Aug. 24, 1954 W. B. HERNDON, JR 2,687,023

EVAPORATOR FOR HOUSEHOLD REFRIGERATORS

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Fig-1

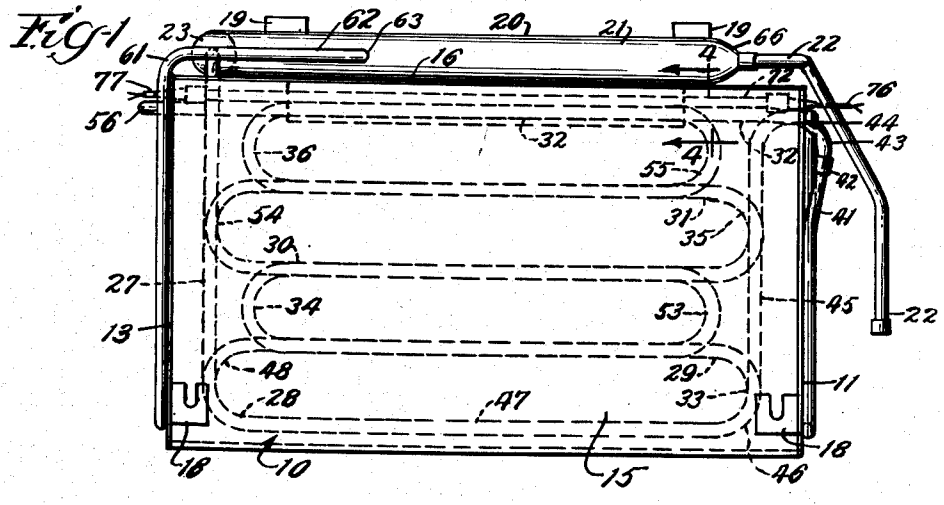


Fig-2

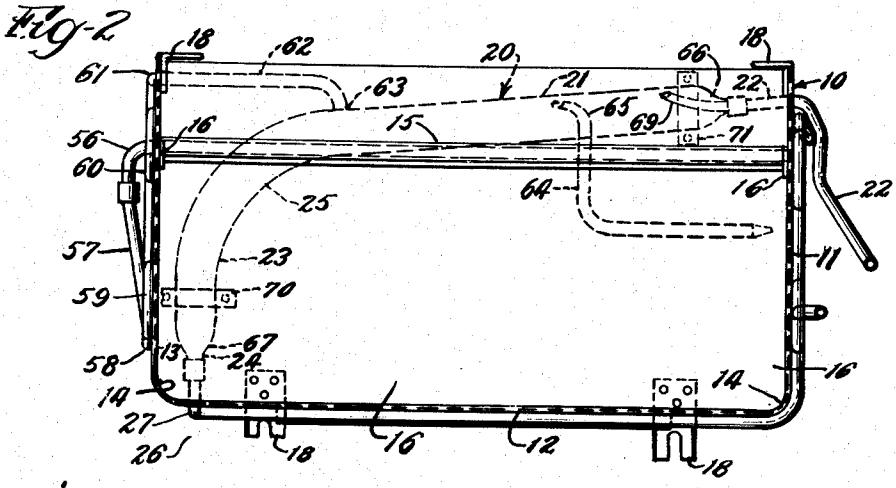


Fig-3

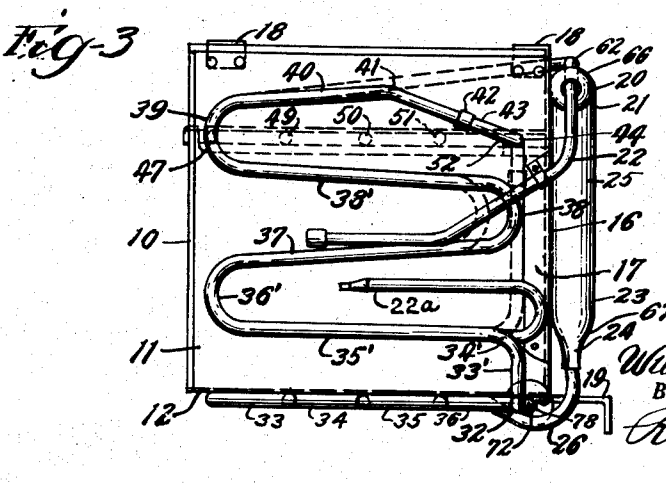
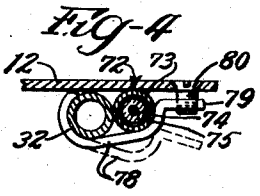


Fig-4



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EVAPORATOR FOR HOUSEHOLD REFRIGERATORS

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Fig-5

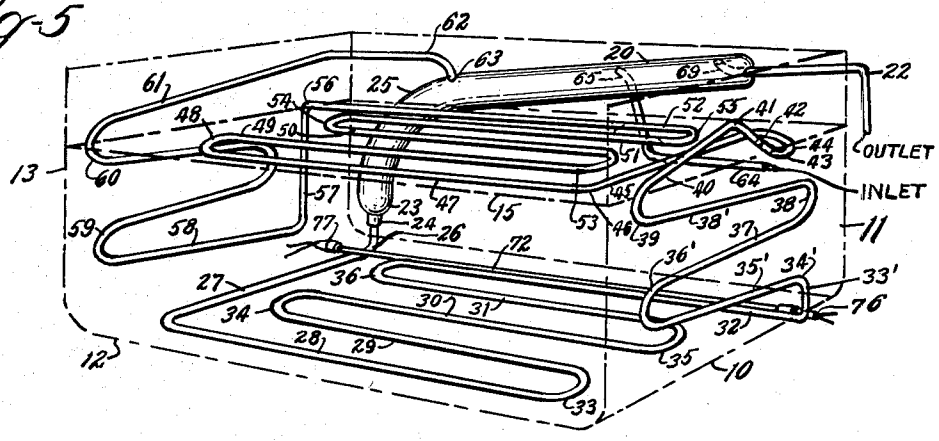


Fig-6

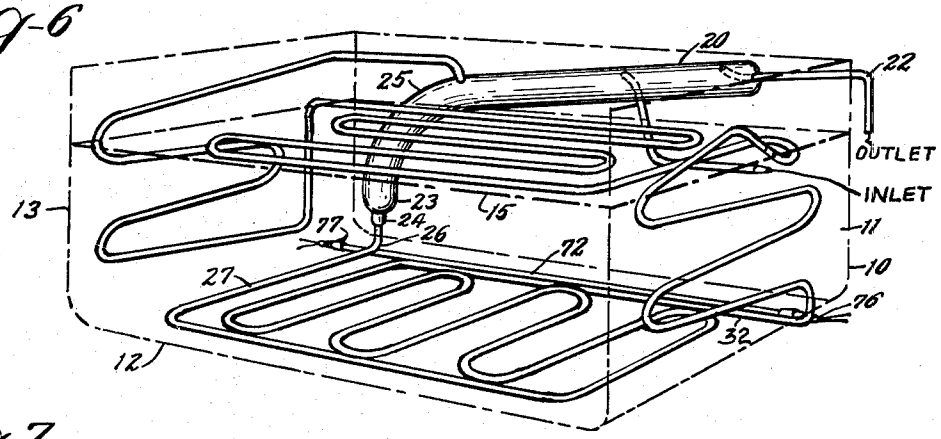


Fig-7

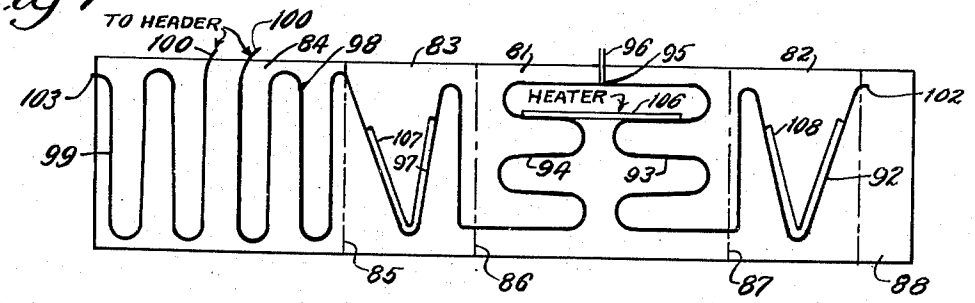
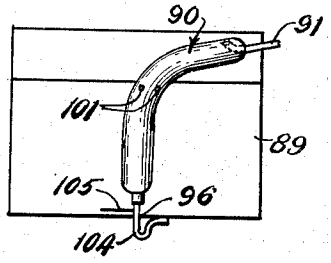


Fig-8



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UNITED STATES PATENT OFFICE

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EVAPORATOR FOR HOUSEHOLD REFRIGERATORS

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Application April 10, 1952, Serial No. 281,552

6 Claims. (Cl. 62—126)

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The present invention relates to evaporators for household refrigerators, and is particularly concerned with evaporators which are adapted to be uniformly defrosted by the action of heat applied by means of heaters.

One of the objects of the invention is the provision of an improved evaporator of the flooded type which is more efficient than the continuous tube type evaporator, especially at low ambient temperatures.

Another object of the invention is the provision of an improved evaporator for household refrigerators which is adapted to be defrosted uniformly by the application of heat by means of electric heaters.

Another object of the invention is the provision of an improved defrosting evaporator for household refrigerators in which a maximum amount of circulation of the hot refrigerant is attained through the frosted conduits of the evaporator, resulting in a rapid defrost before the food which may be carried in the evaporator is in any way affected by the application of heat.

Another object of the invention is the provision of an improved defrosting evaporator for household refrigerators which is simple in construction, which utilizes a minimum amount of metal in its construction, which may be manufactured economically, and which is adapted to meet all of the requirements of such a refrigerator, being adapted to maintain a below-freezing temperature above the shelf for freezing ice, and approximately zero temperature in the lower part of the evaporator for storing frozen food and ice cream, and which is also adapted to cool the rest of the storage space in a household refrigerator by means of the contact of the air with the outside of the evaporator and by means of convection currents suitably controlled by baffles or shutters.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings accompanying this specification,

Fig. 1 is a top plan view of an evaporator embodying my invention;

Fig. 2 is a front elevational view;

Fig. 3 is a side elevational view, taken from the right end of Fig. 2;

Fig. 4 is a fragmentary sectional view, showing the mode of clamping an electric heater to one of the conduits, taken on the plane of the

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line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 is a view in perspective, showing the tubing arrangement of the evaporator shown in Figs. 1–3;

Fig. 6 is another modification;

Fig. 7 is a developed plan view of another modification, showing the bottom, two sides, and shelf;

Fig. 8 is an elevational view of the rear panel of the modification of Fig. 7, showing the header or receiver for this type of evaporator.

Referring to Figs. 1–4, the present evaporator preferably consists of a sheet metal casing, indicated in its entirety by the numeral 10, and including a flat side wall 11, a flat bottom 12, another flat side wall 13, and the side walls being integrally joined to the bottom by easy bends at 14. The two side walls are joined by a rectangular sheet metal shelf 15, having a pair of depending attaching flanges 16, which are riveted or welded to the side walls 11 and 13, thus providing a shelf which is spaced from the top sufficiently to leave room for ice trays, within which ice is to be frozen upon the shelf.

The back of the casing 10 is closed by means of a rectangular back panel 16, having attaching flanges 17 welded or riveted to the bottom and side walls, and completely closing the back.

The present evaporator may be supported by means of a plurality of angle brackets 18 carried by each of the four corners of the top, or it may also be provided with rear wall angle brackets 19, projecting rearwardly from the bottom wall 12, as shown in Fig. 3. All of the brackets are attached to the top and rear of the liner of the domestic refrigerator to support the evaporator.

The rear wall of the evaporator is provided with a curved substantially L-shaped receiver or suction header 20, comprising a tubular member of substantially larger diameter than any of the other tubing. This relatively large tubular receiver comprises a longer leg 21, which slopes diagonally downward along the back from the suction tube 22; and it also includes a shorter depending leg 23, which extends substantially vertically on the back 16 of the evaporator, terminating at the receiver outlet 24 and joined to the other leg by an easy bend 25.

The L-shaped receiver or header enables the use of large enough charge in the high side unit system so that under all ambient conditions there is ample refrigerant in the header to defrost the entire evaporator by application of heat to the refrigerant. This head of refrigerant is main-

tained in the vertical part of the header at all times, and any further variations in the refrigerant in the header are contained in the upper sloping horizontal portion of the header without changing the liquid height in the header by any great amount.

The refrigerant in the combined header and receiver provides a pressure head which is assisted by bubbles in the sinuous tubing for stimulating circulation of refrigerant both during refrigerating conditions and defrosting conditions. Thus the present structure provides excellent circulation of refrigerant during refrigeration which results in uniform cooling of the entire evaporator and which also has excellent circulation during defrost, which results in the quick defrosting of the entire evaporator.

The side walls and bottom of the shelf of the evaporator are provided with suitable sinuous coils of tubing; and the course of this tubing on the said parts may be substantially as follows: From the depending outlet 24 of the receiver the tubing has a substantially 90 degree easy bend at 26, extending forwardly, and a straight tube 27 (Fig. 1), which extends forward across the bottom of the evaporator bottom. In some embodiments of the invention the easy bend at 26 may take the form of a trap like that shown at 104 (Fig. 8), to increase resistance to back flow in the evaporator. The tubing then proceeds sinuously across the bottom from side to side by means of the straight portions 28, 29, 30, 31, 32, joined by the easy bends 33, 34, 35, 36, successively, ending at the last horizontal pass 32.

From the point 32 the tube proceeds to the right side of the evaporator, where it is turned upwardly at 33' and laterally at 34', and passes horizontally at 35', along the outside of the right side wall. Thereafter it proceeds sinuously up the right side wall by means of easy bends 36', diagonal portion 37, easy bend 38, diagonal portion 38', easy bend 39, and the diagonal portion 40.

The latter is bent downwardly at 41 and is joined at 42 to the shelf tubing 43, which passes through the side wall at 44 and is bent forwardly, and proceeds to the front of the evaporator along the bottom of the shelf by means of the horizontal portion 45 (Fig. 1).

The shelf is then provided with sinuous coils, which are formed by having an easy bend at 46, a straight portion at 47, a U bend at 48, and successive straight portions 49, 50, 51, and 52 all joined by easy bends, indicated at 53, 54, 55, and terminating in a longitudinally extending conduit at the rear of the shelf, the end of which is indicated at 56 (Fig. 2), where it is bent downwardly to extend to the bottom of the left side by means of the portion 57.

The tube then proceeds forwardly along the bottom of the left side at 58 and has the U bends at 59 and 60 proceeding sinuously from the bottom to the top of the left side, and ending in a tube portion 61 at the top of the left side, which extends backwardly to the back of the evaporator and is bent around the corner and provided with a horizontal portion 62 above the receiver 20, and turned downwardly into and communicating with the receiver at 63 in advance of the easy bend downward leg 23.

The inlet for refrigerant comprises a tube 64, which extends into the bottom of the longer leg 21 of the receiver 20 adjacent it, but spaced from the right end of the receiver, and preferably has an inwardly projecting portion 65, which is laterally bent and directed away from the suction outlet 22.

The evaporator 22*a* may have another inlet for a capillary tube at easy bend 34' (Fig. 3).

The receiver 20 preferably has its ends spun down to a smaller diameter, as indicated by the tapering portion 66 and 67 at the two ends; and the outlet has the suction tube 22 extending into the receiver and turned upwardly at 68 inside to suck vapor or gas from the top of the receiver, which may have liquid below the suction outlet end 69.

The course of the refrigerant through the evaporator is as follows: Liquid refrigerant comes from the condenser through the pipe 64 and is conducted into the receiver 20 in a direction pointed away from the suction outlet 22 and is deposited in the receiver, which may have a predetermined amount of refrigerant in it in the form of liquid and also bubbles and vapor. From the outlet 24 of the receiver 20 the refrigerant passes forwardly on the bottom and then sinuously back and forth from left to right, leaving the bottom at the right rear.

The refrigerant then goes sinuously up the right side, terminating at the top rear right, where it proceeds through the side wall to the bottom of the shelf and forwardly on the bottom of the shelf.

It then proceeds sinuously from left to right across the shelf and toward the back, terminating at the rear side, where it passes through the left side wall 13. It proceeds downwardly on the left side wall and forwardly along the bottom of the left side wall, and thence sinuously from front to back and upwardly on the left side wall, terminating at the top rear of the left side wall, where it is led back to the receiver at 63.

The refrigerant in the form of vapor is pumped off the receiver 20 by means of the suction tube 22. The receiver is secured to the rear wall by means of a pair of partly circular sheet metal clamps 70, 71, one near each end, these clamps having attaching flanges which engage the rear wall 16 and are riveted or soldered to it.

The present evaporator is preferably made of sheet aluminum, which may be provided with steel or aluminum tubing. The evaporator is preferably provided with electric heating means, indicated at 72 (Fig. 1, Fig. 3, Fig. 4), extending along that portion of the tubing which is indicated at 32 on the bottom of the evaporator at the rearmost edge.

The electric heating element 72 is preferably of the type including a tube 73 of aluminum, or some other metal that does not corrode in contact with aluminum, an electrical resistance wire 74, and a heat insulating and electrically insulating filler 75 of a mineral nature, the heating element 74 being sealed in the tube 73 and having its terminals 76 and 77 projecting from the opposite ends.

A plurality of sheet metal clamps 78 are curved to fit about the tube 32 and the heating element tube 73 and provided with an attaching flange 79, having a threaded bore for receiving the screw bolt 80 by means of which the heating element is clamped to the bottom 12 and to the tube 32 in good heat conducting contact.

Thus the heating element 74 is arranged in heat conducting relation with the bottom of the evaporator casing and with a transversely ex-

tending tube at the bottom of the casing, near the rear end, tending to cause the refrigerant to boil up from this tube into the tubing and receiver on all other parts of the evaporator.

The large header or receiver permits the use of a generous charge of Freon, which insures an ample supply of Freon in the evaporator for defrosting and refrigeration purposes, even when the unit is operating in low ambient temperature and consequently on low percent running time, under which conditions Freon absorption in the oil is at a miximum.

The size of the depending portion of the header, as compared with the tubing forming other portions of the circuit, tends to cause a downward circulation in the depending portion of the header because the bubbles in this part of the header occupy only a small space and leave a definite head of liquid in the header, whereas the tubing extending upward is so small that bubbles tend to fill it and diminish the weight of liquid in the tubing. Therefore, there is a tendency toward a downward circulation from the depending end of the header.

The tendency is, therefore, to defrost the bottom as well as the sides and shelf; and the location of the header on the back and the heater near the back panel tends to defrost the back of the evaporator.

Referring to Fig. 5, this is a diagrammatic illustration showing the course of the tubing over the parts of the evaporator.

Referring to Fig. 6, this type of evaporator is the same, except that the tubing extends sinuously from front to back on the bottom, instead of from side to side. All of the rear bottom loops preferably contact the rearmost straight tube 32 in Fig. 6, which engages heater 72. Defrosting of the bottom is thus aided by heat conduction.

Referring to Fig. 7, this shows a developed view of a modification. In this evaporator 81 indicates the bottom, 82 the right side, 83 the left side, and 84 the shelf. When these parts are bent along the dot-dash lines 85, 86, and 87, they form a box-like evaporator, the upper sides of which may be provided with short unrefrigerated sections 88 to enclose the ice tray shelf. The back of the evaporator is shown at 89; and it again has an L-shaped header or receiver 90 carried by the back, as shown in Figs. 1 and 2, and having a suction pipe 91 at the top.

The course of the tubing may be substantially as follows: There is a V-shaped formation of tubing at 92 on the right side 82 and a plurality of sinuous formations 93 and 94 extending from front to back on the bottom 81. The sinuous formations are joined together at 95 and are provided with a tube 96 which is joined to the bottom of the header 90.

From the sinuous formations 94 the tubing extends to a V-shaped tubing portion 97 on the side 83, and thence to a sinuous formation 98 on the shelf 84. There is a further sinuous formation 99 on the shelf 84, these two sinuous formations 98 and 99 connecting at 100 into apertures 101 (Fig. 8) of the header. The end 102 of the V formation 92 is connected to the end 103 of the shelf tubing 99.

The connection at 96 to the bottom of the header preferably takes the form of a trap 104; and the inlet may be by means of a capillary tube at 105 just above the trap 104, directed into the tubing 96.

This form of evaporator may be provided with an electric heater clamped to the tubing at 106 on the sinuous tubing 93, 94 on the bottom 81. Heaters may also be located in the V-shaped portion at 107 and 108, clamped to the tubing 92 and 97 on the sides 83 and 82.

In some embodiments of the invention some of the heaters 107, 108 may be eliminated; and the heaters 107, 108 may be placed in series with each other. Any one, or two or all three heaters 106, 107, 108, may be used to effect defrosting.

The gas trap 104 tends to cause a restriction which causes circulation to start through the evaporator circuits rather than back into the header. The depending portion of the header is so large that it provides a definite head of liquid, whereas the opposing upwardly extending tubes are so small that they are filled with bubbles, which diminishes their head. Therefore, circulation is downward from the header and upward in the side tubes.

It will thus be observed that I have invented an improved form of defrosting evaporator which is very compact and simple, and in which the form of header is such as to cause downward circulation out of the header and an upward circulation in the upwardly extending tubes. The location of the header on the rear wall tends to defrost the rear wall; and the heater on the rear bottom wall tends to defrost the bottom and rear panel, as well as the sides and the shelf.

Defrosting may be accomplished in such a short time that frozen materials stored in the evaporator will not be affected by the heated condition of the evaporator.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. A defrosting evaporator for comprising a metal casing having a bottom, two side walls, and a rear wall, and a shelf, an angular header of substantial size carried by the rear wall and having a depending leg extending to a point adjacent the bottom, a suction tube extending into the other end of said header and turned upwardly therein, an inlet tube extending into said header and directed away from the suction tube toward the other end of said header, and sinuous coils extending from a point near the bend of said angular header and sinuously down one of the sides, and sinuously from side to side of the shelf, and sinuously down the other side of the evaporator, and sinuously across the bottom of the evaporator to the lower end of the depending leg of said header, the said tubing also including a straight section extending across the bottom near the rear edge thereof, and an electric heater clamped to said latter straight portion in heat conducting contact with the tubing and bottom of the evaporator.

2. An evaporator for household refrigerators comprising, a sheet metal housing having a bottom wall integrally connected to two upwardly extending side walls, a shelf extending from side wall to side wall and secured to the side walls, a rear wall secured to the side walls and to the shelf and bottom wall, sinuous tubing secured to the bottom wall, to the shelf, and to the two side walls of said housing and extending upwardly

and downwardly on said side walls, and a combined header and receiver carried by said rear wall and comprising a large tubular member having its ends closed but provided with a liquid outlte at its lower end and a vapor outlet at its upper end, said large tubular member having its upper end provided with a suction tube communicating with said vapor outlet, said upper end being located on the rear wall adjacent the upper edge of the rear wall, said large tubular member having an upper straight portion located above the shelf level and sloping downwardly across the rear wall, and said large tubular member having an easy bend portion extending downwardly to its lower end above the bottom wall level, said liquid outlet being connected to one end of the bottom sinuous tubing, the other end of which is connected to the lower end of one side wall sinuous tubing, the upper end of which is connected to one end of the shelf tubing, the other end of which is connected to the other side wall tubing at the lower end thereof, said latter side wall tubing being connected with the upper side of said header at a point spaced from said suction tube and an inlet tube communicating with said header.

3. An evaporator for household refrigerators comprising, a sheet metal housing having a bottom wall integrally connected to two upwardly extending side walls, a shelf extending from side wall to side wall and secured to the side walls, a rear wall secured to the side walls and to the shelf and bottom wall, sinuous tubing secured to the bottom wall, to the shelf, and to the two side walls of said housing and extending upwardly and downwardly on said side walls, and a combined header and receiver carried by said rear wall and comprising a large tubular member having its ends closed but provided with a liquid outlet at its lower end and a vapor outlet at its upper end, said large tubular member having its upper end provided with a suction tube communicating with said vapor outlet, said upper end being located on the rear wall adjacent the upper edge of the rear wall, said large tubular member having an upper straight portion located above the shelf level and sloping downwardly across the rear wall, and said large tubular member having an easy bend portion extending downwardly to its lower end above the bottom wall level, said liquid outlet being connected to one end of the bottom sinuous tubing, the other end of which is connected to the lower end of one side wall sinuous tubing, the upper end of which is connected to one end of the shelf tubing, the other end of which is connected to the other side wall tubing at the lower end thereof, said latter side wall tubing being connected with the upper side of said header at a point spaced from said suction tube and an inlet tube communicating with said header, said large tube being adapted to retain a supply of refrigerant in its downwardly extending end portion and to receive additional refrigerant in its upper straight portion with a minimum change of level, the head of liquid in said large tube promoting downward circulation through the bottom wall tubing, upward through the side wall tubing and shelf tubing to the top of the header.

4. An evaporator for household refrigerators comprising, a sheet metal housing having a bottom wall integrally connected to two upwardly extending side walls, a shelf extending from side wall to side wall and secured to the side walls, a rear wall secured to the side walls and to the shelf and bottom wall, sinuous tubing secured to the bottom wall, to the shelf, and to the two side walls of said housing and extending upwardly and downwardly on said side walls, and a combined header and receiver carried by said rear wall and comprising a large tubular member having its ends closed but provided with a liquid outlet at its lower end and a vapor outlet at its upper end, said large tubular member having its upper end provided with a suction tube communicating with said vapor outlet, said upper end being located on the rear wall adjacent the upper edge of the rear wall, said large tubular member having an upper straight portion located above the shelf level and sloping downwardly across the rear wall, and said large tubular member having an easy bend portion extending downwardly to its lower end above the bottom wall level, said liquid outlet being connected to one end of the bottom sinuous tubing, the other end of which is connected to the lower end of one side wall sinuous tubing, the upper end of which is connected to one end of the shelf tubing, the other end of which is connected to the other side wall tubing at the lower end thereof, said latter side wall tubing being connected with the upper side of said header at a point spaced from said suction tube and an inlet tube communicating with said header, said large tube being adapted to retain a supply of refrigerant in its downwardly extending end portion and to receive additional refrigerant in its upper straight portion with a minimum change of level, the head of liquid in said large tube promoting downward circulation through the bottom wall tubing, upward through the side wall tubing and shelf tubing to the top of the header, said inlet tube having a nozzle-shaped end extending into the header and directed away from the suction tube toward said lower liquid outlet.

5. An evaporator for household refrigerators comprising, a sheet metal housing having a bottom wall integrally connected to two upwardly extending side walls, a shelf extending from side wall to side wall and secured to the side walls, a rear wall secured to the side walls and to the shelf and bottom wall, sinuous tubing secured to the bottom wall, to the shelf, and to the two side walls of said housing and extending upwardly and downwardly on said side walls, and a combined header and receiver carried by said rear wall and comprising a large tubular member having its ends closed but provided with a liquid outlet at its lower end and a vapor outlet at its upper end, said large tubular member having its upper end provided with a suction tube communicating with said vapor outlet, said upper end being located on the rear wall adjacent the upper edge of the rear wall, said large tubular member having an upper straight portion located above the shelf level and sloping downwardly across the rear wall, and said large tubular member having an easy bend portion extending downwardly to its lower end above the bottom wall level, said liquid outlet being connected to one end of the bottom sinuous tubing, the other end of which is connected to the lower end of one side wall sinuous tubing, the upper end of which is connected to one end of the shelf tubing, the other end of which is connected to the other side wall tubing at the lower end thereof, said latter side wall tubing being connected with the upper side of said header at a point spaced from said suction tube and an inlet tube communicating with said header, said large tube being adapted to retain a supply of refrigerant in its downwardly ex-

tending end portion and to receive additional refrigerant in its upper straight portion with a minimum change of level, the head of liquid in said large tube promoting downward circulation through the bottom wall tubing, upward through the side wall tubing and shelf tubing to the top of the header, said liquid outlet communicating with a depending portion forming a liquid trap tending to resist flow in the reverse direction.

6. An evaporator for household refrigerators comprising, a sheet metal housing having a bottom wall integrally connected to two upwardly extending side walls, a shelf extending from side wall to side wall and secured to the side walls, a rear wall secured to the side walls and to the shelf and bottom wall, sinuous tubing secured to the bottom wall, to the shelf, and to the two side walls of said housing and extending upwardly and downwardly on said side walls, and a combined header and receiver carried by said rear wall and comprising a large tubular member having its ends closed but provided with a liquid outlet at its lower end and a vapor outlet at its upper end, said large tubular member having its upper end provided with a suction tube communicating with said vapor outlet, said upper end being located on the rear wall adjacent the upper edge of the rear wall, said large tubular member having an upper straight portion located above the shelf level and sloping downwardly across the rear wall, and said large tubular member having an easy bend portion extending downwardly to its lower end above the bottom wall level, said liquid outlet being connected to one end of the bottom sinuous tubing, the other end of which is connected to the lower end of one side wall sinuous tubing, the upper end of which is connected to one end of the shelf tubing, the other end of which is connected to the other side wall tubing at the lower end thereof, said latter side wall tubing being connected with the upper side of said header at a point spaced from said suction tube and an inlet tube communicating with said header, said bottom wall tubing being provided with an electric heater in heat engaging relation with the bottom wall tubing, for heating the refrigerant and evaporator, the heated refrigerant tending to move upward through the side wall tubing to the shelf tubing and from the shelf tubing through the other side wall tubing to the header, to defrost the entire evaporator.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,143,171	Anderson	Jan. 10, 1939
2,167,036	Baker	July 25, 1939
2,601,466	Thomas	June 24, 1952
2,635,439	Philipp	Apr. 21, 1953