

Nov. 21, 1939.

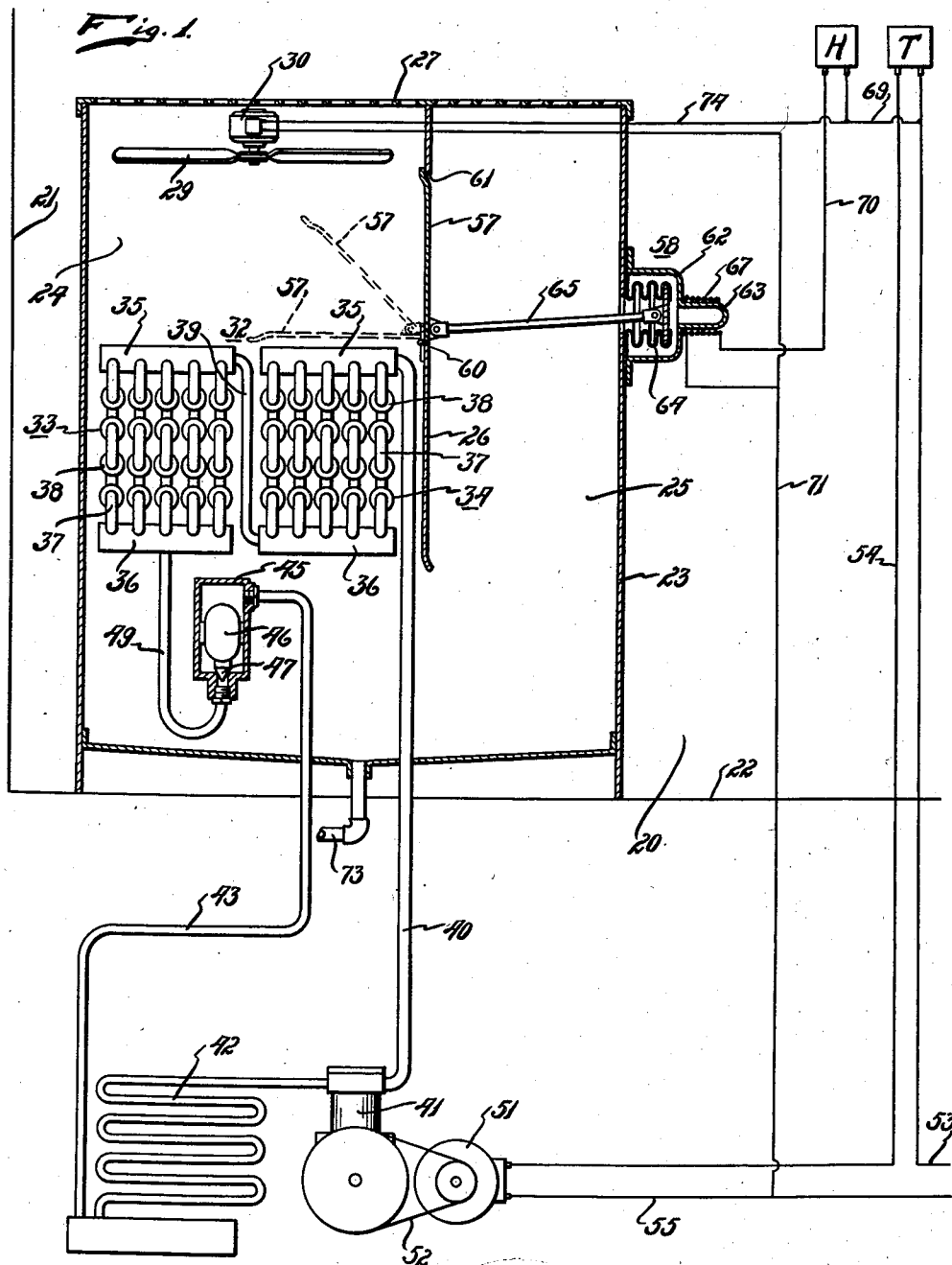
L. A. PHILIPP

2,180,479

AIR CONDITIONING SYSTEM

Filed March 7, 1934

2 Sheets-Sheet 1



INVENTOR.
LAWRENCE A. PHILIPP
BY
Warren H. J. Schmeiding
ATTORNEY.

Nov. 21, 1939.

L. A. PHILIPP

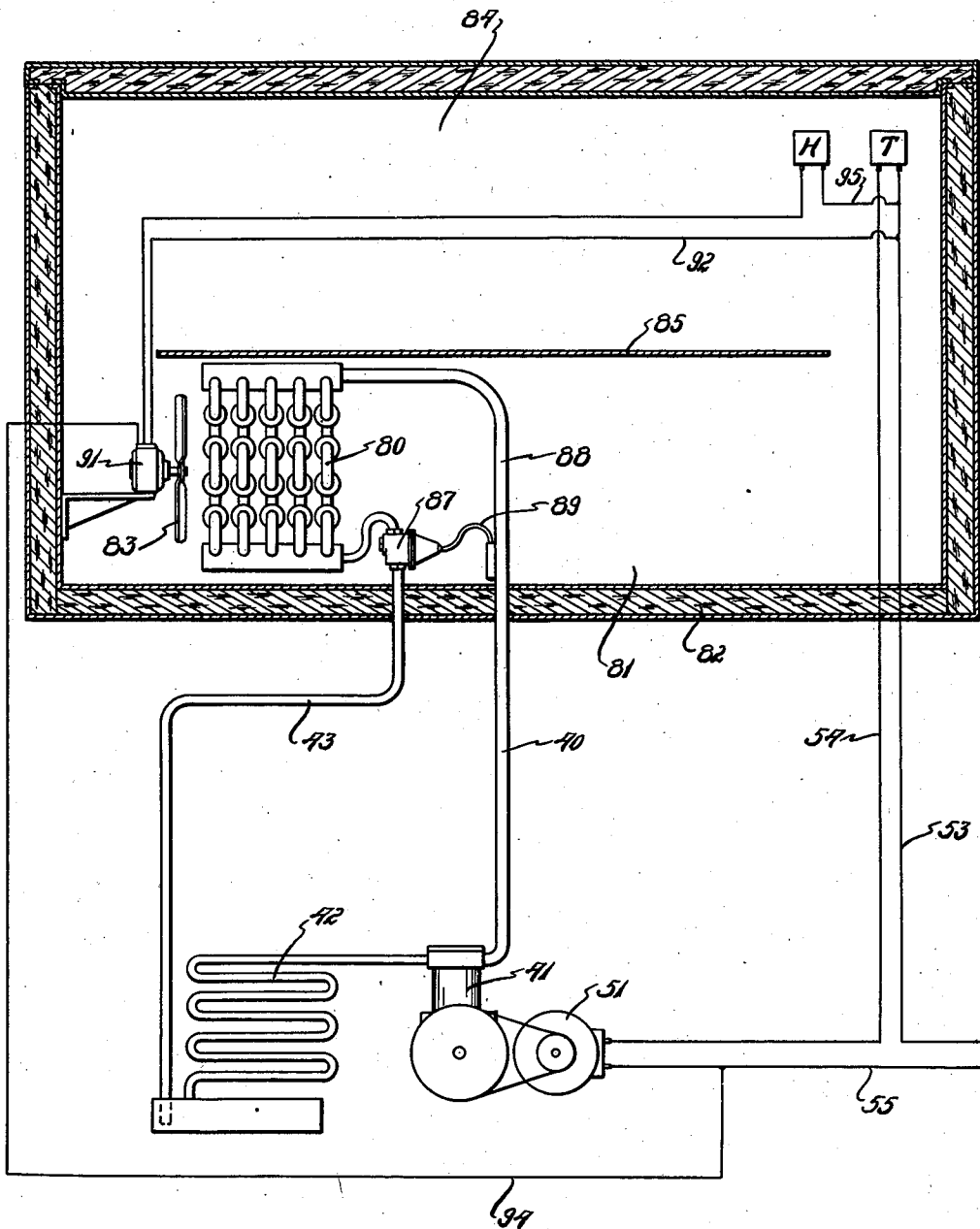
2,180,479

AIR CONDITIONING SYSTEM

Filed March 7, 1934

2 Sheets-Sheet 2

Fig. 2.



UNITED STATES PATENT OFFICE

2,180,479

AIR CONDITIONING SYSTEM

Lawrence A. Philipp, Detroit, Mich., assignor, by
mesne assignments, to Nash-Kelvinator Cor-
poration, Detroit, Mich., a corporation of Mary-
land

Application March 7, 1934, Serial No. 714,431

3 Claims. (Cl. 62—6)

The present invention relates to refrigerating and humidity controlling methods and systems and particularly to methods and systems employing artificial refrigerating apparatus.

5 In certain types of refrigerating apparatus, such as the compressor-condenser-expander type, by increasing and decreasing the heat load on the evaporator of such apparatus, the tempera-
10 ture of the evaporator is increased and decreased respectively and one of the objects of the present invention is to utilize this phenomena or characteristic of the refrigerating system for maintaining the desired humidity and tempera-
15 ture conditions of air and to control the relative humidity of the air by controlling the quantity of air flowing over the evaporator, and to control the amount of heat removed from the air in accordance with the temperature of the air.

Another object of the present invention is to
20 utilize the above characteristics of such types of refrigerating apparatus to dehumidify and temper the air by decreasing the flow of air over the evaporator by preventing some of the circ-
25 ulating air from flowing over the evaporator and causing this unconditioned air to merge with the stream of air cooled by the evaporator.

Further objects and advantages will be ap-
30 parent from the following description, reference being had to the accompanying drawings where- in preferred forms of embodiment of the present invention are clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of my improved
35 refrigerating apparatus for carrying out the im- proved air conditioning method and system; and

Fig. 2 is a diagrammatic view of another form of the invention.

In the illustration shown in Fig. 1, the inven-
40 tion is shown as applied to an air conditioning system for the purpose of maintaining the proper temperature and humidity in a room or rooms. A room 20 is diagrammatically shown by a side wall 21 and a floor 22 and within the room there is disposed a cabinet 23 having a cooling com-
45 partment 24 and an air mixing compartment 25. A partition wall 26 depends from the top wall 27 of the cabinet 23 and extends from the front to the rear thereof to form said compartments 24 and 25.

Partition wall 26 stops short of the bottom of the cabinet for the free flow of air from com-
50 partment 24 to compartment 25. The top wall 27 is of lattice formation for the free flow of air from the room 20 into compartment 24 and for the free flow of air out of compartment 25

into the room. A fan 29 driven by a motor 30 is disposed preferably in compartment 24 and causes a forced circulation of air through the cabinet 23.

An evaporator 32 of a mechanical refrigerat-
5 ing apparatus is disposed within compartment 24 and lies in the path of the air flowing through said compartment. Any suitable type of evap-
10 orator may be employed and I have herein shown an evaporator including two sections 33 and 34. Each of these sections includes upper 35 and
15 lower 36 headers interconnected by parallel ducts 37, and fins 38 are intimately attached to the ducts 37 for increasing the heat absorbing sur-
20 faces of the evaporators. The outlet or upper header 35 of section 33 is connected to the inlet or lower header 36 of section 34 by a pipe 39.

Gaseous refrigerant is withdrawn from the
25 evaporator 32 by a pipe 40 which is connected to the outlet header 35 of section 34. This pipe 40 is connected at its other end to the low pres-
30 sure side of a compressor 41, which compressor compresses the refrigerant and forces the same into a condenser 42 wherein it is liquefied and delivered to a pipe 43. Any suitable type of ex-
35 pansion valve may be interposed between the condenser 42 and the evaporator 32 and for the purpose of illustrating the invention, I have shown a high-side-float type expansion valve 45.
40 Liquid refrigerant is delivered to the valve 45 by the pipe 43 and the outlet of the valve 45 is controlled by a float 46 which actuates a needle
45 valve 47. After a predetermined quantity of liq- uid refrigerant accumulates in valve 45, the float 46 permits refrigerant to flow from the valve 45
50 through a pipe 49 to the lower or inlet header 36 of section 33.

It is apparent from the foregoing that when
the compressor is in operation, it will reduce the
40 pressure within evaporator 32 causing a reduc- tion in temperature within evaporator 32 and air flowing over the evaporator will be cooled. In
45 order to control the temperature of the air, a thermostat T is provided for controlling the re- frigerating apparatus. In the present illustra-
50 tion, the compressor 41 is driven by a motor 51 by a belt 52. The circuit to the motor 51 includes wire 53, thermostat T, wire 54, motor 51 and wire 55. Thermostat T is preferably placed in the
55 room 20 and maintains the circuit to the motor 51 until the temperature of the air in the room is decreased to a desired minimum at which time it operates to break the circuit to the motor 51. This circuit will remain interrupted until the temperature of the air in the room increases to

a predetermined high degree at which time the thermostat T will complete the circuit to the motor 51 so as to render the refrigerating apparatus operative. Thus it is apparent that the refrigerating apparatus maintains the air in the room between predetermined high and low temperature limits.

In addition to controlling the temperature of the air in the room, it is also desirable to control the relative humidity of the air. To accomplish this, I control the quantity of air flowing over the evaporator 32 in accordance with the relative humidity of the air to be conditioned and for this purpose I provide a baffle 57, a humidostat H and a controller 58. The baffle 57 is hinged at 60 to the partition 26 and is shown as closing and opening 61 in the partition 26. When the baffle 57 is in the position shown in the drawing, all of the air entering the cabinet 23 passes over the evaporator 32. However, when the baffle 57 is in the dotted line position, air flows substantially only over section 33 of evaporator 32 and part of the air is directed by the baffle 57 through the opening 61 in partition 26 into the upper part of compartment 25.

The baffle 57 is moved by the controller 58 which controller comprises a casing 62 having a projection 63 which contains a volatile fluid and which when heated causes an increased pressure within the container 62 and imparts a collapsing movement to a metallic bellows 64. The movable wall of the bellows 64 is connected to the baffle 57 by a rod 65. An electric heating coil 67 surrounds projection 63 for heating the fluid contained therein and in the casing 62. The heating coil 67 is controlled by the humidostat H and the humidostat H is disposed at a desired place in a room 20. When the relative humidity in the room attains a predetermined maximum, humidostat H completes a circuit to the heating coil 67 over wires 53, 69, humidostat H, wire 70, coil 67 and wires 71 and 55. This will cause an expansion of the fluid in casing 62 which in turn causes the baffle to move from its full line position to its dotted line position. When the relative humidity in the room is decreased to a predetermined lower minimum, humidostat H will operate to interrupt the circuit to the heating coil 67 and the fluid within casing 62 will decrease in temperature permitting the bellows 64 to expand to cause the baffle 57 to move from its dotted line position to its full line position.

The compressor motor 51, when in operation, drives the compressor 41 at substantially constant speed and therefore, when the compressor is in operation, the volume of gaseous refrigerant withdrawn from the evaporator 32 is constant. If air passes over the entire evaporator, the compressor tends to maintain a substantially even temperature throughout the length of the evaporator. However, if the flow of air over the evaporator is decreased, that is the heat load on the evaporator is decreased, and since the volume of refrigerant withdrawn from the evaporator is substantially constant, the temperature of the evaporator will be decreased. In accordance with the invention disclosed in Fig. 1, the size of the compressor is computed relative to the evaporator 32 so that, when air flows over the entire evaporator, the evaporator temperature is such as to remove principally sensible heat from the air flowing thereover. The arrangement is also such that when the flow of air over the evaporator 32 is decreased as when the baffle is in its full line position, the temperature of the evapo-

rator is decreased to such low degree that the air flowing thereover will be cooled to considerably below the dew point thereof whereby moisture from the air will be precipitated. The water will drip from the evaporator and will be conducted from the cabinet 23 by the drain pipe 73.

It is desirable to cause a continuous circulation of air in the room 20 and therefore the fan motor 30 operates continuously, it being connected as follows: wires 53, 69 and 74, motor 30 and wires 75, 71 and 55.

Thus it is apparent I maintain the proper temperature condition by starting and stopping the compressor in accordance with the temperature of the room. Also, the proper humidity is maintained by varying the temperature of the evaporator by controlling the quantity of air flowing thereover.

When a relatively smaller quantity of air is flowing over the evaporator 32, this air is reduced to a relatively colder temperature and in order to temper this air before it is discharged from the cabinet 23, the baffle 57 directs relatively warm air through the opening 61 in partition 26 whereby relatively warm air is mixed with the relatively cold air before the air is discharged from the cabinet 23. In this manner the air discharged from the cabinet 23 is at substantially the same temperature when the air is merely being cooled to remove sensible heat or being cooled to a relatively low temperature for removing latent heat.

In the form of the invention illustrated in Fig. 2, the quantity of air flowing over the evaporator is controlled by changing the speed of a fan. In this embodiment, the evaporator 80 is disposed in the lower compartment 81 of a refrigerator box or cabinet 82 and a fan 83 causes air to be forced over the evaporator 80, through the lower compartment 81 and then, in the opposite direction, through the upper compartment 84. The partition wall 85, between compartments 81 and 84 serves as a shelf for food articles and stops short of the opposite end walls of the cabinet for the free flow of air between the compartments. The compressor, condenser, the compressor motor and the thermostat control mechanism is similar to that shown in Fig. 1. Any suitable type of expansion valve may be employed and in the present illustration I have shown an expansion valve 87 which is responsive to the pressure in the evaporator and to the temperature of the outlet of the evaporator. This type of valve is known in the art as a "thermostatically controlled expansion valve" and such valve is shown in the Marshall Patent No. 630,617 and is employed as shown in the Marshall Patent No. 1,003,283. For the purpose of subjecting the expansion valve to the temperature at the outlet of the evaporator, a bulb 88 is intimately connected to suction pipe 40 and is connected by a pipe 89 to the back side of the flexible wall of the valve 87. The bulb 88 and pipe 89 contain a volatile fluid to affect the operation of the valve 87 so that the valve will operate also in accordance with changes in temperature of the outlet of the evaporator.

When a heavy heat load is placed on the evaporator, the compressor will operate over a longer period of time which in effect will tend to cause such lowering of the temperature of the evaporator that it will remove too much moisture from the air and cause too low relative humidity. In accordance with the present invention, if the relative humidity falls to a certain percentage, the

speed of the air fan 83 is increased to decrease the temperature differential between the air in the cabinet and the evaporator. This in effect will cause an increase of the temperature of the evaporator and a consequent decreasing of removal of latent heat from the air whereby the air will not be too dry for proper food preservation. A variable speed motor 91 is herein employed and satisfactory results are obtained by operating the motor at either of two speeds. When the relative humidity of the air is above a predetermined low minimum, the motor 91 operates at its relatively low speed, the circuit therefore including wires 53, and 92, motor 91, and wires 94 and 55. When the relative humidity decreases to the desired minimum humidity condition, the humidostat H closes the following circuit: wires 53 and 95, motor 91 and wires 94 and 55 whereby the motor operates at its higher speed. The motor will continue to operate at this speed until the humidity of the air increases to above said predetermined minimum relative humidity and after the relative humidity is increased to a predetermined maximum, the humidostat will operate to restore the motor 91 to its lower speed operation.

From the foregoing it will be seen that the temperature of the air in the cabinet 82 is controlled by the thermostat T by varying the duration of operation and non-operation of the compressor 41 and that the relative humidity of the air is controlled by the humidostat H by varying the quantity of air flowing over the evaporator 80.

While the forms of embodiment of the present invention as herein described constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. An air conditioning system comprising in

combination, an evaporator over which air flows for cooling such air, means for withdrawing gaseous refrigerant from the evaporator and for condensing the refrigerant and for delivering the same to the evaporator, means responsive to the temperature of the air for controlling the operation of the first means, and means responsive to a relatively high humidity condition of the air for impeding the flow of air over a portion of the evaporator.

2. An air conditioning system comprising in combination, an evaporator over which air flows for cooling such air, means for withdrawing gaseous refrigerant from the evaporator and for condensing the refrigerant and for delivering the same to the evaporator, means responsive to the temperature of the air for controlling the operation of the first means, means responsive to a relatively high humidity condition for preventing a portion of the flowing air from passing over the evaporator and for directing said portion into the stream of air cooled by the evaporator.

3. The method of conditioning air in a single treating zone which serves to condition air to the desired temperature and humidity conditions which comprises, causing air to circulate at a substantially constant rate, controlling the amount of sensible heat removed from the air by reducing the temperature of said zone in accordance with a demand for reduction in temperature of the air, controlling the amount of latent heat removed from the air during said demand by concurrently by-passing some of said circulating air around said zone and causing a further reduction in temperature in said zone for dehumidifying the air passing through said zone to the desired condition solely upon an increase of the relative humidity of the air, and merging the air thus treated with the by-passed air.

LAWRENCE A. PHILIPP.