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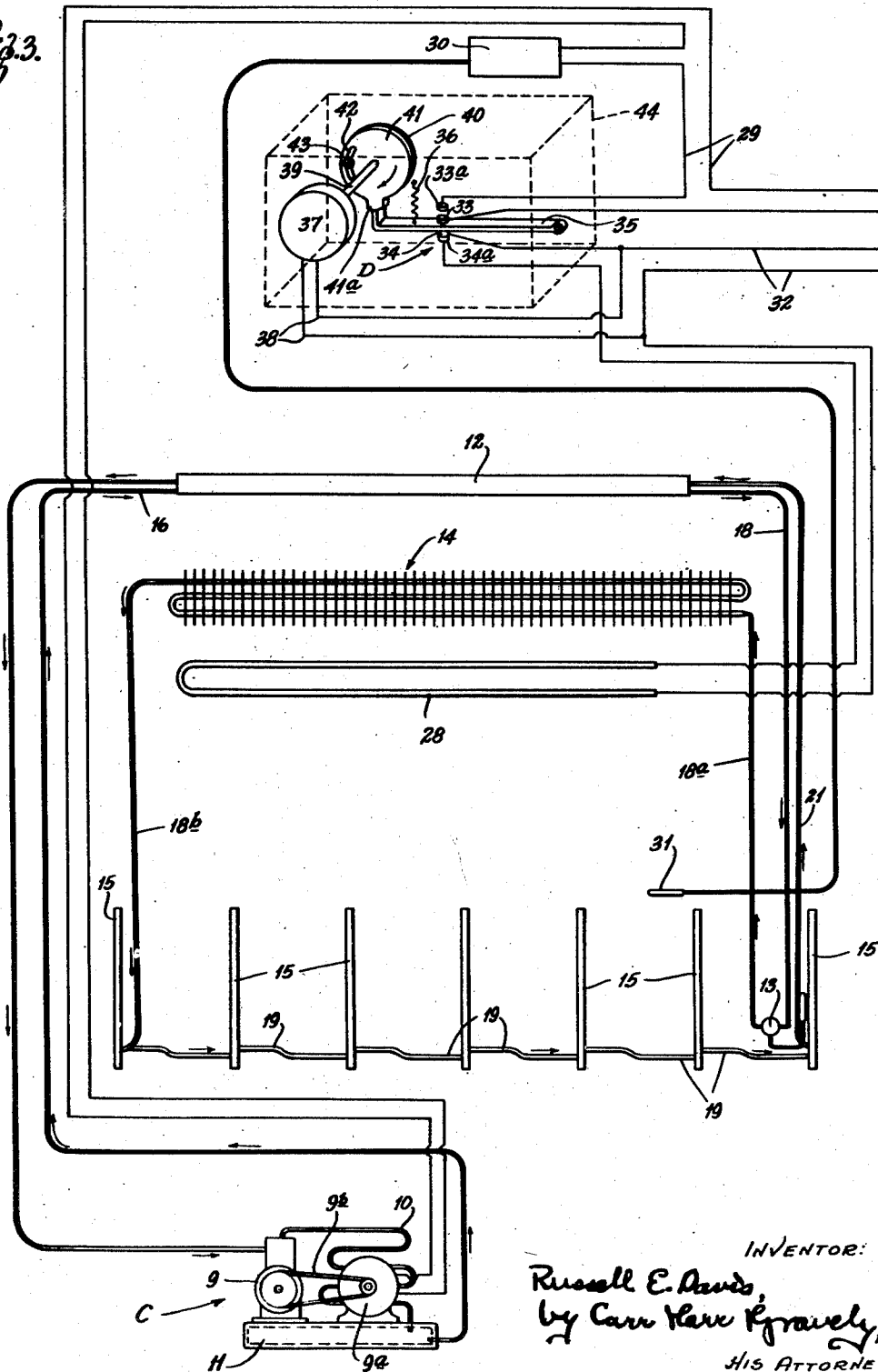
2,430,329

DISPLAY REFRIGERATOR INCLUDING CONTROLS FOR THE OPERATION THEREOF

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2 Sheets-Sheet 2

Fig. 3.



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DISPLAY REFRIGERATOR INCLUDING CONTROLS FOR THE OPERATION THEREOF

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6 Claims. (Cl. 62-4)

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This invention relates to improvements in refrigerated food display cases of the kind shown in my copending application Serial No. 547,385 wherein sub-zero temperatures are maintained in the continuously open self-service food display chamber of the case by a closed thermosiphon system of refrigerated air produced by a refrigerating circuit including expansion coils located in the display chamber and an upper chamber in communication therewith and a condensing unit common to both expansion coils, and the upper expansion coil is defrosted by an electric heater which is turned on when the condensing unit stops and is turned off when the condensing unit starts.

The present invention has for its principal objects to preserve all of the advantages of the above type of refrigerated display case and, at the same time, provide for automatically turning on the defrosting heater and stopping the condensing unit at a predetermined time, eliminate the electrically operated refrigerant valve heretofore employed and attain other advantages hereinafter appearing. The invention consists in the refrigerated display case and in the parts and combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawings which form a part of this specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a front elevational view of an open-top, self-service refrigerated display case embodying my invention,

Fig. 2 is an enlarged vertical cross sectional view through said case in line 2-2 in Fig. 1; and

Fig. 3 is a diagrammatic view illustrating the refrigerating circuit and the electric control circuit for said refrigerating circuit and the defrosting heater therefor.

In the accompanying drawings my invention is shown embodied in an open-top, self-service refrigerated display case of the type shown in my copending application Serial No. 547,385, wherein the display case comprises a top wall 1, a bottom wall 2, a relatively high rear wall 3, a relatively low front wall 4 and end walls 5. As shown in the drawings, the top wall 1 extends from the rear wall 3 of the case and terminates short of the front wall 4 thereof in a depending baffle or curtain wall 6 that extends below the level of the top edge of the front wall 4. The above described arrangement of walls provides a lower food storage and display chamber A with an access or reach-in opening A¹ in the top thereof between the front wall 4 and the baffle wall 6, and an upper chamber B communicating with the upper portion of said food chamber rearwardly of said access opening. As shown in the drawings, a sealed multi-pane glass panel 4a constitutes the upper portion of the low front wall

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4 of the case; and sector-shaped glass panels 5a constitute the upper portions of the end walls 5 of said case between said front wall and the baffle wall 6. A suitable light, such as fluorescent tubing 7a, is mounted in a suitable wiring conduit, shade and reflector 7, which is secured to the front face of the baffle wall 6 flush with the upper surface of the top wall 1; and an inclined mirror 8 inclines downwardly and rearwardly from said conduit to said baffle wall.

The hereinbefore described display case is provided with a mechanical refrigerating apparatus of the compressor-condenser-expander type. As illustrated in the diagram shown in Fig. 3, the refrigerating circuit comprises a suitable condensing unit C, including the usual compressor 9 and electric driving motor 9a, and driving belt connection 9b therebetween condenser 10 and liquid receiver 11 therefor. The refrigerating circuit also includes a suitable heat exchanger 12, a suitable throttle or expansion valve 13, and evaporators or expanders in the form of a fin-type cooling coil 14 and a series of plate type cooling coils 15. The refrigerant flows from the compressor 9 to the receiver 11 through the condenser 10, thence from the receiver to the heat exchanger 12 through a conduit 16, thence from the heat exchanger to the expansion valve 13 through a conduit 18, thence from the expansion valve to the fin coil 14 through a conduit 18a, thence through a conduit 18b to the plate coils 15 and connecting conduits 19 therefor and thence from the plate coils and through the heat exchanger back to the compressor through a return conduit 21. As shown in the drawings, the fin coil 14 is located in the upper portion of the rear upper chamber B of the food case and extends longitudinally thereof substantially from end to end thereof, while the plate coils 15 are mounted on edge in the cold storage food display chamber A in spaced apart relation so as to form bins 22 therein that preferably extend from front to back thereof. As shown in Fig. 2, each of the plate coils 15 comprises a sealed casing 15a containing a flat cooling coil 15b and a suitable eutectic solution 15c which surrounds said coil and has a relatively low freezing point.

Mounted in the rear upper chamber B of the case immediately below the fin coil 14 therein are drains or gutters 23 for receiving and carrying away moisture that drips from said coil. The gutters 23 extend longitudinally of the fin coil from end to end thereof and are inclined from one end to the other so as to discharge into a suitable drain pan 24 mounted in said chamber below the discharge end of said gutters. As shown in Fig. 2, a vertical baffle or partition wall 25 extends from end to end of the upper chamber B of the case beneath the fin coil 14 therein substantially midway between the rear wall 3 and the baffle wall 6 with its upper edge fixed to the

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under side of one of the gutters 23 and with its lower edge disposed in the lower display chamber A slightly below the level of the lower edge of said baffle wall. The partition or baffle wall 25 divides the portion of the upper chamber below the fin coil 14 therein into vertical front and rear flues 26 and 27, respectively. The rear upper chamber B is provided with means for rapidly defrosting the fin type cooling coil 14 therein, said means comprising an electric heater

preferably in the form of electric resistance wires or cables 28 secured to the undersides of the gutters 23 for receiving the liquid condensate from said cooling coil. As shown in Fig. 3, the compressor motor 9a is operated by a 220 volt electric circuit 29 which is normally opened and closed by a suitable thermostatic switch 30 having a feeler bulb 31 located in the lower food display chamber A adjacent to or in thermal contact with the plate coils 15 therein. The defrosting heater 28 is operated by a normally open 110 volt electric circuit 32. A time controlled switch D has a pair of contacts 33, 33a, which open and close one side of the motor circuit 29, and a pair of contacts 34, 34a, which open and close the heater circuit 32. The contacts 33 and 34 are fixed one on each side of a hinged or pivoted arm 35 for movement therewith into and out of engagement with the stationary contacts 33a and 34a respectively. A spring 36 yieldably holds the contact 33 in engagement with the contact 33a, to thereby close the motor circuit 29, and with the contact 34 out of engagement with the contact 34a so as to open the heater circuit 32. Thus, the contacts 33, 33a in the motor circuit 29 are closed when the contacts 34, 34a in the heater circuit 32 are open and vice versa.

The time switch D also includes electrically controlled mechanism adapted at a predetermined time to actuate the contact carrying lever 35 to open the motor circuit 29 and close the heater circuit 32. This mechanism preferably comprises an electric clock 37, which is connected through wires 38 to heater circuit 32 for continuous operation thereby, a shaft 39 driven by said clock, a driving disk 40 fixed to said shaft, and an edge cam 41 fixed to said driving disk and in continuous edgewise contact with a laterally bent free end portion of the hinged contact carrying arm 35 so as to operate said arm whenever the rise 41a of said cam moves into engagement with the laterally bent free end portion of said arm. As shown in the drawings, the cam 41 is secured to the cam disk 40 by means of a screw 43 which extends through an arcuate slot 42 in said cam and is threaded into said disk, thus permitting said rotational adjustment of said cam relative to said disk to vary the time of operation of the switch D. The cam 41 makes one complete revolution, say once every 24 hours; and the circumferential length of the rise 41a of said cam determines the length of time that the contact arm 35 is held in motor circuit opening and heater circuit closing position during each complete revolution of said cam. As shown in Fig. 3 the time controlled switch D and the thermostatic switch 30 may be enclosed in a common housing 44.

As indicated by the flow arrows in Fig. 2, when the refrigerating circuit is operating to reduce the display chamber temperature to the desired sub-zero level there is a continuous circulation of refrigerated air downwardly from the upper fin coil cooling unit 14 through the flue 27 into the

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lower display chamber A and a return flow of said air from said display chamber to said upper fin coil unit through the flue 26. The baffle curtain wall 6 of the case extends below the level of the top edge of the front wall 4 thereof and thus permits the refrigerated air in the open top display chamber A to rise above the lower edge of said curtain wall and this height, plus the atmospheric pressure exerted on the display space opening A¹, balances the weight of the refrigerated air in the sealed space back of said curtain wall and forms in said opening a layer 48 of stratified or dead insulating air which tends to prevent the escape of the refrigerated air therethrough.

When the refrigerating apparatus is operating, the motor circuit 29 is closed by the thermostatic switch 30 and the time switch D and the heater circuit 32 is opened by said time switch, thus putting the refrigerating apparatus into operation and rendering the defrosting heater 28 inoperative. During the operation of the refrigerating apparatus, liquid refrigerant passes from the liquid receiver 11 of the condensing unit C through the conduit 16, heat exchanger 12, conduit 18, expansion or throttle valve 13, conduit 18a into the upper fin type expansion coil 13 and thence through the conduit 18b into the lower plate type expansion coils 15. The liquid refrigerant, after evaporating and absorbing heat in the expansion coils 14 and 15 is then converted into vaporized refrigerant which is returned to the condensing unit C through the conduit 21, heat exchanger 12 and again converted into liquid form in said condensing unit and again returned to the receiver 11 thereof.

When the temperature in the lower display chamber A of the case reaches a predetermined low level, the thermostatic switch 30 is opened, thereby opening the motor circuit 29 and stopping the condensing unit C and the flow of refrigerant therefrom through the refrigerating system. When the display chamber temperature rises a few degrees above the desired predetermined low level, the thermostatic switch 30 again closes the motor circuit 29 and puts the refrigerating apparatus into operation. The refrigerating apparatus starts and stops in response to temperature requirements in the food display chamber A, while the defrosting heater 28 remains inoperative and entirely unaffected by the food chamber temperatures and the refrigerating cycle.

The time controlled switch D is set to bring about the defrosting of the top coil 14 at any desired time or times. Thus the time of defrosting can be set for the most opportune time of the day or night. For instance, the time switch may be set to bring about the defrosting in the early morning hours when the store is cool and there is no activity therein so as to minimize dangerous temperature fluctuation. When the time for defrosting arrives, the rise 41a on the clock operated cam 41 moves into engagement with the free end of the contact carrying arm 35 and operates the latter against the tension of the spring 36, thus separating the contacts 33, 33a and rendering the refrigerating apparatus inoperative and engaging the contacts 34, 34a and starting the defrosting heater 28. The rise 41a of the cam 41 remains in contact with the contact carrying lever 35 for a period of time sufficient to defrost the upper expansion coil 14, after which the rise of the cam rides off the free end of the contact carrying lever and permits the spring 36 to operate the latter in a direction that will engage the contacts 33, 33a and again place

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the refrigerating apparatus under the control of the thermostatic switch 30 and disengage the contacts 34, 34a and cut off the defrosting heater.

An important advantage of the above described arrangement is that it eliminates the electrically operated valve heretofore used in the liquid line of the refrigerating system and renders the refrigerating system directly responsive to temperature requirements in the food display chamber. Another advantage is that it eliminates the numerous temperature fluctuations which occur when the defrosting heater is turned on during each cycle of the refrigerating system and thus prevents the display chamber from being subjected to abnormal temperatures during each refrigerating cycle.

Obviously, the hereinbefore described open-top self-service low temperature refrigerating display case admits of considerable modification without departing from the invention. Therefore, I do not wish to be limited to the precise arrangements shown and described.

What I claim is:

1. A refrigerated display case having a food chamber and a second chamber in continuous communication therewith, and a compressor-condenser-expander type refrigerating apparatus including an electric motor for operating the compressor, an expansion coil in said food chamber and an expansion coil in said second chamber, an electric control circuit for said motor including a thermostatic switch responsive to temperature conditions in said food chamber only for starting and stopping said motor, an electric heater in said second chamber for defrosting the expansion coil therein, an electric control circuit for said heater, and a time switch associated with said motor and heater circuits for opening said motor circuit and closing said heater circuit and vice versa at predetermined times.

2. A refrigerated display case having a lower food chamber with a continuously open access opening in the top thereof and an upper chamber in continuous communication with said lower chamber below the top thereof and rearwardly of the access opening therein, and a compressor-condenser-expander type refrigerating apparatus including a motor for operating the compressor, a fin-type expansion coil in said upper chamber and a plurality of plate-type expansion coils arranged in spaced relation in said lower chamber to form bins therein, an electric heater in said upper chamber for defrosting the expansion coil therein, an electric control circuit for said motor including a thermostatic switch responsive to temperature conditions in said lower chamber only for starting and stopping said motor, an electric control circuit for said heater, and a time controlled switch associated with both circuits and operable at predetermined times to close said heater circuit and open said motor circuit and vice versa.

3. A refrigerated case having two communicating chambers and a single refrigerating apparatus including expansion coils in the respective chambers, control means responsive to temperature conditions in one chamber only for both starting and stopping the operation of said refrigerating apparatus, a heater for defrosting the expansion coil in the other of said chambers, and means operable at predetermined times for turning on said heater and for preventing the starting of said refrigerating apparatus by said temperature responsive control means.

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4. A refrigerated display case having a food chamber and a second chamber in continuous communication therewith, and a refrigerating apparatus of the compressor-condenser-expander type including an electric motor for operating the compressor, an expansion coil in said food chamber and an expansion coil in said second chamber, an electric control circuit for said motor including a thermostatic switch responsive to temperature conditions in said food chamber only for both starting and stopping said motor, an electric control circuit for said heater, and a time controlled switch associated with both circuits for opening the motor circuit and closing the heater circuit at predetermined times.

5. A refrigerated display case having a food chamber and a second chamber communicating therewith, and a refrigerating apparatus of the compressor-condenser-expander type including an electric motor for operating the compressor, an expansion coil in said food chamber and an expansion coil in said second chamber, an electric control circuit for said motor including a thermostatic switch responsive to temperature conditions in said food chamber only for both starting and stopping said motor, an electric control circuit for said heater, and a switch associated with both circuits for opening the motor circuit and closing the heater circuit at predetermined times, said switch including a pair of normally closed contacts located in said motor circuit, a pair of normally open contacts disposed in said heater circuit, and time controlled means for opening the contacts in said motor circuit and for closing the contacts in said heater circuit.

6. A refrigerated display case having a food chamber and a second chamber communicating therewith, and a refrigerating apparatus of the compressor-condenser-expander type including an electric motor for operating the compressor, an expansion coil in said food chamber and an expansion coil in said second chamber, an electric control circuit for said motor including a thermostatic switch responsive to temperature conditions in said food chamber only for both starting and stopping said motor, an electric control circuit for said heater, and a switch associated with both circuits for opening the motor circuit and closing the heater circuit at predetermined times, said switch including a pair of normally closed contacts located in said motor circuit, a pair of normally open contacts disposed in said heater circuit, and time controlled means for opening the contacts in said motor circuit and closing the contacts in said heater circuit, said last mentioned means comprising a pivotal arm supporting one of the contacts of each pair for movement into and out of engagement with the other contact thereof, a rotary cam for actuating said arm, and an electric clock for rotating said cam.

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