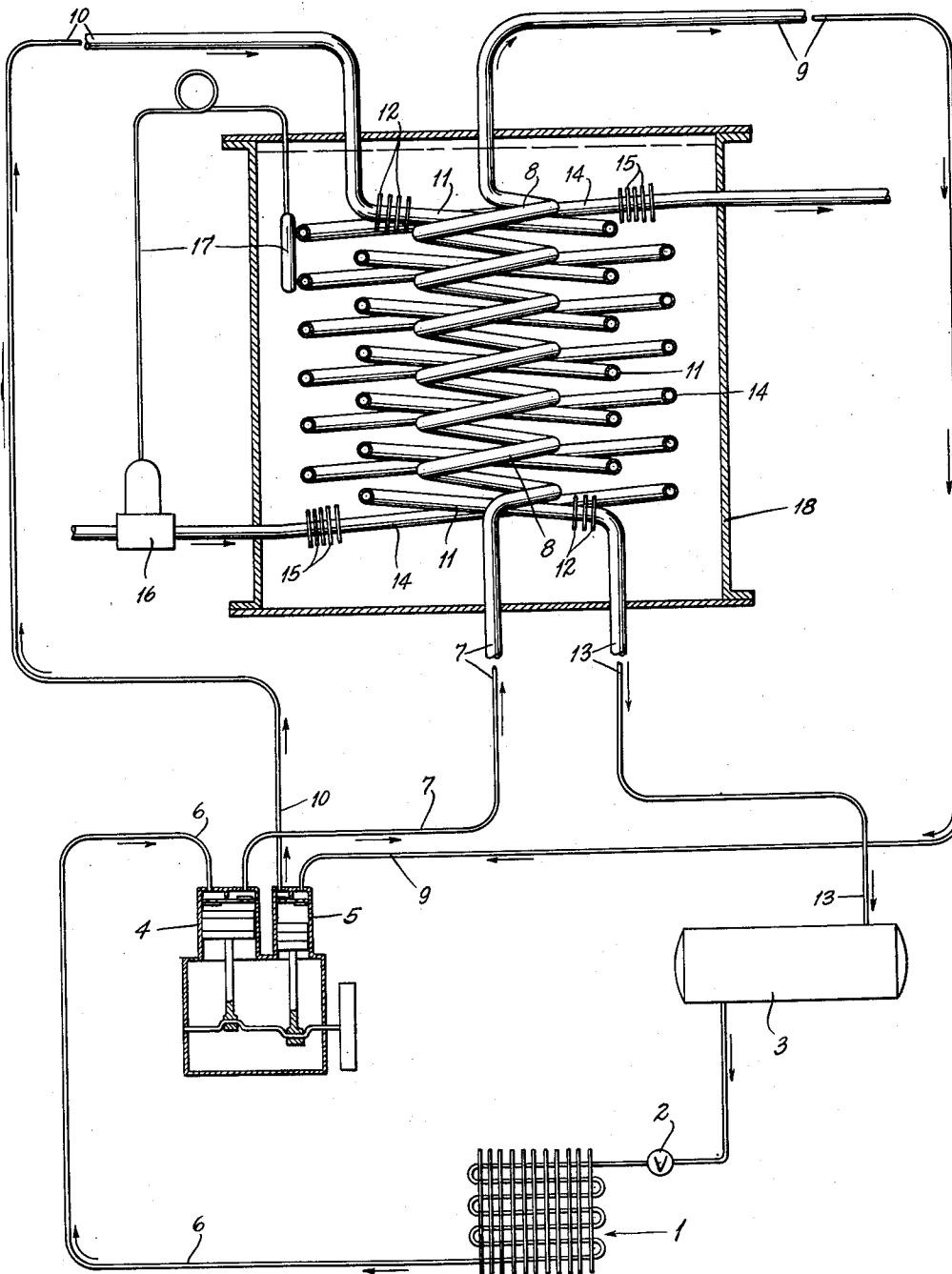


Feb. 14, 1950

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REFRIGERATION SYSTEM
Filed Aug. 2, 1945

2,497,450



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UNITED STATES PATENT OFFICE

2,497,450

REFRIGERATION SYSTEM

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Application August 2, 1945, Serial No. 608,496

9 Claims. (Cl. 62—115)

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This invention relates to refrigeration methods, and more particularly to a condensing stage of such a system.

As is generally understood in the art, when the operation of a refrigeration system is initiated, there is an abnormal load on the condenser due to the fact that it is necessary to cool the metallic mass of the evaporator, and to establish a predetermined cooling temperature. This results in a substantial increase in the evaporator pressure, and raises the corresponding evaporation temperature, which, in turn, increases the load not only on the compressor, but on the condenser. The condenser, therefore, is required to handle the primary supercharge of the compressed gas, which materially increases the cooling load.

Where the cooling agent for the condenser is an out-of-contact flow of a cooling medium, such as water, a substantial increase of the circulation thereof during the initial stages, beyond the normal requirements for establishing a condensing temperature, is required, and a relatively long period of time is required before normal conditions are established for efficient operation of the refrigerating system.

Likewise, where the condenser is fluid cooled, any temporary interruption of volume of flow, or change in temperature of the cooling medium, results in interruption of normal conditions in the entire system.

An object of the invention, therefore, is to provide a method of rapidly establishing optimum condensing conditions by providing a supplemental cooling means in the condensing stage of a fluid cooled condenser, in order to equalize the condensing load in the initial stage of operation of the system, by providing an initial and supplemental cooling medium which will provide a rapid heat transfer or cooling effect sufficient to establish condensing conditions.

With this general object in view, I have provided a refrigerating system, including a novel condensing stage, illustrated diagrammatically in the accompanying drawing which, in addition to the general object, attains specific advantages which will be readily understood from the following detailed description.

The refrigerating system, as illustrated in the drawing, includes a conventional evaporator 1, comprising expansion coils through which the expanded gas from the expansion valve 2 is circulated. The refrigerant is supplied from a liquid refrigerant tank or receiver 3, connected with the

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evaporator through the intermediate expansion valve 2.

The illustrated embodiment includes a two-stage compressor comprising a low pressure cylinder 4, and a high pressure cylinder 5.

The inlet or suction of the low stage compression unit is connected by a line 6 with the outlet of the evaporator.

While a two-stage compression unit has been illustrated, it will be understood that the invention is also applicable to a single-stage compressor.

The compressed gas from the low pressure cylinder 4 of the compressor is carried by a line 7 to a coil, or intercooler, 8 within the condenser comprising a continuous cylindrically formed coil mounted vertically in the condenser chamber. The gas preferably enters the lower end of this coil, and is discharged through a line 9 in communication with the suction orifice or inlet to the second or high-stage compressor cylinder 5.

When a two-stage compressor is used, it is important to note that the temperature of the intercooler should be maintained high enough to prevent condensation of the gas in order to avoid the refrigerating agent entering the second stage of the compressor in liquid form. By suitable control of pressure and temperature, this result may be attained.

The compressed gas from the second stage of the compressor is carried by a line 10 to the upper end of a condensing coil 11, which comprises a continuous cylindrical coil formed around the coil 8 and spaced therefrom. The coil 11 is preferably provided with extended exterior surfaces, comprising fins 12 which, it will be understood, are preferably formed throughout the length of the coil 11.

The line 10, as stated, preferably enters the secondary condensing coil 11 at the upper end thereof, and the condensed liquid refrigerant, discharged from the lower end, will therefore flow by gravity to the refrigerant storage tank or receiver 3 by a line 13.

The primary cooling agent for the condenser is circulated in a coil 14 having a sufficiently greater coil diameter than the coil 11, in order to surround the same in spaced relationship. The coil 14 preferably is provided with an extended exterior heat transfer surface in the form of fins 15, coextensive with the length of said coil 14.

Circulation in the coil 14 is through a thermostatically controlled liquid inlet valve 16, as illustrated, located adjacent to the end of said coil.

The thermal regulation of the valve 16 is preferably under control of the discharge temperature of the circulating fluid in said coil, which is accomplished, as diagrammatically illustrated, by a thermal bulb and tube control 17. A pressure control of the valve 16 responsive to the discharge pressure of the high pressure gas could alternatively be employed for the temperature control illustrated.

The primary and secondary refrigerant coils, as well as the cooling medium coil, are mounted in a sealed chamber 18, which chamber is charged with a cooling agent, which has a melting temperature sufficiently high to produce an adequate cooling effect to condense the second stage compressor gas circulating in the secondary stage coil 11 at the pressure of the gas in said coil, and to act as an adequate cooling agent for the first stage refrigerant circulating in the coil 8.

A cooling agent satisfying this requirement may be a eutectic mixture of diphenyl and diphenyl-oxide in the ratio of 50 parts to 50 parts by weight.

The refrigerating agent indicated has an approximate freezing temperature of 100° F., and has a high cooling effect, due to a high latent heat factor, in its transition from a solid to a liquid.

As an illustration such an eutectic comprising the mixture indicated would have a latent heat content of approximately 150 B. t. u. per pound. The approximate weight of a cubic foot would weigh approximately 61 pounds. Each cubic foot would, therefore, represent a latent heat reserve of approximately 9150 B. t. u. For one ton of refrigeration, the condenser load amounts to approximately 220 B. t. u. per minute, so that for each cubic foot of the eutectic, there would be sufficient cooling or heat transfer effect for one ton of refrigeration for approximately forty minutes, without additional cooling, assuming a refrigerating agent in the main refrigerating system having a 25 pound suction pressure from the evaporator, and a temperature rise in the compressor of approximately 30° F., or a discharge pressure of approximately 125 pounds, which represent a normal refrigerant.

The foregoing figures represent a practical working condition for refrigeration and condensation. It will, therefore, be understood that as a supplemental cooling agent, an eutectic such as that specified will provide for immediate operation of the condenser to provide for initial or intermediate overloads on the condenser.

After the operating conditions have been established, and the cooling effect by the circulation of the primary cooling medium has reached normal efficiency, and the temperature of the evaporator is reduced below the solidifying temperature of the eutectic, it again stores up a latent heat supply, which would become operative either because of a condenser overload, or by reason of the interruption in the cooling effect of the primary cooling agent, requiring the supplemental cooling.

The use of the eutectic in connection with the two-stage condenser coils also has additional advantages in that, in the event the temperature of the primary cooling agent falls below the required condensing temperature, the eutectic would remain as a solid and act as a heat insulator, preventing the over-cooling of the low pressure gas coil or intercooler 8, and, therefore, a condensation in that coil would not occur. This is because the eutectic would start to melt in the

area of the high pressure condenser coil 11, and in the area of the inter-cooler coil 8, producing the normal cooling effect for these coils, before the cooling effect from the reduced temperature from the primary cooling agent becomes effective to produce abnormal cooling of the intercooler 8.

When the supplemental cooling agent liquefies, it provides an efficient heat transfer medium tending to equalize the temperature throughout the condenser.

In the foregoing description, it will be understood that I have provided an efficient supplemental cooling agent for a condenser that is usable in all cooling systems, and which has particular advantage in room cooling systems where the initial operation produces a substantial overload on the condenser.

It should also be understood that the invention is not confined to the specific eutectic specified, as other mixtures and chemical agents are generally known in the art, which may equally serve the purpose. It is preferable to select one that has a low vapor pressure, high heat transfer factor, and a high latent heat factor.

What I claim and desire to secure by Letters Patent is:

1. In a refrigerating method, a condensing stage which includes circulating a gaseous refrigerant under pressure in a confined stream, cooling the circulating gas stream by circulation of a liquid cooling agent in a confined stream, passing said gas stream in direct heat exchange relation to a solid cooling medium comprising an eutectic mass of material having a melting temperature sufficiently high to cause a sufficient heat loss from the gas stream to condense the same independently of the cooling effect of said first-named cooling agent.

2. In a refrigerating method, a condensing stage comprising the circulation of a compressed gas refrigerant at a relatively low pressure, raising the pressure of said gas and recirculating the same counterflow to said low pressure gas, initially cooling said gas by a solidified cooling agent in direct heat transfer relation with said gas, having a melting point sufficiently high to cool the low pressure gas and to liquefy said high pressure gas, and an additional cooling agent having a cooling effect sufficient to liquefy the high pressure gas and to solidify said first-named cooling agent.

3. In a refrigerating method, a condensing stage comprising the circulation of a compressed gas refrigerant at a relatively low pressure, raising the pressure of said gas and recirculating the same, initially cooling said gas by a solidified cooling agent in direct heat transfer relation with said gas having a melting point sufficiently high to lower the temperature of the low pressure gas without condensation and to liquefy said high pressure gas, and an additional cooling agent out of direct heat exchange relation with said gas streams.

4. In a refrigerating method, a condensing stage which includes circulating gas under pressure in a confined stream within a confined space, cooling the circulating gas by circulation of a primary cooling agent in a confined stream out of contact with the confined stream of gas, and supplementing the cooling of said circulating gas by a cooling agent immersing and directly contacting the confined stream of gas, said supplemental cooling agent comprising a material hav-

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ing a melting temperature at approximately the final condensation temperature of the compressed gas.

5. In a refrigerating method, a condensing stage which includes circulating a confined gas stream under pressure within a confined space, cooling the circulating gas stream by circulation of a primary cooling agent in heat transfer relation to and out of contact with the confined gas stream, and supplementing the cooling of said circulating gas by a cooling agent contained in said confined space in heat transfer relation to said gas stream, said supplemental cooling agent comprising a material having a melting temperature at approximately the final condensation temperature of the compressed gas.

6. In a refrigerating method, a condensing stage which includes circulating a confined gas stream under pressure within a confined space, cooling the circulating gas by circulation of a primary cooling agent in a confined stream out of contact with the gas stream, and supplementing the cooling of said circulating gas by a cooling agent comprising an eutectic mass of material having a melting temperature sufficiently high to cause a sufficient heat loss in the circulating compressed gas to condense the same independently of the cooling effect of said primary cooling agent.

7. In combination, condenser apparatus including a closed chamber, a refrigerant gas coil in said chamber, a second coil in said chamber for passage of a primary cooling medium for cooling gas in said coil to condense the same, and a secondary cooling medium in said chamber characterized by high latent heat content and by a melting point sufficiently high to liquefy refrigerant gas passing through said gas coil.

8. In combination, condenser apparatus including a closed chamber, a refrigerant gas coil in

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said chamber, a second coil in said chamber for passage of a primary cooling medium for cooling gas in said coil to condense the same, and a secondary cooling medium in said chamber comprising an eutectic mixture characterized by high latent heat content and by a melting point sufficiently high to liquefy refrigerant gas passing through said gas coil.

9. In combination, condenser apparatus including a closed chamber, a first coil in said chamber for receiving a compressed gas refrigerant from the first stage of a two-stage compressor, a second coil in said chamber for receiving a compressed gas refrigerant from the second stage, a third coil in said chamber for receiving a primary cooling and condensing medium, and a secondary cooling and condensing medium in said chamber and surrounding said three coils, said secondary medium comprising an eutectic mixture characterized by high latent heat content and a melting point sufficiently high to produce a cooling effect to condense gas in the second stage coil and to cool gas in the first stage coil without effecting condensing.

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