May 12, 1931. M. HIRSCH 1,805,400

REFRIGERATION APPARATUS

Filed May 15, 1928 2 Sheets-Sheet 1

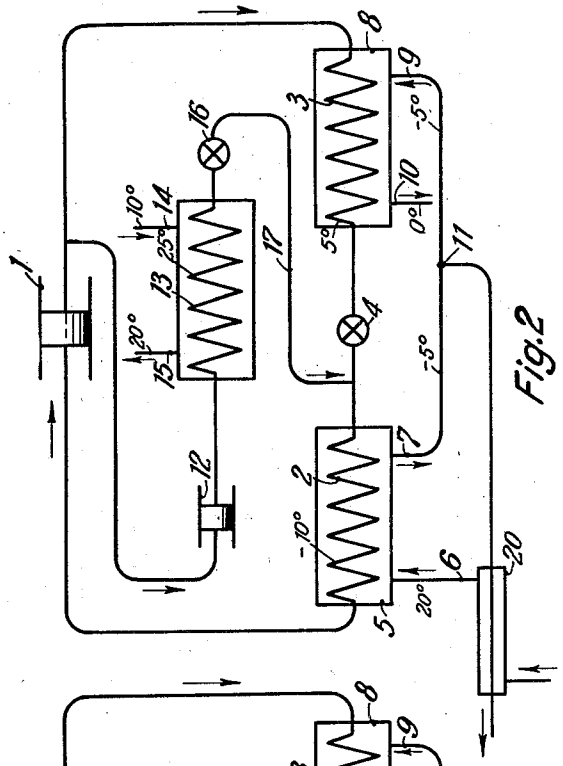


Fig. 2

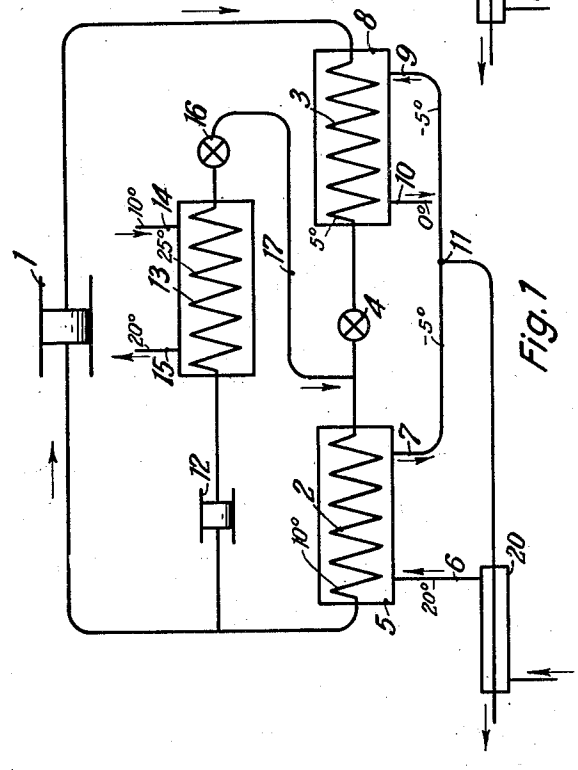


Fig. 1

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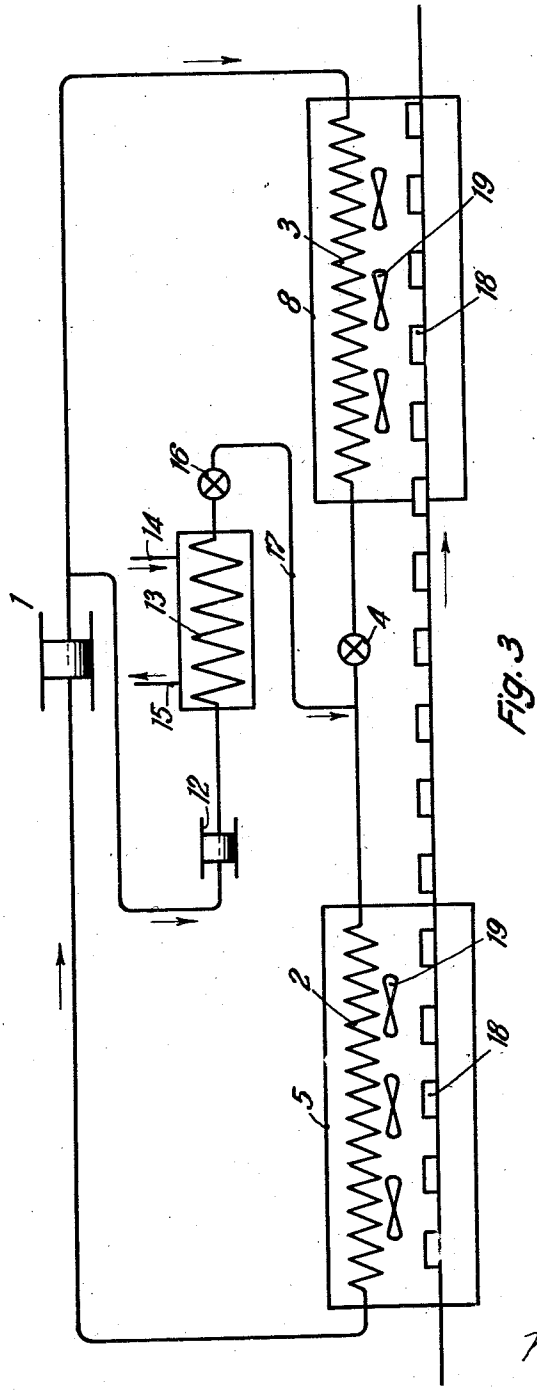


Fig. 3

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UNITED STATES PATENT OFFICE

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REFRIGERATION APPARATUS

Application filed May 15, 1928, Serial No. 277,900, and in Germany May 12, 1927.

This invention relates to improvements in processes of refrigeration and has for its object the provision of means whereby greater economy in operation can be obtained than has been possible heretofore.

In the refrigeration of wine a temporary reduction in temperature thereof is effected in order to bring about the separation of albumen and other substances. In the refrigeration of oils, paraffin and other substances in crystal, flake or other form are separated from the remaining solvent. In the complete freezing of cider, the crystallization of part of the water content is effected in order to obtain a more strongly concentrated solution. If wet peat is completely frozen, the water previously combined is more easily removed after thawing. In all such cases, in respect of which the instances cited only represent examples, the substances, mostly of a fluid character are cooled in order to effect a physical or chemical change to enable portions of the substance to be separated. After carrying out the separation it is possible, and in most cases desirable, to cause the products obtained to be warmed up again.

It has been proposed to use the frozen or cold constituents of refrigerated substances as the cooling medium for the main or auxiliary condenser of the compression refrigerating plant employed in the cooling.

This invention is characterized by the arrangement in a refrigerating plant of two condenser stages working with different pressures, the low pressure or main condenser being cooled by the substance which has been cooled in an evaporator or by parts of this substance, the high pressure or auxiliary condenser being cooled by water as usually, said condenser stages being fed by two compressor stages working with different pressures, the low pressure or main compressor being arranged to operate in parallel with the high pressure or auxiliary compressor and connected with the evaporator on the suction end and with the low pressure or main condenser on the discharge end, or being arranged to operate partly in series with the high pressure compressor and connected with the evaporator on the suction end and with the suction line of the high pressure compressor and the low pressure condenser on the discharge end, the high pressure or auxiliary compressor being connected with the discharge line of the main compressor on the suction end and with the high pressure or auxiliary condenser on the discharge end.

In order that the invention may be the better understood, I will now proceed to describe the same in relation to the accompanying drawings, reference being had to the letters and figures marked thereon; like letters refer to like parts in the various figures in which:

Figure 1 diagrammatically illustrates one method of carrying the invention into effect.

Figure 2 diagrammatically illustrates an alternate method; and,

Figure 3 diagrammatically illustrates a further modification.

In Figure 1 the numeral 1 indicates the main compressor of a refrigerating machine, which sucks the vapours from the evaporator 2 and forces them into the main condenser 3. The condensed working material flows through the expansion cock 4 into the evaporator 2. The material to be cooled enters the space 5 at 6 at a temperature of, for instance, 20° and leaves at 7 with a temperature of, for instance, 5° below zero.

In the present invention, the material cooled in space 5 is wholly or partly used as the cooling medium in 8 into which it enters at 9 and leaves at 10. The separation of the constituent parts of the material refrigerated can be effected in any manner at 11. One constituent part, for instance, the concentrated solution may serve for the preliminary cooling of the material to be treated in the heat interchanger 20. The other constituent part is delivered to the space 8 at 9 mainly in solid form and leaves at 10 in liquefied form. Apart from losses, in the example represented a temperature of 5° below zero occurs at 9 and about 0° at 10, when, for instance, the solid constituent is water ice and the resultant water is not to be heated up above the thawing point.

The condenser output equals the evaporator output increased by the thermal equiv-

alent of the compressor work. The amount of heat conducted into the condenser space 8 is therefore superior to the amount of heat released in the evaporator space 5. Consequently, the solid matters formed in 5 the melting heat of which alone is not sufficient to absorb the condenser output is supplemented by further cooling means for condensation. It is accordingly necessary to condense a part of the vapours formed in the evaporator 2, by the use of a further cooling medium, for which purpose cold water may be used. According to the invention this auxiliary condensation is effected by connecting up a second or auxiliary compressor 12 in parallel with the main compressor 1, and including a second or auxiliary condenser 13, which is cooled in known manner by water, introduced at 14 for instance at 10° and discharged at 15 for instance at 20°. 16 represents an auxiliary expansion cock through which the throttled refrigerant passes to the evaporator 2 through pipe 17. It does not matter in this connection whether a joint evaporator, as indicated, is used for the two circuits or two separate ones.

The connection of the auxiliary compressor in series with the main compressor in accordance with Figure 2 is more convenient. In this case, the main compressor 1 extracts all the vapours developed in the evaporator 2. A part of these vapours passes through the main condenser 3 and the remainder of such vapours passes through the auxiliary compressor 12 into the auxiliary condenser 13 flowing from there, as previously described, through the expansion cock 16 and the piping 17 into the evaporator 2.

In the instance represented, the temperature of condensation in the main condenser 3 may be taken at about 5° whilst that in the condenser 13 is about 25°. If at the same time the temperature of evaporation in the evaporator 2 is taken at about 10° below zero the first circuit works between 10° below zero and 5° and the second circuit between 10° below zero and 25°. The expenditure of energy per unit of cold output is therefore materially lower in the first circuit than in the second circuit; in the example described the reduction amounts to about one-half. When compared with the previous method of working, in respect of which the conditions of the second circuit are the controlling factor, a material saving in energy therefore results. This is so much the higher, the greater the quantity of the material supplied in solid form to the main condenser 3. The improved process forming the subject of the present invention is therefore well adapted to handle materials which hitherto were not a very economic proposition. An example of this is afforded by the draining of water from peat after the freezing process.

The interchange of heat between evaporator 2 and condenser 3 respectively on the one side and the material to be treated on the other side can be effected in any manner desired in the spaces 5 and 8, for instance by causing the material to be treated to surround the cooling coils in which the working material circulating in the refrigerating machine is contained or indirectly, in accordance with Figure 3 by conducting the material 18 to be treated through the evaporator space 5 and condenser space 8 one after the other, the material at the same time interchanging heat with the cooling surfaces of the evaporator 2 and condenser 3 respectively through the agency of a conductor, such as the ordinary atmosphere, filling the spaces 5 and 8 respectively. In this connection the interchange of heat may be improved, for instance, by special circulating means 19, such as fans. Figure 3 also discloses how the invention can be applied to a material in the case of which the separation is not effected, as in Figures 1 and 2, between evaporator space 5 and condenser space 8, but only in the condenser space 8. In this connection the bodies 18 represent, for instance, peat sods which are frozen in 5 and thawed in 8 and subsequently yield up their water contents to a greater extent.

It is also possible to use the constituent parts separated at 11 in accordance with Figures 1 and 2 both independently of one another for the cooling of the condenser 3, for instance, in such way that the condenser 3 is divided into two parts each of which is cooled by a part of the decomposed material.

I claim:

1. A refrigerating plant having an evaporator for refrigerating a material, a condenser, an auxiliary condenser, a compressor for said condenser, a compressor for said auxiliary condenser, said compressors being connected in series, the suction side of one of them being connected to said evaporator, its delivery side being connected with said condenser, the suction side of the other compressor being connected with the delivery side of the first compressor and its delivery side being connected with said auxiliary condenser, and means for supplying the refrigerated material to one of said condensers.

2. A refrigerator plant having an evaporator for refrigerating a material, a condenser, an auxiliary condenser, a compressor for said condenser, a compressor for said auxiliary condenser, said compressors and condensers being connected in parallel, the suction side of both compressors being connected to said evaporator, the delivery side of said compressor being connected with said condenser and of said auxiliary compressor with said auxiliary condenser and means for supplying the refrigerated material to one of said condensers.

3. A refrigerating plant having an evap-

orator for refrigerating a material, a condenser, an auxiliary condenser, a compressor for said condenser, a compressor for said auxiliary condenser, said condensers being connected in parallel, the suction side of both compressors being connected to said evaporator, the delivery side of said compressor being connected with said condenser, and of said auxiliary compressor with said auxiliary condenser, and means for supplying a refrigerating material to one of said condensers.

In testimony whereof I have signed my name to this specification.

MORITZ HIRSCH.