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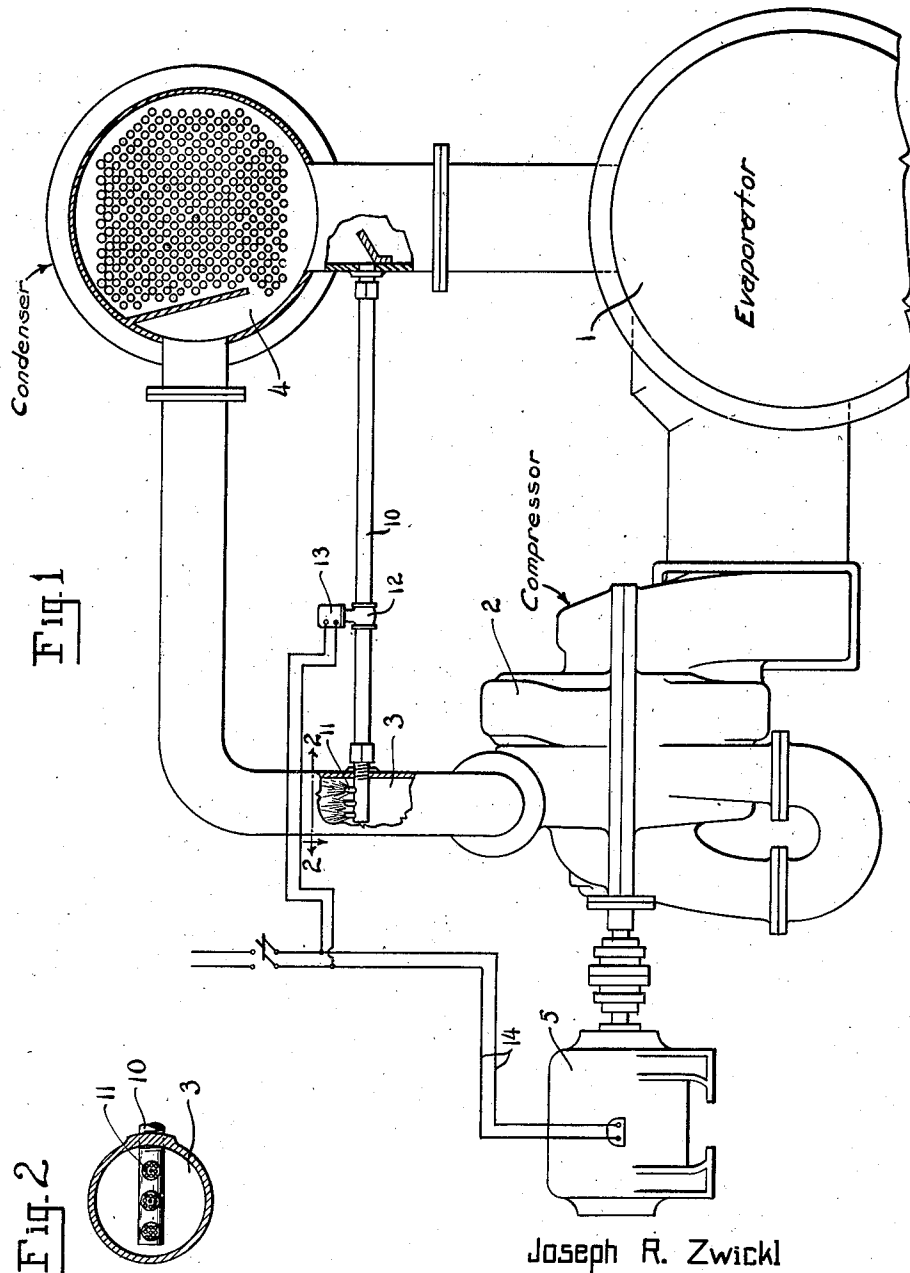
J. R. ZWICKL

2,292,259

REFRIGERATION SYSTEM

Filed Feb. 15, 1941

3 Sheets-Sheet 1



Joseph R. Zwickl
INVENTOR

BY

Robt. H. Hays
ATTORNEY

Aug. 4, 1942.

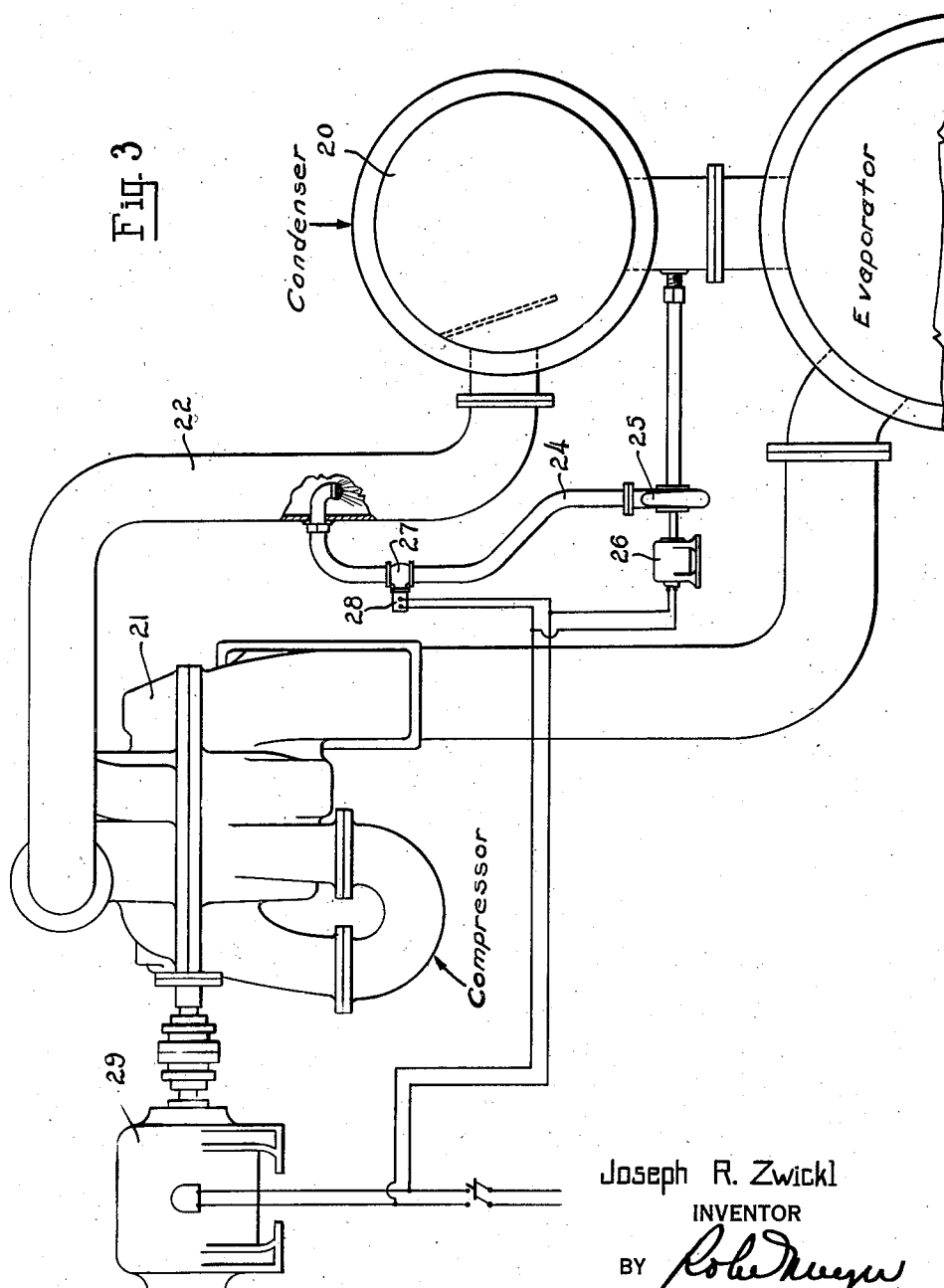
J. R. ZWICKL

2,292,259

REFRIGERATION SYSTEM

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3 Sheets-Sheet 2



Joseph R. Zwickl
INVENTOR

BY *Robert H. Zwickl*
ATTORNEY

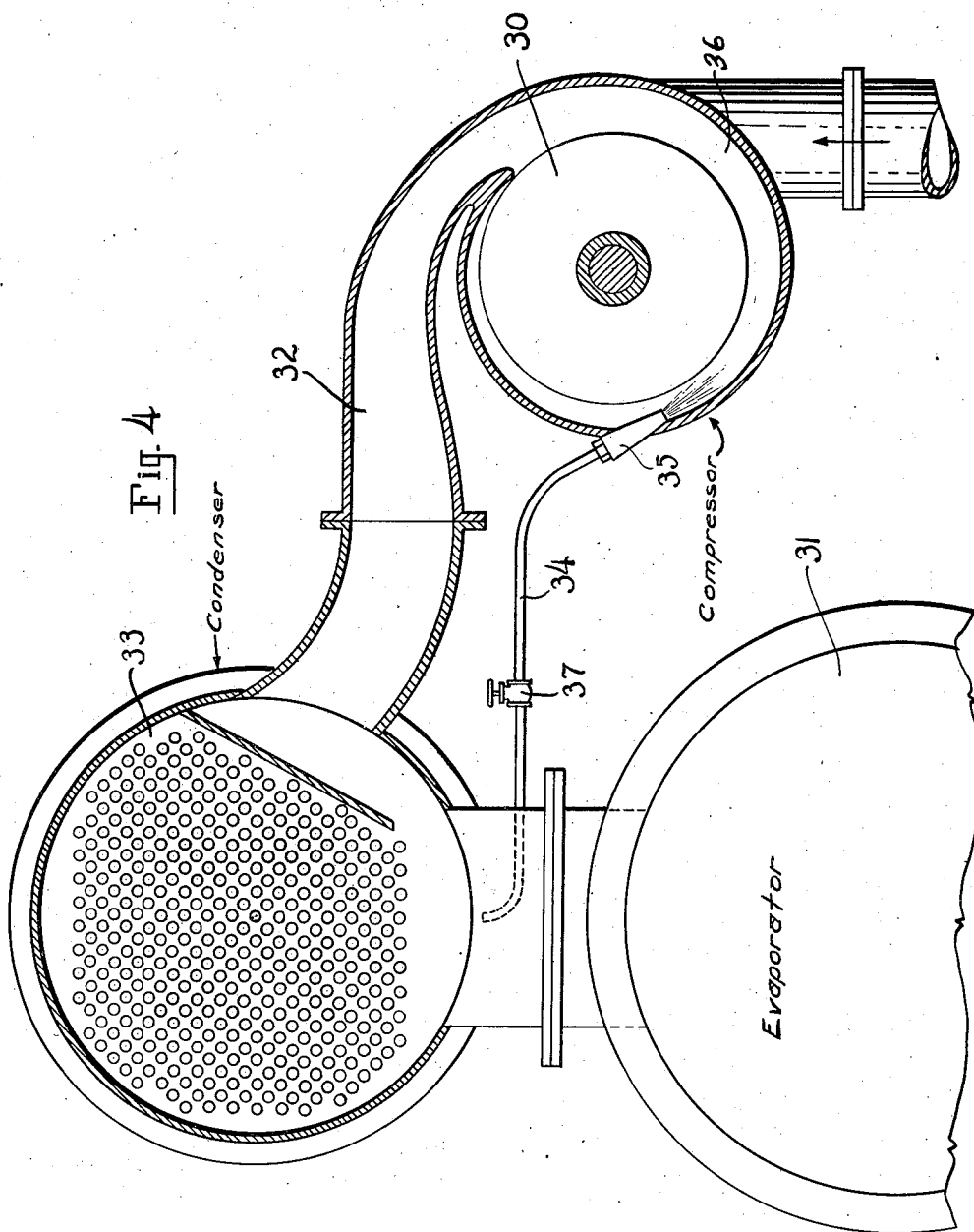
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J. R. ZWICKL
REFRIGERATION SYSTEM

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3 Sheets-Sheet 3



Joseph R. Zwickl
INVENTOR

BY

Robert Meyer

ATTORNEY

UNITED STATES PATENT OFFICE

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REFRIGERATION SYSTEM

Joseph R. Zwickl, East Orange, N. J., assignor to
Worthington Pump and Machinery Corpora-
tion, Harrison, N. J., a corporation of Dela-
ware

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3 Claims. (Cl. 62—115)

This invention relates to refrigeration, and more particularly to a refrigerating system and apparatus employing a volatile liquid refrigerant, such refrigerant being evaporated in an evaporator or cooler wherein the cooling medium is cooled; a compressor for compressing the refrigerant vapor; and a condenser for condensing the compressed refrigerant vapor and returning it to the evaporator for re-evaporation.

In refrigerating systems of this type the refrigerating vapor or gas discharged from the compressor is in a superheated condition, thus requiring a certain amount of surface in the condenser for removing this superheat prior to condensation of the vapor, necessitating a larger and more expensive condenser for use in the system than would be required if the vapor or gas were delivered to the condenser free of superheat.

An object of the present invention is to provide means for saturating the compressed vapor and converting the superheat therein into latent heat. Since the heat transfer rate from a superheated vapor is considerably less than the heat transfer rate for a saturated vapor, a definite advantage will be obtained in such a refrigeration system in that less condensing surface will be required resulting in savings in space required and in cost of condenser, or a lower discharge pressure from the compressor will be required, resulting in savings in space requirements, cost of compressor, and power required for its operation.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a refrigeration system of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a diagrammatic view of a refrigerating system embodying the means for removing superheat from the compressed vapor prior to condensation.

Figure 2 is a cross-section on the line 2—2 of Figure 1.

Figure 3 is a diagrammatic view, partly in section, of a modified form of the invention.

Figure 4 is a diagrammatic view, partly in section, of a further modified form of the invention.

Referring more particularly to the drawings, the refrigerating system illustrated diagrammatically in Figure 1 thereof comprises an evaporator

1 in which the refrigerant is vaporized for cooling a cooling medium. The refrigerant vapor passes from the evaporator 1 into the compressor 2, where it is compressed. From the compressor it is discharged, through the connection 2, into the condenser 4, where the compressed vapor is condensed, then returned to the vaporizer or cooler 1 for revaporization. The compressor illustrated in the drawings is of the centrifugal type, driven by an electric motor 5. However, the compressor may be of any suitable type, without departing from the spirit of the present invention.

In refrigeration systems of this type the compressed vapor discharged by the compressor 2 is in a superheated condition. Containing such superheat, in the ordinary approved types of systems, it requires additional surface in the condenser for removing the superheat.

The present invention embodies means for removing the superheat from the compressed refrigerant vapor prior to its entrance into the condenser 4, consequently permitting the use of a smaller and less expensive condenser than required in the usual system wherein the superheat of the vapor is not removed.

A pipe 10 communicates either with the connection between the condenser 4 and the evaporator 1, or with the lowest part of the condenser 4, so that part, or a limited supply of condensate from the condenser will flow into and through the pipe 10. The pipe 10 extends into the conduit 3, and has a plurality of nozzles 11 connected thereto for spraying the condensate from the pipe 10 into the compressed vapor passing to the condenser 4. The spraying of the condensate, in finely divided form, into the conduit and the compressed refrigerant vapor flowing there-through will lower the temperature of the refrigerant vapor and remove the superheat therefrom, or convert the superheat into latent heat.

As the heat transfer rate of saturated vapor is much greater than the heat transfer rate of superheated vapor, condensation of the saturated compressed refrigerant vapors may be provided in a condenser of smaller surface, resulting in savings in cost of the condenser, in the cost of circulating the cooling medium through the condenser, and in space requirements for the system.

A valve 12 is interposed in the pipe 10 and, as shown in the drawings, is a solenoid operated valve of any approved type which may be purchased upon the open market. The solenoid 13 of the valve structure 12 is connected in circuit with the control circuit 14 of the compressor mo-

tor 5 so that when the compressor motor 5 is started the valve 12 will be opened, permitting the flow of the condensed refrigerant liquid through the pipe 10 and into the conduit 3. When the motor 5 is stopped, the solenoid 13 will be deenergized, permitting the closing of the valve 12.

In the construction shown in Figure 1 of the drawings, the condenser 4 is at sufficient elevation above the conduit 3 to permit the condensed refrigerant to flow through the pipe 10 by force of gravity. However, in some installations this will not be the case, and such an installation is illustrated in Figure 3 of the drawings.

In the modified construction shown in Figure 3 of the drawings the condenser 20 is shown as being below the level of the compressor 21, so that the conduit which serves to convey the condensed liquid refrigerant from the lower part of the condenser into the conduit 22 through which the compressed vapor passes to the condenser is positioned in such manner that the liquid refrigerant will not flow therethrough by gravity. Consequently the conduit 24, which serves to convey the condensed liquid refrigerant to the conduit 22 to be sprayed into the superheated, compressed refrigerant vapor has a pump 25, of any suitable construction, imposed or connected therein for the purpose of providing sufficient pressure to deliver the condensed liquid refrigerant to the conduit 22. The pump 25 is shown as being operated by an approved type of electric motor 26. A valve 27 is interposed in the conduit 24, as is the form shown in Figure 1, and this valve 27 may be the same as such valve 12, i. e. a solenoid actuated valve of any approved type obtainable upon the open market. The solenoid 28 of the valve 27 and the motor 26 of the pump 25 are connected in circuit with the motor 29, which latter drives the compressor 21, so that when the compressor 21 is started the valve 27 will be opened and the pump 25 will be energized and, conversely, when the compressor 21 is stopped the pump 25 will be stopped and the valve 27 closed.

In the construction shown in Figures 1 to 3 of the drawings the condensed liquid refrigerant is delivered from the condenser into the conduit connecting the discharge of the compressor with the condenser. However, it may be desirable and advantageous to deliver this heat removing liquid refrigerant directly into the compressor itself. Such a construction is illustrated in Figure 4 of the drawings.

In the system shown in Figure 4 the compressor 30 compresses the refrigerant vapor, which is delivered thereto from the evaporator 31. The compressed refrigerant vapor is discharged through the conduit 32 into the condenser 33. A pipe or conduit 34 communicates with the lowest part of the interior of the condenser 33 for receiving a limited quantity of condensed refrigerant therefrom. This conduit 34 discharges such condensed refrigerant through a nozzle 35 into the final or discharge volute 36 of the compressor 30. Thus the compressed vapor is saturated and its superheat removed during its passage through the final volute of the

compressor to the outlet or discharge of the compressor. A valve 37 is interposed in the pipe 34 and is shown as a hand operated valve, but it is to be understood that a solenoid operated valve such as the valves 12 or 27 may be utilized in lieu thereof, or that a hand operated valve may be utilized in lieu of the solenoid operated valves 12 or 27 in the structures shown in Figures 1 and 3, without departing from the spirit of the present invention.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a refrigerating system in which a volatile refrigerant is vaporized, the vapor compressed, and the compressed vapor condensed and returned to be again vaporized, the combination with a condenser, a compressor and a connection between the compressor and condenser for delivering compressed vapor to the condenser, of a conduit for receiving a limited quantity of liquid refrigerant from said condenser and spraying it into the compressed refrigerant vapor after the vapor has been fully compressed and prior to its entrance into the condenser, a valve in said conduit, and means operated upon starting and stopping of the compressor for operating said valve.

2. In a refrigerating system in which a volatile refrigerant is vaporized, the vapor compressed and the compressed vapor condensed and returned to be again vaporized, the combination with a condenser, a compressor, and a connection between the compressor and the condenser for delivering compressed vapor to the condenser, of a conduit for receiving a limited quantity of liquid refrigerant from said condenser, a pump in said conduit for forcing the liquid refrigerant therethrough and spraying it into the compressed refrigerant vapor after the vapor has been fully compressed and prior to its entrance into the condenser, a valve in said conduit, and means operated upon the starting and stopping of said compressor for operating said valve.

3. In a refrigerating system in which a volatile refrigerant is vaporized, the vapor compressed and the compressed vapor condensed and returned to be again vaporized, the combination with a condenser, a compressor, and a connection between the compressor and the condenser for delivering compressed vapor to the condenser, of a conduit for receiving a limited quantity of liquid refrigerant from said condenser, a pump in said conduit for forcing the liquid refrigerant therethrough and spraying it into the compressed refrigerant vapor after the vapor has been fully compressed and prior to its entrance into the condenser, a valve in said conduit, valve operating means operated upon starting and stopping of the compressor for opening and closing said valve, and means operable upon starting and stopping of the compressor for starting and stopping said pump.

JOSEPH R. ZWICKL.