit the location of the refrigeration elements below the floor of the unit so that a unitary package may be provided.

Applicant provides for the sweeping of the front face of the doors 11, 12, and 13 with an upwardly directed air blanket in order to maintain the door faces and door gaskets free from the accumulation of moisture and ice which prevent inspection of the contents of the refrigerator and prevent ready opening of the doors.

The refrigeration mechanism may be of conventional type and has not been illustrated in detail since such mechanisms are well-known in the art. However, applicant has provided a blower unit indicated by unit 15, mounted in the base of the refrigerator unit 10, with flow channels directing air toward the front of the unit and upwardly.

More particularly and as shown more clearly in FIG. 2, the blower unit 15 directs the flow of air upwardly into a distributing plenum chamber 16 formed between a baffle 17 and the front surface of the refrigerator 10. Baffle 17 extends from substantially below the bottom of the doors 11—13, upwardly adjacent to the bottom of the doors. As shown in FIG. 1, air from blower 15 is distributed through plenum chamber 16 along the entire length of the refrigerator 10 so that there is produced an upwardly directed blanket of air which sweeps the front of the refrigerator to maintain the panes of glass clear on the outside and to maintain the gaskets free from the accumulation of moisture and the formation of ice.

As illustrated in FIG. 2, the door 11 is formed with frame elements 20 and 21 in which three panes of glass 22, 23, and 24, are glazed, being spaced apart one from another to provide inter-pane zones 25 and 26. The inner frame element 21 is provided with a flow channel 27 which leads from the inside of the door frame to communicate with each of the inter-pane spaces of zones 25.
3 and 26. In a similar manner, the lower frame element 20 is provided with a passage 28 which permits communication between the inside of the refrigerator and the inter-pane spaces 25 and 26.

In operation of this system it will be recognized that when doors 11-13 are open, there will be an interchange of the interior air and refrigerator air so that moisture often accumulates on the glass surfaces to cloud the glass and obstruct the view therethrough. The provision of flow channels 27 and 28 into the inter-pane spaces permits openings such that when the door is closed after having been opened, any condensate on the surface of the glass panes in the inter-pane spaces will rapidly disappear through the equalization of moisture conditions in all of the contents of the box since communication is provided to the inter-pane spaces via passages 27 and 28.

Applicant has found that by providing an upwardly directed flow of air from plenum chamber 16, there is effected a substantial reduction in the loss of cooling when the door is opened, by reason of the fact that the heavier cold air which tends to spill out of the refrigerator upon the opening of the door is met by the upwardly directed blanket of air which provides sufficient force to maintain the cold air inside the refrigerator and permit but a minimum interchange of air. At the same time, the open door in an upwardly directed air stream would tend to experience an increased interchange of air from the outside with the cool air in the inter-pane spaces. Applicant has found it desirable to employ valve elements normally to close the channels 27 and 28 and to cause said channels to be opened upon closure of the door. Valve elements thus employed are actuated in response to closure of the door. More particularly, as shown in FIGS. 2 and 3, valve elements 30 and 31 are provided, each being spring loaded and mounted on the door frame elements 20 and 21 respectively. When the door is closed, the valve elements are open. Closure of the door serves to overcome the force of the spring elements thereto to open parts 27 and 28. When the door is open, valves 30 and 31 are closed so that there is prevented any interchange of air to the inter-pane spaces.

As shown in the enlarged view of FIG. 3, the valve structure comprises a bracket 40 which is mounted on the inner face of the lower door frame element 20 by screws 41 and 42. The bracket provides pivotal support for a shaft 43 on which there is mounted a valve element comprising a valve arm 44. Arm 44 is mounted on shaft 43 at a central point thereon and is thus cantilevered around the upper edge 45 of the frame 20. The upper extremity of the valve element 44 is provided with a resilient stop 45 which is positioned completely to close the mouth of channel 28 when the door is open. The lower extremity of the valve element 44 has a helical spring 50 attached thereto which exerts force between the inside of the door frame element 20 and the end 51 of the valve element 44. Spring 50 preferably is secured as by soldering or welding to the end 51. When the door is opened, the spring expands, forces the resilient member 45 into engagement with the face of the frame 20 to close the channel 28. Applicant has found that the use of such closure members both at the upper and the lower edges of the door to close communication between the inter-pane spaces is desirable. He has further found it desirable to use such closure members even though the air blanket may not be employed to sweep the front of the refrigerator unit. In the latter case, the natural exchange of air that would be present upon the opening of a door and exposing flow channels, 27 and 28, and the air is not to be forced or the inter-pane spaces and the glass surfaces therein may be maintained clear and unobstructed for long periods of time. Absent such valves, the surfaces gradually become clouded through deposition of dust particles therein upon repeated condensation.

However, applicant has found it to be greatly advanta-
face of said door to the spaces between said panes, means including a fan and a plenum chamber at the bottom edge of said door and adapted to direct a blanket of air upwardly over the outer surface of said door to maintain the edges thereof free from condensation, and valve means adapted to close said passageways when said door is opened into said blanket of air.

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