March 27, 1956 C. D. GRAHAM 2,739,794

AIR HEATING AND COOLING APPARATUS

Filed March 22, 1952 4 Sheets-Sheet 1

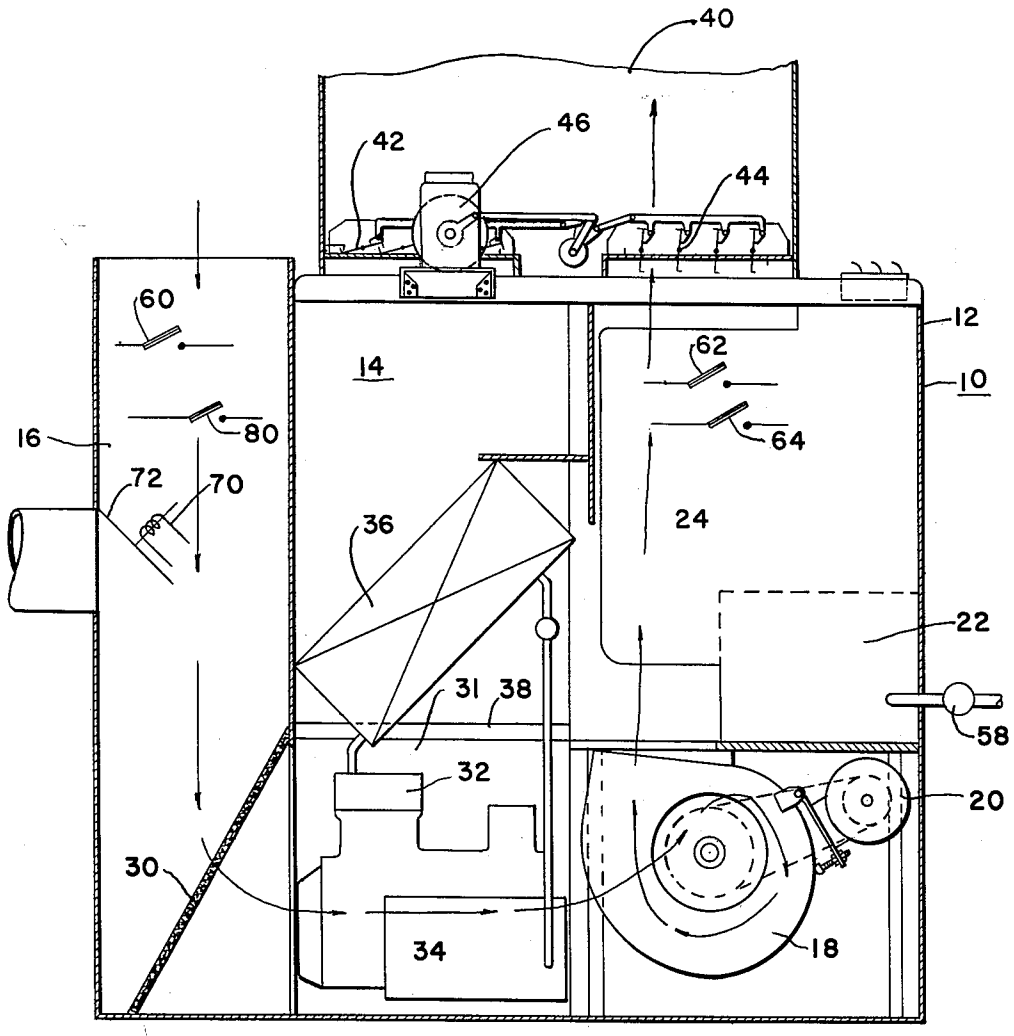


Fig. 1

INVENTOR.
Charles D. Graham.

BY
Willits, Hardman & Fehr.

March 27, 1956 C. D. GRAHAM 2,739,794

AIR HEATING AND COOLING APPARATUS

Filed March 22, 1952 4 Sheets-Sheet 2

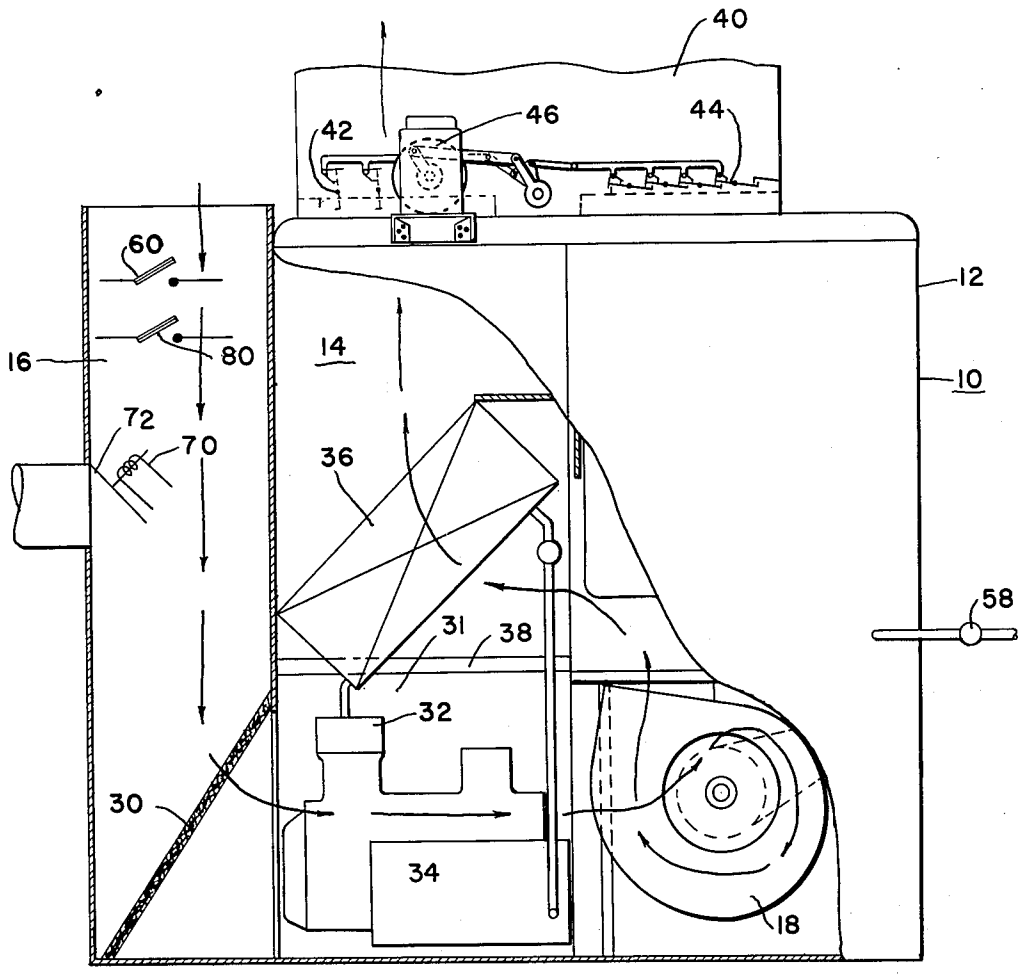


Fig. 2

INVENTOR.
Charles D. Graham,

BY
Willis, Hardman & Fehr.

March 27, 1956 C. D. GRAHAM 2,739,794

AIR HEATING AND COOLING APPARATUS

Filed March 22, 1952 4 Sheets-Sheet 3

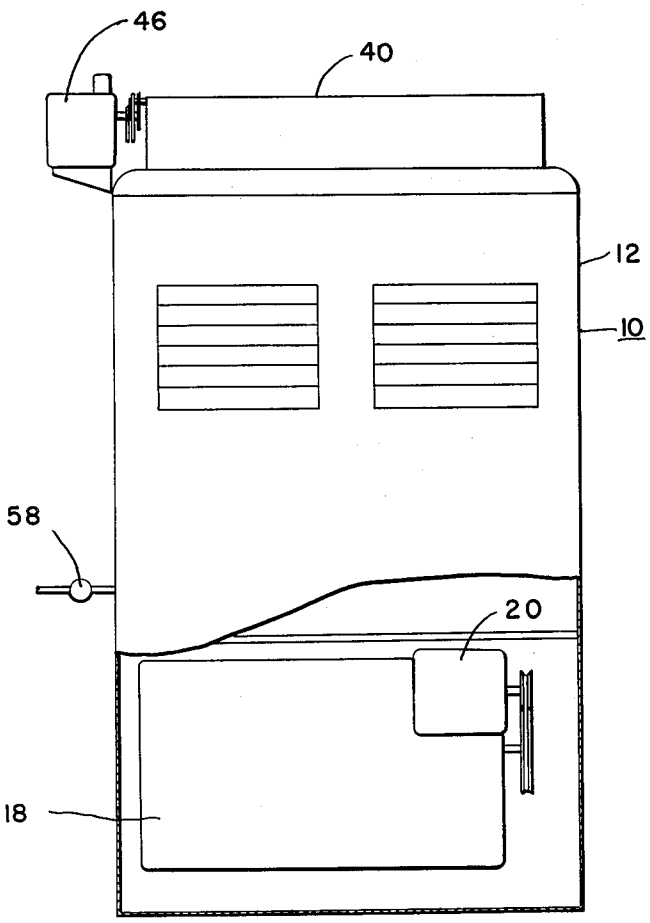


Fig. 3

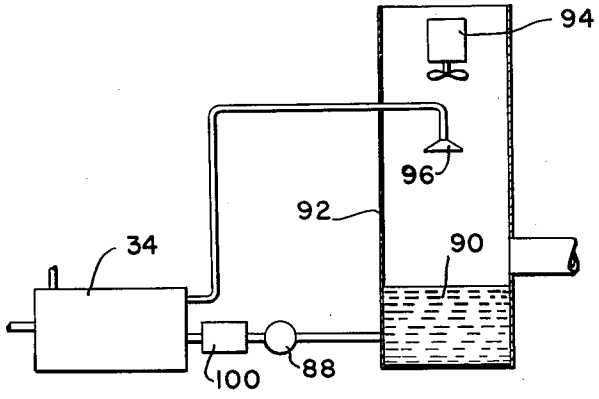


Fig. 5

INVENTOR.
Charles D. Graham.
BY Willits, Hardman & Fehr.

March 27, 1956 C. D. GRAHAM 2,739,794

AIR HEATING AND COOLING APPARATUS

Filed March 22, 1952 4 Sheets-Sheet 4

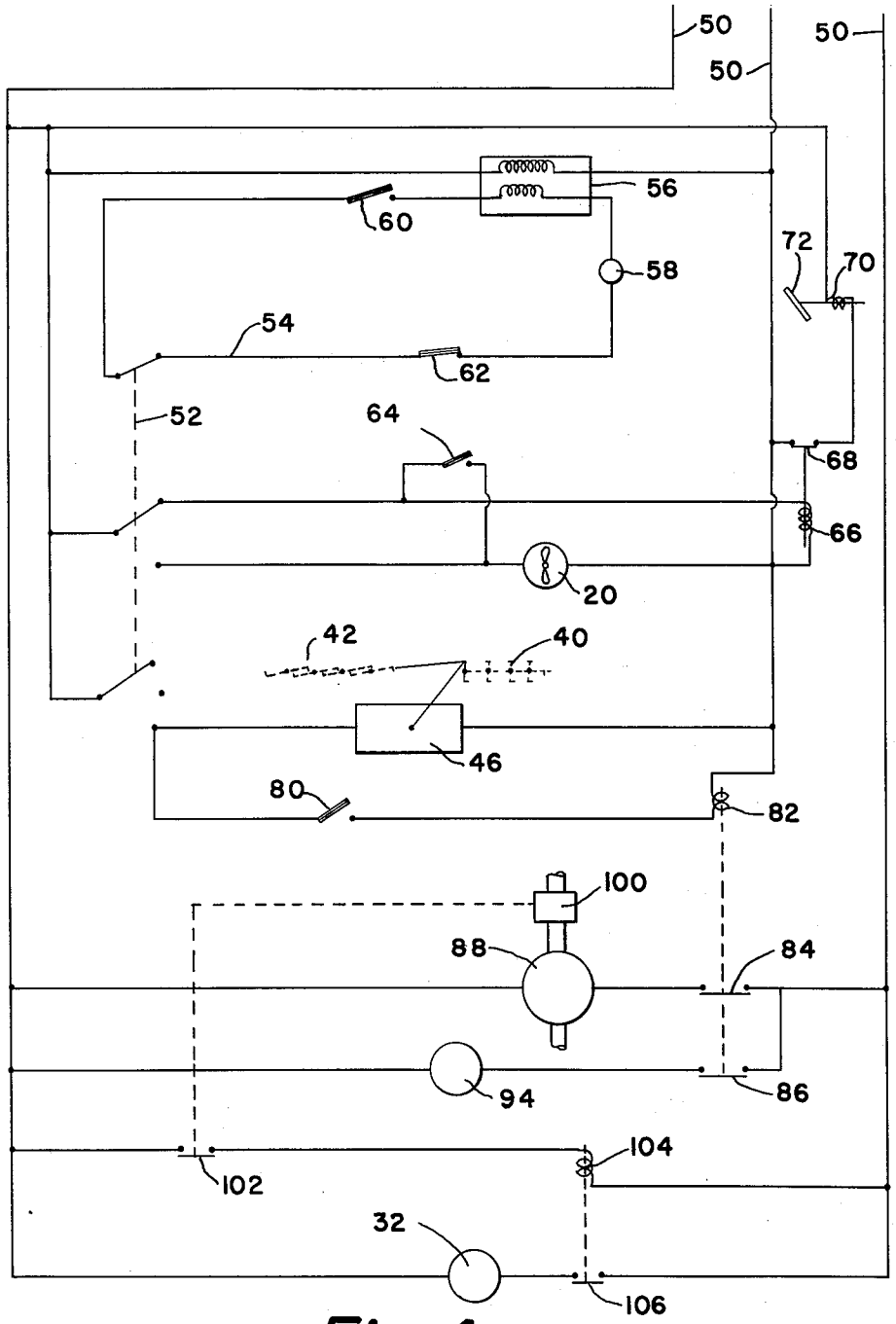


Fig. 4

INVENTOR.
Charles D. Graham.

BY Willits, Hardman & Fehr.

United States Patent Office 2,739,794 Patented Mar. 27, 1956

2,739,794

AIR HEATING AND COOLING APPARATUS

Charles D. Graham, Oakwood, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application March 22, 1952, Serial No. 277,971

1 Claim. (Cl. 257—9)

This invention relates to refrigerating apparatus and more particularly to an improved system for either refrigerating or heating air for private homes and the like.

It is an object of this invention to provide a self-contained unit in which the parts are compactly arranged so as to occupy a minimum amount of space.

A further object of this invention is to provide an improved air flow arrangement whereby the same filters and the same fan may be used both during the heating season and the cooling season without adding excessive restriction to the air flowing through the assembly.

More particularly it is an object of this invention to provide an improved arrangement wherein a single blower unit is provided for selectively circulating the air to be conditioned either in thermal exchange relationship with a conventional gas burner type of heating unit or the evaporator of a self-contained watercooled refrigeration system.

Another object of this invention is to provide an improved control arrangement for the apparatus.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a side elevational view of the apparatus with the side wall removed so as to show the arrangement of the apparatus within the outer casing and so as to show the path of the air during the heating season.

Figure 2 is a view similar to Figure 1 showing the air flow during the cooling season.

Figure 3 is a front view with parts broken away showing the cabinet construction.

Figure 4 is a circuit diagram which schematically shows the controls used with the equipment shown in the other figures of the drawing.

Figure 5 is a diagrammatic elevational view of the watercooling tower.

Referring now to the drawing wherein there is shown a preferred embodiment of the invention, reference numeral **10** generally designates the main cabinet which is divided into three separate sections which have generally been designated by the reference numerals **12, 14** and **16**. Section **12** houses the heating apparatus which is used during the winter season and such other times when heating may be resuired and the blower **18** which is used both during heating and cooling of the air. The blower **18** is mounted in the lower portion of the section **12** and is adapted to be driven by means of a motor **20** which is arranged as shown.

A conventional gas burner or heater generally designated by the reference numeral **22** is mounted directly above the motor **20** as shown and serves to supply heat to the air flowing over the bonnet portion of the heater located in the heating compartment **24** in accordance with well-known practice. During the heating season the air to be heated is discharged from the blower **18** upwardly as shown in Figure 1 so as to flow in thermal exchange relationship with the exterior surfaces of the heater in the heating compartment **24**. By arranging the heater at the outlet of the blower **18**, it is obvious that the air pressure surrounding the walls of the heater will be in excess of atmospheric pressure and will thereby discourage the infiltration of any of the gases from the combustion chamber into the body of air to be conditioned. Reference numeral **58** designates a conventional valve for controlling the gas burner **22**. Inasmuch as the construction and arrangement of the gas burner and the combustion chamber are well known and may be varied without departing from the spirit of my invention, this portion of the equipment has not been described in detail.

While there is shown a heating unit of the type utilizing a gas burner, it is obvious that certain aspects of the invention are equally applicable to heating units using an electric heater, a fuel oil heater, or any other well known type of heater.

The air to be conditioned is pulled into the unit by the fan **18** and is first required to pass through the return air and filter section or compartment **16** wherein dust and other impurities are removed from the air by means of one or more filter elements such as the filter element **30**. An opening is provided between the filter compartment **16** and the refrigeration or machinery compartment adjacent the bottom of the section **14** as shown. All of the air handled by the fan **18** is at all times required to pass through the machinery compartment **31** in which a motor-compressor unit **32** and watercooled condenser **34** are mounted. The motor-compressor unit **32** and condenser **34** are intended to represent parts of a conventional refrigerant liquefying system which is provided for supplying liquid refrigerant to an evaporator **36**. Water for cooling the condenser is supplied from the sump **90** of a watercooling tower **92** (see Figure 5) by means of a pump **88** as will be explained more fully hereinafter. A partition member **38** separates the machinery compartment from the evaporator compartment as shown in Figures 1 and 2. The arrows shown in Figure 1 of the drawing show the path of the air during the heating cycle whereas the arrows in Figure 2 show the path of the air during the cooling cycle. Thus, as shown in Figure 2, the air leaving the blower **18** is directed through the evaporator **36** before being discharged up into a plenum chamber **40** which is mounted directly above the casing **10**.

Suitable duct means (not shown) would be provided for discharging the air from the plenum chamber into the space or spaces to be conditioned. Since the construction and arrangement of the air distributing duct means leading from the plenum chamber to the conditioned space may be varied without departing from the spirit of my invention, these have not been shown. The means for determining the path of the air through the heating and cooling sections of the apparatus comprises a pair of damper units **42** and **44** which are mounted adjacent the outlets provided in the upper ends of the heating and cooling sections **14** and **12** respectively. These damper units are connected together so as to be operated in unison by means of the damper operating mechanism **46** so that under normal operating conditions one or the other of the damper units is closed at all times. When the damper unit **42** is closed, all of the air handled by the fan will be required to flow through the heating section of the apparatus whereas when the damper **44** is closed all of the air will be required to pass through the cooling section of the apparatus as shown in Figure 2 of the drawing.

By virtue of this damper arrangement, it is obvious that maximum simplicity has been provided and that the

parts can be arranged very compactly in such a manner that the same filter unit and blower may be used for year-around air conditioning and the restriction to air flow through the unit is at a minimum. Furthermore the dampers make it possible to divide the air flow through the heating and cooling units if dehumidification only is desired. Thus in the event that dehumidification only is required it would be possible to operate both the heating unit and the cooling unit and to arrange both of the dampers **42** and **40** in the half open position so that a mixture of heated and cooled air would be discharged into the conditioned space. That portion of the air flowing over the cooling evaporator **36** would have moisture removed therefrom and would be cooled but that portion of the air flowing over the heating unit **24** would be heated so as to compensate for the cooling effect of the evaporator **36**. The heated and cooled air would then mix in the plenum chamber **49** with the result that dry air would be discharged into the conditioned space at a temperature such that no appreciable change in room temperature would take place.

While the apparatus described hereinabove may be manually controlled it is preferable to provide automatic means for controlling the operation of the system especially when the system is used for either heating or cooling the air. Figure 4 of the drawing diagrammatically shows a control circuit which may be used for controlling the system so as to selectively provide either heating or cooling.

Reference numeral **50** designates a conventional three-wire power circuit which is used for energizing the various controls and electrical equipment. For purposes of illustrating the invention, there is shown a system in which a three pole, double-throw, manually operated switch **52** is provided for changing over from heating to cooling or vice versa, whereas automatic means could be provided for making this change-over. Thus, a thermostat responsive to the outdoor temperature or a combination of outdoor and indoor temperatures could be used for controlling the switch **52** if desired. The one pole of the switch **52** is used for energizing the heater controlling circuit **54** as shown. A transformer **56** supplies power at a reduced voltage to this circuit for operating the main gas valve **58** of the heating unit. A first thermostatically operated switch **60** is provided in series with the gas valve **58** and is designed to close the circuit to the gas valve so as to turn on the heat whenever the room temperature falls below a predetermined value such as 72 degrees. A second thermostatically operated switch **62** is also provided for safety purposes and is arranged in series with the gas valve **58** and serves to open the circuit to the valve in case the bonnet temperature exceeds a predetermined safe value such as 250 or 300 degrees.

During the heating season the blower motor **20** is adapted to be controlled by a thermostatically operated switch **64** which is designed to close the circuit to the motor **20** whenever the bonnet temperature reaches a predetermined value such as 120 degrees. Whenever the switch **52** occupies the position shown in Figure 4, the solenoid **66** is energized and serves to hold the switch **68** closed. The switch **68** controls a damper operating solenoid **70** which regulates the introduction of fresh air into the unit.

When the manually operated switch **52** is moved from the position shown in Figure 4 to the position in which the cooling equipment is energized, the fan motor **20** will be directly connected across the power line whereby the fan will operate continuously. The control circuit for the gas valve will be deenergized so as to prevent operation of any of the heating equipment during the cooling cycle and the solenoids **66** and **70** will be deenergized whereby the outside air damper **72** will open. Upon manually operating the switch **52** to the position calling for cooling, the damper control motor **46** shifts the dampers so that the damper **44** will be fully closed and the damper **42** will be fully opened. Simultaneous with energizing the damper motor **46** the circuit will be close to the thermostatically operated switch **80** which is set to close the circuit to the solenoid **82** whenever the temperature in the conditioned space falls below a predetermined value indicating the need for cooling.

The thermostats **60** and **80** may be located either in the return air passage **16** or in one of the rooms to be conditioned. Upon energization of the solenoid **82** in response to a demand for cooling the switches **84** and **86** are closed. Closing of the switch **84** energizes the water pump **88** which pumps water from the water reservoir or sump **90** into the watercooled condenser **34** and back to the spray head **96** in the upper portion of the watercooling tower **92**. The watercooling tower **92** is preferably located on the roof or the back yard of the building to be conditioned and is of conventional construction.

Closing of the switch **86** energizes the blower **94**, which pulls air up through the water sprayed into the upper portion of the watercooling tower **92**. In order to prevent operation of the refrigeration equipment when there is inadequate water for cooling the condenser a water pressure responsive switch **100** is provided in the water line leading from the pump **88** and is designed to close the compressor controlling switch **102** only at such times when the water pressure is adequate to supply the necessary amount of water to properly cool the condenser **34**. The switch **102** energizes a solenoid **104** which in turn operates the switch **106** in the power line leading to the motor-compressor unit **32**.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

In a self-contained air conditioning unit, a main housing, a vertical partition defining with the walls of said housing a heating chamber and a cooling chamber, said vertical partition having an opening adjacent its lower end whereby said heating and cooling chambers are in open communication, said heating and cooling chambers each having top outlets and damper means adjacent each of said top outlets for individually controlling the flow of air through each of said outlets, a refrigerant evaporator in said cooling chamber, a heating unit in said heating chamber, refrigerant liquefying means comprising a compressor and a liquid cooled condenser disposed below said evaporator, means connecting said refrigerant liquefying means and said evaporator for supplying refrigerant to said evaporator, partition means separating said refrigerant liquefying means and said evaporator and forming with the walls of said housing a compartment for said refrigerant liquefying means, an opening in said housing providing an air inlet to said compartment and a blower disposed directly below said heating unit and between said compartment and heating chamber to transfer air therebetween whereby the air to be conditioned is passed in thermal exchange relationship with said refrigerant liquefying means prior to its introduction into said blower.

References Cited in the file of this patent

UNITED STATES PATENTS

1,701,978	Lakin	Feb. 12, 1929
1,933,330	Johnson	Oct. 31, 1933
2,155,256	Crago	Apr. 18, 1939
2,186,145	Perham	Jan. 9, 1940
2,212,222	Austin	Aug. 20, 1940
2,238,688	Guler	Apr. 15, 1941
2,319,062	Holmes	May 11, 1943
2,381,427	Andersson	Aug. 7, 1945
2,547,657	Olsen	Apr. 3, 1951
2,572,582	Andrews	Oct. 23, 1951