Aug. 27, 1940. H. D. HARPER 2,212,710

REFRIGERATOR

Filed July 1, 1937 3 Sheets-Sheet 1

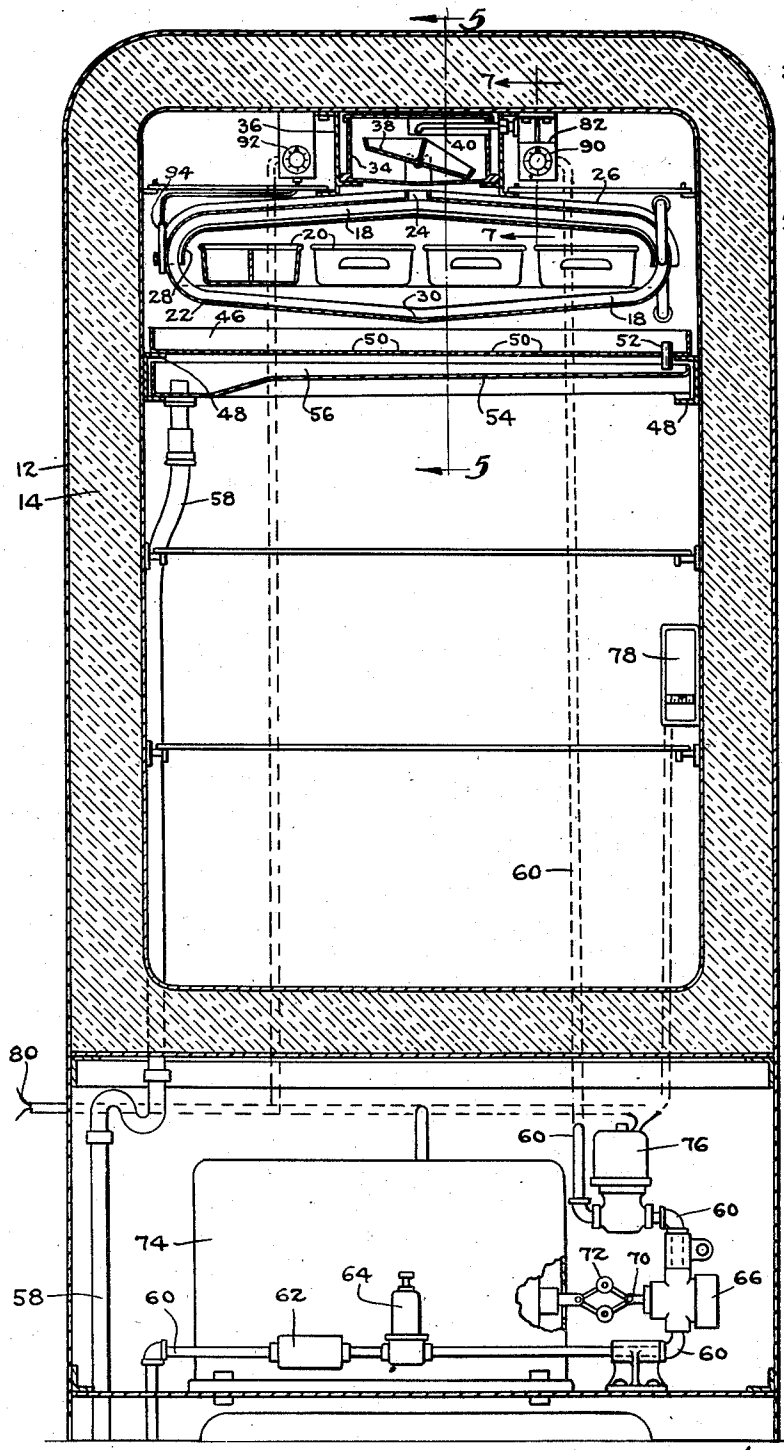


Fig. 1

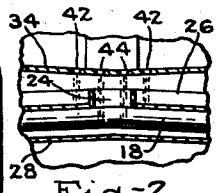


Fig. 2

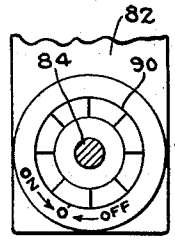


Fig. 3

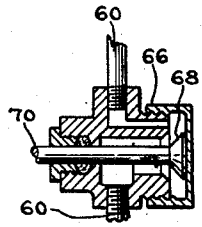


Fig. 4

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REFRIGERATOR

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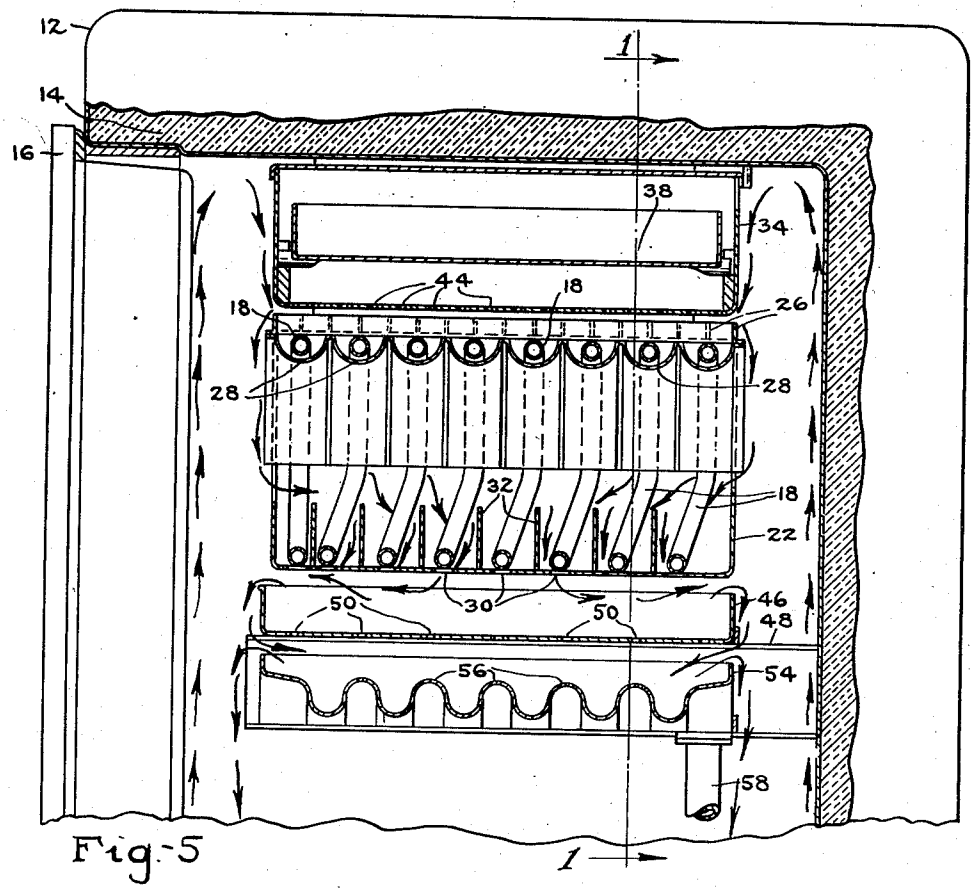


Fig.-5

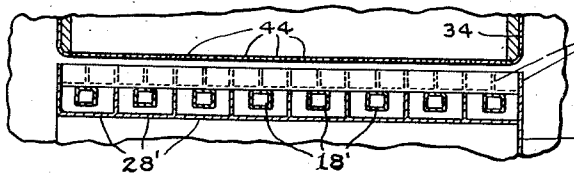


Fig.-6

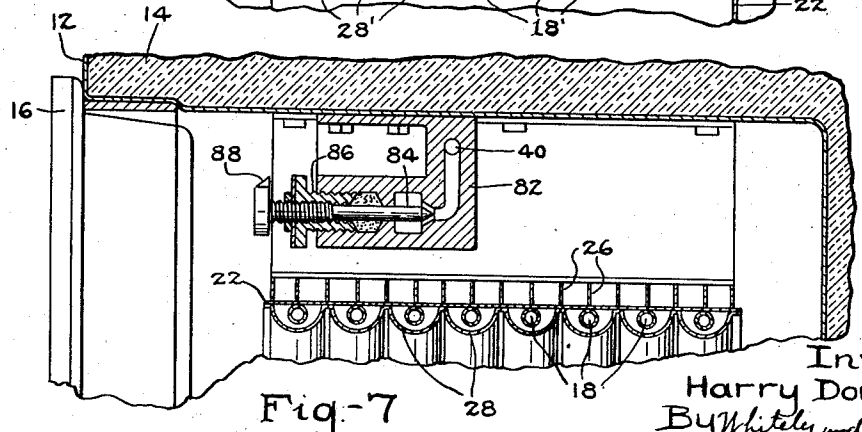


Fig.-7

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REFRIGERATOR

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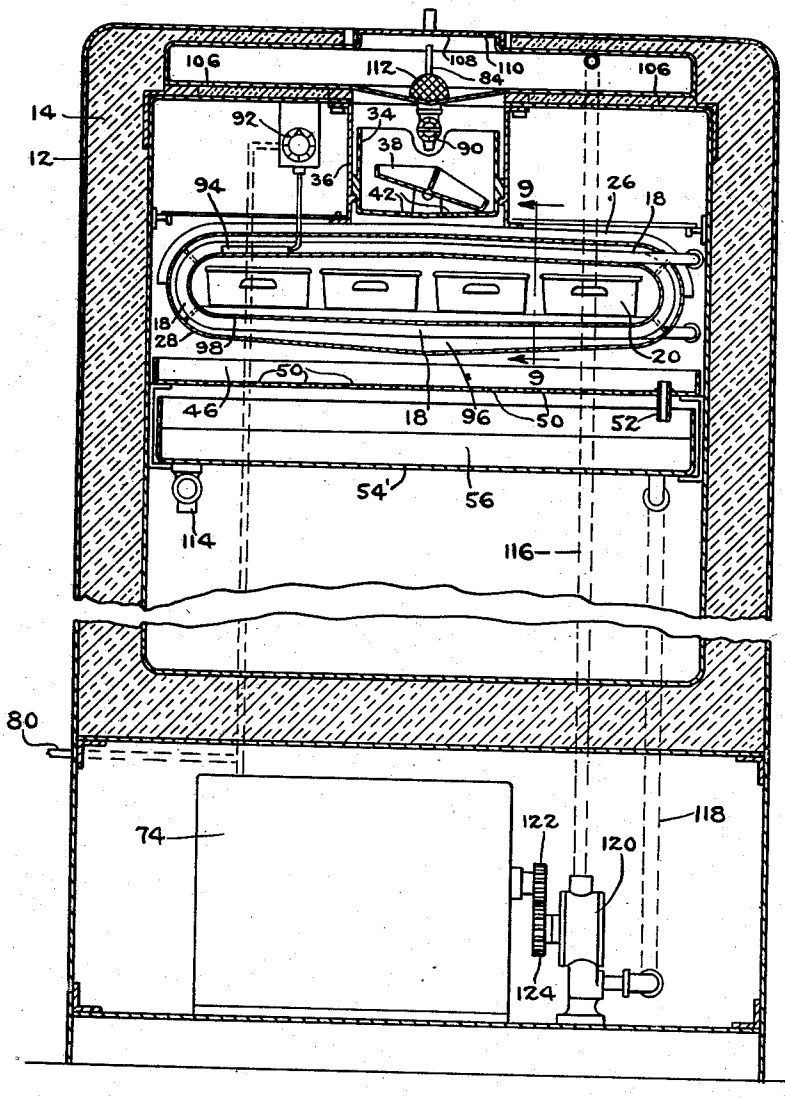


Fig-8

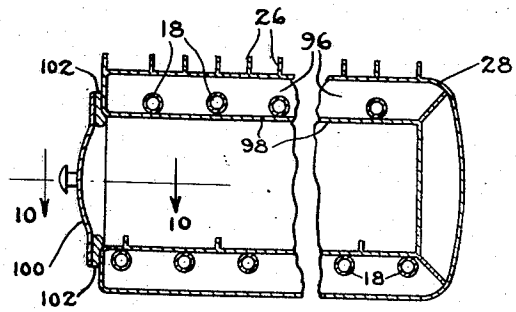


Fig-9

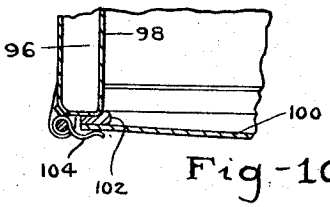


Fig-10

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UNITED STATES PATENT OFFICE

2,212,710

REFRIGERATOR

Harry Dorr Harper, Minneapolis, Minn.

Application July 1, 1937, Serial No. 151,529

13 Claims. (Cl. 62—103)

My invention relates to refrigerators. It relates more particularly to mechanical refrigerators having expansion coils and to apparatus and processes for humidifying and conditioning the air therein, for automatically controlling such humidity, and for preventing the accumulation of frost and ice on the expansion coils.

One of the objects of the invention is to provide for introducing suitable liquid such as water into the interior of the refrigerator in such manner that a predetermined humidity is maintained therein, and the expansion coils are subjected to the washing action of the liquid at a temperature such that frost and ice cannot accumulate on the expansion coils or if a film of frost should form thereon, it is soon washed away. The necessity of de-frosting the cooling and freezing coils of the refrigerator is therefore eliminated.

Another object of the invention is to provide for so controlling the rate of flow of the water or other liquid into the refrigerator that the desired humidity within the refrigerator may be substantially maintained. In addition to normally controlling the rate of flow of the water or other liquid introduced into the refrigerator for the purpose of conditioning and humidifying the air therein, I provide that the flow of liquid is regulated automatically as the temperature within the refrigerator is changed, so as to maintain a predetermined percentage of humidity which percentage will be maintained relatively at different temperatures desired within the refrigerator.

Another object of the invention is to provide means for causing the air within the refrigerator to move or circulate in such manner that the desired humidity may be maintained substantially throughout the interior of the refrigerator and at the same time maintain the air within the refrigerator at substantially the same temperature throughout.

Another object of the invention is to purify the air within the refrigerator and cause a substantial absorption of the odors and exhalations which are given off by the foods whereby such odors are removed from the interior of the refrigerator and prevented from contact with other foods which have a tendency to absorb foreign odors.

Another object of the invention is to maintain an almost uniform temperature in the interior or food compartment, without the variation in temperature which normally occurs in the average mechanical refrigerator during the freezing and de-frosting period, and in addition to maintaining a uniform temperature as compared to freezing and de-frosting periods, to cause the thermostatic control to function at a closer range variation, resulting in a more uniform temperature on the interior of the refrigerator.

Another object of the invention is to eliminate the necessity of having two distinct expansion coils, one for cooling and the other for freezing.

A further object of the invention is to be able to secure a satisfactory relative humidity whether a very low temperature or a relatively higher temperature is desired by the operator of the refrigerator.

A further object is to control automatically the temperature of the water or liquid used in the humidifying and frost preventing operation.

As is well known in the state of the art in mechanical refrigerators whether of the absorption type or compression type, the expansion coils become covered with frost or moisture condensed from the air within the refrigerator, if the expansion coils are maintained at a temperature below 32° F. As these coils continue to remain at 32° F. or at a lower temperature, the process of collecting frost and dehydrating the surrounding air continues. As this frost continues to build up on the expansion coils it condenses and causes an ice formation. As this frost or ice formation constitutes an insulation to the expansion, cooling and freezing coils, the surrounding air is prevented from contacting the exterior of the metal coils resulting in a loss of cooling efficiency, and as a result the desired temperature on the interior of the refrigerator is not maintained. If this accumulation of frost or ice on the expansion coils is allowed to continue to an appreciable extent, the temperature of the surrounding air and throughout the interior of the refrigerator will rise in many cases above a normal safe temperature for the preservation of foods.

Heretofore in mechanical refrigerators where the cooling and freezing expansion coils are one and the same it has necessitated a so-called defrosting at periodic times. This defrosting operation has been accomplished mechanically by one of two methods; either to shut off the current and make the controlling thermostat inactive, or to so adjust the thermostat that the temperature of the expansion coils is allowed to rise above the freezing point. In either case by entirely cutting out the current or thermostat or by adjusting the thermostat range, the frost or ice is removed from the expansion coils by the action of the surrounding air of the interior of the refrigerator. This results in many cases in an abnormal rise of temperature within the refrigerator and the temper-

ature during this rising period and at the end of the de-frosting period will not be uniform in the interior of the refrigerator. The rise in temperature is due to lack of sufficient cooling effect during the de-frosting period and the variation in temperature is largely due to the lack of air circulation.

In addition to the objections above indicated, different operators will de-frost at different times, resulting in a lack of uniform temperature conditions in the same type and make of refrigerator in different homes or locations. In addition to the rise of temperature, which in some cases would be above the danger point for proper preservation of certain types of foods, there is considerable inconvenience in disposing of the accumulated frost or ice and water which drops from the expansion coils.

It is a known fact that certain vegetables and certain foods when placed in a refrigerator become rapidly dehydrated by the absorption of moisture into the surrounding air, which air had been previously dehydrated by the action and cooling effect of the expansion coils. As these foods, including meats, become dehydrated it is impossible in a normal mechanical refrigerator to cause these foods to assume subsequently their normal original condition which they had prior to dehydration. It is therefore essential that such foods which are readily dehydrated be maintained as near as possible in their normal state. This has heretofore been accomplished to some extent by placing such vegetables and foods in covered containers in order to prevent the dehydrated air from acting on these foods.

The condensation or frost which collects on the expansion coils during the cooling or freezing operation is supplied first from the air in the interior of the refrigerator, which air in turn reabsorbs moisture from the foods, and this partially re-hydrated air is again subjected to a dehydrating process by the action of the expansion coils. As this process continues, if not interrupted, certain foods become dry and hard due to loss of moisture, and certain vegetables wilt due to the dehydrating process. In order to maintain foods in a mechanical refrigerator in as near a normal state as possible without dehydration, it is desirable to provide means for maintaining the air on the interior of the refrigerator in such a humid state that it will not cause any appreciable dehydration of the foods. In order to accomplish this result it is necessary to introduce moisture into the interior of the refrigerator, and this moisture must be so introduced so as to balance the dehydrating effect produced upon the air by the action of the expansion coils.

In order to maintain the temperature of the air within the refrigerator at the desired temperature, for illustration, 42° F., and not allow this temperature to vary any appreciable extent, it is necessary to maintain the expansion coils also at a relatively close temperature range. This necessitates an accurate and close adjustment thermostat, which readily reacts to increases and decreases of the temperature of the expansion coils either by means of a thermostatic bulb placed adjacent and in heat transferring relation to the expansion coils, or a thermostat operated by the interior pressure of the expansion coils themselves. This close temperature adjustment of the expansion coils will cause different results and different temperatures in the surrounding air when such expansion coils are covered with frost or ice than when the coils are free from frost and ice and in efficient operating condition. It is therefore desirable to maintain the expansion coils at the correct temperature in order to maintain the air in the refrigerator at 42° F. in the illustration given above, to prevent the formation of frost and ice on the expansion coils to any appreciable extent, and to frequently remove the film of frost if it should form.

One of the objects of my invention is to introduce into the present mechanical refrigerator a process or step which is not now in use. This step or process tends to cause a greater condensation on the expansion coils than would normally be secured in a mechanical refrigerator where no moisture was introduced into the interior thereof other than the moisture which is given up by foods and normal drinking water during the cooling and dehydrating of such foods. The continuation of my process or step is to prevent or to liquefy the normal frost together with the excess frost or condensation and in so doing together with the method of distribution to cause the air on the interior of the refrigerator to be maintained at a relative predetermined humidity.

In carrying out the objects of my invention, while the refrigerating unit and expansion coils are caused to do a greater amount of work than normally would be necessary in the absence of maintaining a satisfactory relative humidity in the interior of the refrigerator, the fact that the expansion coils are kept in a more efficient operating condition, which results in less work on the part of the compression unit, causes the effect that this increased work on one hand is largely compensated for by the increased efficiency on the other hand. The beneficial effects of maintaining the food in an excellent condition, eliminating to a large extent the dehydrating effect and loss of flavors and other desirable constituents in foods, and the lack of attention necessary and the inefficiency caused by the necessity of defrosting, more than compensate for any slight additional cost of electricity or gas used in operating such a mechanical refrigerator.

In the accompanying drawings which illustrate some of the forms in which my invention may be embodied,

Fig. 1 is a view of one form of refrigerator in vertical section on the line 1—1 of Fig. 5;

Fig. 2 is a detail sectional view on an enlarged scale showing the central portion of the distributor for liquid;

Fig. 3 is a face view of a manually controlled liquid regulating device;

Fig. 4 is a sectional view of a governor controlled shut-off device;

Fig. 5 (sheet 2) is a sectional view on an enlarged scale on the line 5—5 of the upper portion of Fig. 1 and at right angles thereto;

Fig. 6 is a vertical section of a modified form of coil construction;

Fig. 7 is a fragmentary sectional view on an enlarged scale taken on the line 7—7 of Fig. 1;

Fig. 8 (sheet 3) is a view corresponding to Fig. 1, and shows a modified form of construction;

Fig. 9 is a view in section on the line 9—9 of Fig. 8;

Fig. 10 is a fragmentary view in section on the line 10—10 of Fig. 9 turned through an angle of 90°.

As illustrated in the drawings, I provide a double walled refrigerator cabinet 12 having insulation material 14 between the wall members

and having a door 16. In the form shown in Fig. 1, there are expansion coils 18 surrounding a freezing chamber containing trays 20 for freezing ice cubes. The coils 18 are in a casing 22 whose upper wall contains a middle slot 24 from which this upper wall inclines downwardly in both directions and is provided with upstanding ribs 26 as best shown in Fig. 7. Inside of the casing 22 and underneath the upper turns of the coils 18, there are trough like members 28 for receiving liquid which has passed through the slot 24, and for delivering the liquid to the lower wall of the casing 22 which inclines downwardly from both sides to middle openings 30 for escape of such liquid as enters through the slot 24. In the construction shown in Fig. 1, the openings 30 are underneath the respective turns of the coils 18 and between upstanding ribs 32 interposed between the lower portions of the coils. As shown in Figs. 1, 5 and 7, the coils 18 are circular in cross section and the trough members 28 are semicircular in cross section. In the slight modification shown in Fig. 6, the coils 18' are flattened or square in cross section while the trough members 28' are rectangular in cross section.

A distributing box 34 for liquid is supported above the coils 18 upon brackets 36 depending from the top of the refrigerator. A bucket 38 is mounted for rocking movement in the box 34. The bucket 38 contains a central partition to provide two compartments so that when the bucket is in the position shown in Fig. 1 and liquid is delivered thereto from a tube 40, the bucket becomes overbalanced and tips so as to discharge its charge of liquid into the box 34. Continued delivery of liquid from the tube 40 causes the bucket to tip in the other direction and again spill the charge of liquid. The bottom of the box 34 is provided with four longitudinal rows of holes, there being two outer rows of holes 42 and two inner rows of holes 44 as best shown in Fig. 2 from which figure it will be understood that the liquid which passes through the outer holes 42 is delivered upon the top wall surrounding the coils and at opposite sides of the slot 24 so as to run down exteriorly between the ribs 26. It is also apparent that the liquid which passes through the inner holes 44 is delivered through the slot 24 so as to be delivered into the central part of the troughs 28 and run down in both directions around the coils 18 so as to be received upon the bottom of the casing 22 between the ribs 32 and then discharge through the row of openings 30. The liquid, after it has passed the coils 18, is received in a tray 46 supported on brackets 48 below the expansion coils. The bottom of the tray 46 is provided with longitudinal rows of holes 50 and an overflow tube 52 which stops short of the top of the tray. Supported underneath the tray 46 by the brackets 48 is a depository pan 54 the bottom of which as shown in Fig. 5 is formed with a series of corrugations 56 the tops of which lie underneath the rows of holes 50 respectively. At one end of the pan 54 as shown in Fig. 1, the bottom thereof is depressed and provided with a drain pipe 58 leading to the outside of the refrigerator for carrying off the used liquid.

The manner in which the liquid is supplied to the tube 40 so as to drip therefrom will now be described. As shown in Fig. 1, the liquid enters through a pipe 60 which may be conveniently connected to the water supply system in which case city water would be supplied. The pipe 60 is provided with a strainer 62 and a pressure reducer 64 of well known construction. The pipe 60 after being turned upwardly is provided with a valve device 66 including a valve 68 as shown in Fig. 4 having a valve stem 70 connected to one end of a centrifugal governor 72 the other end of which is connected to the shaft of an electric motor 74 which may be a motor used in connection with the refrigerator or may be a separate motor. Obviously the valve 68 is closed when the motor is running and is open when the motor is at rest. The pipe 60 beyond the valve 68 is provided with a solenoid valve device 76 which may be of well known construction so as to be electrically controlled. In order to thus control the valve device 76, it is associated with a hygrometer or humidostat 78 which is connected in a circuit 80 which is adapted to supply current to the solenoid valve device 76. The hygrometer may be of any well known or suitable construction so connected that when the humidity in the refrigerator reaches the desired point for which the hygrometer is set, the electric connection is broken and the solenoid valve closes. When the humidity is below the predetermined point, the circuit is completed and the valve is opened. Beyond this valve, the pipe 60 leads up to a valve casing 82 mounted within the top of the refrigerator as best shown in Fig. 7. The casing 82 contains a needle valve 84 having a stem which is screw threaded through a packing gland 86. The outer end of the needle valve carries a pointer 88 adapted to be revolved around a circular scale 90 which indicates "on" and "off" positions of the valve as well as intermediate positions. As will be apparent from Figs. 1 and 7, the passage in the casing 82 beyond the valve 84 is directly connected with the tube 40 from which the liquid allowed to pass the needle valve drips into the two compartment rockable bucket 38.

Fig. 1 shows a dial 92 associated with a thermostat 94 which controls the temperature of the expansion coils. As the coils 18 become warmer, the gas in the thermostat bulb expands, thereby causing an expansion of the customary bellows which trip a switch to cause the electric motor to operate. This construction is not illustrated in detail, since it is not claimed specifically as part of this invention. However, due to the fact that the expansion coils are maintained at all times in a frost free condition, the thermostat bulb is enabled to function more accurately than it would if the coils should become covered with frost and ice. It should also be noted that the adjustment of the thermostat merely relates to maintaining the temperature of the expansion coils, and that this thermostat does not need any special mechanism for varying the temperature for defrosting. The adjustment is merely for predetermined temperature and for an "off" position. The particular significance in showing this feature is that by keeping the expansion coils in an effective operating condition, a close predetermined temperature of the expansion coils may be maintained and in turn a close temperature of the interior of the refrigerator.

The same reference numerals will be used in connection with Fig. 8 so far as they relate to common features. In this last form, the expansion coils are in an air chamber 96 produced by placing a casing 98 in spaced relation inside of the casing 28. The freezing trays 20 are placed inside of the casing 98 which is provided with door 100 as shown in Figs. 9 and 10. This door when in closed position fits in airtight manner upon a gasket 102 so that the trays 20 in the interior

compartment are kept from communication with the air outside of this compartment. The door 100 is normally kept closed by a spring 104 as shown in Fig. 10. The bottom of the distributing box 34 as shown in Fig. 8 has only two rows of holes indicated at 42 since the liquid drips only upon the exterior of the expansion coils 18. The construction thus far described for Fig. 8 is interchangeable with the corresponding construction disclosed in connection with Fig. 1 since either construction might be employed with Figures 1 and 8.

The construction shown in Fig. 8 differs from that shown in Fig. 1, in that it does not necessitate connecting the refrigerator with a source of water or other liquid supply outside of the refrigerator or having a drain to the outside of the refrigerator. A water or liquid supply tank 106 is placed in the top of the refrigerator between the outer and inner walls thereof. This tank is provided with a cover 108 having a slight vent 110. The bottom of the tank 106 is concaved toward the center which is provided with a valve 84 which may be of the needle valve type disclosed in connection with Fig. 1 and which may be regulated by means of a scale device 90 such as shown in Fig. 3. Associated with the valve is a strainer 112 which may be removed for cleaning upon lifting the cover 108. The receiving tray 46 is the same as that shown in Fig. 1, but the depository pan 54' differs and is not connected with an outside drain. The bottom of this pan is provided with a faucet 114 by means of which the liquid may be drained off if it is desired to change the same. In order to transfer the liquid from the pan 54' back to the tank 106, a pipe 116 extends from the bottom of the pan between the rear walls of the refrigerator to a rotary pump 120 which is connected by a pipe 118 to the top of the tank 106. The pump is driven by the motor 74 to whose shaft is secured a spur gear 122 meshing with a spur gear 124 secured to the shaft of the pump.

The thermostat bulb 94 in Fig. 8 is placed in engagement with the expansion coils in the air chamber 96. Since the expansion unit has an interior freezing compartment, the liquid passing around the outside surface of the air chamber 96 would have no delaying action during the freezing operation. Therefore it is not necessary to prevent the passage of liquid from the distributor during the freezing operation as is desirable in Fig. 1 where the liquid passes directly around the expansion coils.

The distributing box 34 and its contained bucket 38 can be removed from the refrigerator in the construction shown in Fig. 8 as well as that shown in Fig. 1. Also both receptacles 46 and 54 or 54' may be removed from the refrigerator. Such removal is sometimes desirable for cleaning purposes. In Figs. 1 and 8, the receptacles 46 and 54 or 54' are close to the side walls of the refrigerator cabinet. However as shown in Fig. 5, there is a space in front of as well as at the back of these two receptacles which leaves open spaces both front and rear of these two receptacles. Therefore warm air will rise from the bottom of the refrigerator, will go up past the receptacles 46 and 54', and will pass around the expansion coils. In doing this, the air will be cooled by the effect of the expansion coils and the cold water and in addition will pick up the desired humidity. The air thus becoming colder and heavier will pass down to the bottom of the refrigerator and the process of circulation will be repeated over and over.

The operation and advantages of my invention will be apparent when considered in connection with the foregoing description and the accompanying drawings. Referring particularly to Fig. 1, water enters through the pipe 60 and passes through the strainer 62 and the pressure regulator 64. If the motor 74 is not operating, the valve 68 will be opened. Water will now flow past the solenoid valve 76, if it has not been allowed to close by the hygrometer 78 having reached the humidity point for which it is set. Passing from the solenoid valve, the water goes up through a continuation of the pipe 60 to the needle valve 84 shown in Figs. 3 and 7. When the refrigerator door 16 is open, the pointer 88 may be turned to move the valve 84 to either "off" or "on" position or to intermediate positions. The object in providing the valve 84 is to regulate the flow or dripping of the water into the distributor bucket 38. This valve may be opened wide to "on" position in cases where it is desired to wash off quickly the expansion coils. When the distributor bucket 38 receives enough water to become overbalanced, it tips and spills its charge of water into the bottom of the distributor box 34. As shown in Fig. 2 some of this water runs through the outer rows of holes 42 and washes the metal above the expansion coils. The rest of the water in the box 34 runs through the inner rows of holes 44, passes through the slot 24 to the inside of the casing 22 and washes the coils therein. The water which acts upon the expansion coils together with the condensate washed therefrom falls into the tray 46 and passes through the holes 50 into the depository pan 54. If the water should enter the tray too rapidly to be taken care of by the holes 50, it will pass through the overflow tube 52 into the pan 54 without overflowing into the refrigerator. From the pan 54, the water passes out of the refrigerator through the drain pipe 58. Since the upper end of this pipe passes up beyond the bottom of the pan 54, there is always some water left in this pan.

The reason for closing the valve 68 when the motor 74 is running is so as not to interfere with the freezing operation by allowing water to pass over the expansion coils during this period. The hygrometer or humidostat 78 is placed within the refrigerator and can be so adjusted as to maintain any desired humidity in the refrigerator within a range of from 50% to 80%, and maintain that humidity within a range of 2% to 3%. If the humidity is too low, the hygrometer causes an electrical contact to open the solenoid valve 76 and allow water to pass to the expansion coils. When the humidity reaches the desired point, the hygrometer causes the current to the solenoid to be cut off and the valve to close thereby preventing further water passing this valve. However in regard to the humidity control, even if the humidity is too low as indicated in Fig. 1, if the motor is running to close the valve 68 so that water cannot get past the same, then as soon as the proper temperature has been reached for the expansion coils, the thermostat 94 operates to stop the motor and allow the valve 68 to open. As the solenoid valve is already open, water will be delivered to the expansion coils until the desired humidity is obtained.

In large mechanical refrigerators, where the humidity in the interior of the refrigerator must be kept within a few degrees, the humidity control together with the solenoid valve would be

used. In smaller or household mechanical refrigerators, where the relative humidity need not be maintained so accurately, the humidity control, together with the solenoid valve would probably be eliminated. The desired humidity can be secured by the adjustment of the control or needle valve so as to regulate the amount of water which is circulated over the expansion unit.

Only one method of distributing and intermittently causing water to flow over the expansion unit is illustrated. This intermittent method and distribution of the water over the expansion unit could be carried out mechanically in any desired manner without departing from the principles involved in this invention. The amount of water deposited intermittently over the expansion unit or coils at any one time would depend entirely upon the amount of surface to be covered of the expansion unit, and also the frequency of these intermittent charges of water. The size therefore of the distributing bucket and the distributor box will depend on the relative size of the expansion unit and the results desired.

As used in this description, the expansion or cooling unit refers to not only the expansion coils themselves, but includes any metal which is adjacent to or in contact with these expansion coils, which performs the functions of cooling the interior of the refrigerator, and in addition may cause a direct freezing operation upon water or substances in close contact with such refrigerating coils.

If the water is secured from an outside source as indicated in Figure 1, it may be cooled before allowed to come in contact with the cooling unit by placing the water tube **60** adjacent to the cooling unit itself before being allowed to enter into the distributing mechanism. This cooling of the water before contacting the cooling unit is not necessary where the water is introduced as indicated in Figure 8, as the water which is caused to circulate has been pre-cooled during the passage over and in contact with the cooling unit.

As the water passes over the cooling unit it causes a quick change in the temperature of the thermostatic bulb, which in turn causes the refrigerating mechanism to operate. This causes the water to immediately circulate as indicated in Figure 8. The advantage of causing the refrigerating mechanism as a whole to operate frequently at short intervals rather than for long periods of time with long periods of non-operation, is that the cooling units are maintained at close temperature range which results with the method of air circulation in an almost uniform temperature being maintained throughout the interior of the refrigerator. In addition, the refrigerating mechanism is subjected to less wear and overheating by this frequency of operation at short intervals.

Any desired results may be obtained in such a mechanical refrigerator which has sufficient capacity to maintain a low internal temperature of the air by the mere setting of the thermostatic control for such a low temperature. At the same time the humidity control can be so set as to maintain a relative humidity, for example, 75%, at a low temperature of 38° F. or at any higher degree. Where the hygrometer is not used as in Figure 8, the desired humidity can be maintained by regulating the rate of flow of liquid allowed to enter into the distributing mechanism, by means of adjusting the needle valve. If an increased humidity is desired the needle valve is opened a certain degree which allows the liquid to flow more rapidly into the distributing mechanism, which in turn allows more liquid to pass over the expansion or cooling unit. This results in more liquid being caused to drip from the distributor tray **46** and in turn causes a greater absorption of moisture by the circulating air. In practice in a household model, where the hygrometer is not used, if an excess amount of humidity is present in the interior of the refrigerator, so as to cause precipitation of moisture on vessels and foods, the water regulator or needle valve **84** would be further closed so as to prevent a too rapid circulation of liquid and in turn overcome such precipitation in the interior of the refrigerator.

While in carrying out the principles of this invention, a correct humidity of the interior of the refrigerator is secured, nevertheless in obtaining this desired humidity which may be increased or decreased by adjustment, the expansion coils and the expansion and cooling unit are maintained in a substantial defrosted condition at all times. The manner in which the liquid is caused to flow over the cooling unit and its course of travel may be varied to conform with the particular construction of the expansion unit in order to intermittently and frequently keep the frost from forming. Where the liquid is allowed to flow only over the exterior of the cooling unit, and the freezing compartment is in the interior of the expansion or cooling unit, it would be necessary from time to time to remove the frost on the interior of this freezing compartment in any suitable manner. However, if this particular construction is used and care is exercised, the amount of frost deposits on the interior of this freezing compartment would be restricted solely to the absorption of moisture from water or ingredients in the trays placed in this freezing compartment, and not from the air or foods in the interior of the refrigerator.

Where the separate freezing compartment is used, and the entrance to this freezing compartment is closed by means of one or more closures or doors and an air chamber surrounds this compartment, in which is placed the expansion coils, the size of the air chamber and its relative spacing will depend entirely upon the results desired.

Where water is used as indicated in Figure 8, for the purpose of securing the desired results, it is understood that to this water may be added some chemical which has a purifying effect, in order to prevent the necessity of occasionally changing the entire supply of water used in one operation. This water, together with such added substance which has the property of absorbing and holding odors, for the purpose of this description will be called a liquid. If such a liquid were used it would be necessary only to add to the refrigerator from time to time such amount of the liquid as had escaped through evaporation.

I claim:

1. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of a liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid

coming from the freezing unit to maintain humidity within the refrigerator.

2. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of a liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means, means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator, and means for controlling said humidity.

3. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of a liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, a motor for causing said freezing unit to function, means for starting and stopping said motor, means whereby the liquid is caused to be delivered to said freezing unit only when the motor is stopped, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

4. In a refrigerator, the combination of a freezing unit, means for delivering liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, a motor for causing said freezing unit to function, means for starting and stopping said motor, means controlling the flow of liquid from said delivering means, a connection between said motor and said controlling means whereby the flow of liquid is stopped when the motor is running, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

5. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means for regulating the charges of liquid, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

6. In a refrigerator, the combination of a freezing unit, means for delivering liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means controlling the flow of liquid from said delivering means, a hygrometer in the refrigerator, connection means between said hygrometer and said controlling means whereby the flow of liquid is decreased when the humidity in the refrigerator reaches a predetermined point and is increased when the humidity falls below said point, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

7. In a refrigerator, the combination of a freezing unit, means for delivering liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, a motor for causing said freezing unit to function, means for stopping and starting said motor, means controlling the flow of liquid from said delivering means, a connection between said motor and said controlling means whereby the flow of liquid is stopped when the motor is running, a second means controlling the flow of liquid from said delivering means, a hygrometer in the refrigerator, connection means between said hygrometer and said second means whereby the flow of liquid is decreased when the humidity in the refrigerator reaches a predetermined point and is increased when the humidity falls below said point, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

8. In a refrigerator, the combination of a freezing unit, means for delivering liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, an electric motor in a circuit, a hygrometer in said circuit, electro-magnetic means in said circuit controlling the flow of liquid from said delivering means whereby the flow of liquid is decreased when the humidity in the refrigerator reaches a predetermined point and is increased when the humidity falls below said point, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

9. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, an electric motor in a circuit for causing said freezing unit to function, a thermostat in said circuit associated with said freezing unit, said thermostat opening said circuit when the temperature of the freezing unit falls below a predetermined degree and closing said circuit when the temperature of the freezing unit rises above

the predetermined degree, means whereby the liquid is caused to be delivered to said freezing unit only when the motor is stopped, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator.

10. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of a liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means, means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator, and means for decreasing the frequency of the intermittent charges as the temperature within the refrigerator falls and for increasing the frequency of the charges as the temperature within the refrigerator rises.

11. In a refrigerator, the combination of a freezing unit, means for intermittently introducing charges of a liquid from a source of supply thereof at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means, means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain humidity within the refrigerator, and means for maintaining a predetermined humidity under varying temperature conditions with the refrigerator.

12. In a refrigerator, the combination of a freezing unit, means for intermittently delivering charges of liquid from a source of supply at a temperature above the freezing point of water into contact with said freezing unit to melt and prevent accumulations of frost thereon, means beyond said freezing unit for collecting said liquid and all melted and condensed accumulations carried thereby, means for returning the liquid from said collecting means to said freezing unit, and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain predetermined humidity within the refrigerator.

13. In a refrigerator, the combination of an inner and an outer casing spaced from each other to form an air chamber, freezing coils in said air chamber, a freezing chamber within the inner casing, a substantially air tight closure for said freezing chamber, means for intermittently delivering charges of liquid from a source of supply thereof at a temperature above the freezing point of water into contact with the outer casing to melt and prevent accumulations of frost thereon, means beyond said casings for collecting said liquid and all melted and condensed accumulations carried thereby, means for removing liquid from said collecting means and means for causing the air within the refrigerator as it circulates by gravity to take up moisture from the liquid coming from the freezing unit to maintain predetermined humidity within the refrigerator.

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